SCIENTIFIC POSSIBILITIES OF AGRICULTURAL TRANSFORMATION IN THE TELENGANA AREA OF ANDHRA PRADESH

By

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I. AREA AND INCIDENCE OF DROUGHT

The Telengana region of Andhra Pradesh consists of the districts Khamman, Nalgonda, Warangal, Hyderabad, Mahboobnagar, Medak, Nizamabad, Karimnagar and Adilabad, occupying an area of 42,433 square miles. The total cultivated area in this region is 4.2 million hectares. About 7,00,000 hectares have irrigation facilities mainly from tanks (4,00,000 hectares) and the rest are solely rainfed. It has been calculated that only about 50,000 hectares of additional area can be provided with major and medium irrigation facilities in the foreseeable future. There is drought, as measured by rainfall being less than 75 per cent of normal, in this region once in 3 years (Sen, 1967).

There is no significant degree of industrial development, with the result that the economy is predominantly conditioned by agricultural production. No scientific cattle-development programmes exist. The topography of the area is generally undulating and rugged with numerous small hills. Drought-induced instability in crop production, hence creates much economic hardship to the agrarian population.

II. SOILS

Red and black soils are the main types in this area. The red soils locally known as "chalkas", or where the texture is very coarse as "Dubbas", occur in about 60 per cent of the area. Black and medium black soils occur in the Mahboobnagar area in the South and in the strips stretching from Adilabad to Karimnagar in the North and from Warangal

to Khamman in the south-east. The main mineral constituents of these soils are as follows:

Constituent Clay Mineral	Percentage of occurrence in		
	Red	Black	Medium black
Kaolinite	50 - 60	5	30
Montmorillonite	20 - 25	70 - 80	35
Mica and other minerals	15 - 30	15 - 25	35

Crops suffer more from aberrant rainfall in the red soil area because of the poor physical properties and consequent low water holding capacity of these soils. Even during the rainy season, plants grown in red soils show the effects of water stress, if the interval between two rainy spells exceeds 10 days. In contrast, the black soils have a good water retaining capacity and in these soils crops suffer more due to compaction resulting in the poor growth and penetration of roots. Thus, if moisture is available in the lower regions of the soil, the plants do not benefit, because the roots of even deep rooted crops like cotton and sugarcane do not penetrate below 15 to 20 cms depth. Thus, in the Telengana region crops are affected by low moisture retention in the red soils and low moisture availability in black soils. The adoption of scientific soil management practices such as better tillage and the incorporation of organic residues would help to mitigate the rigours of drought.

III. CLIMATE AND RAINFALL

The normal period for the onset of the South-West monsoon in this region is the second week of June. The peak rainfall occurs in the middle of July. Little or no rain is recieved for periods exceeding

a week to 10 days during late July and August, whenever "break monsoon" situations prevail. The monsoon withdraws from the region between the 1st and 2nd week of October. The southern part of Telengana usually gets some heavy thunderstorms and rainfall both in September and October. An analysis of 50 years data on rainfall collected by hundred raingauge stations (sixty in Telengana and forty in the surrounding areas) revealed that the Telengana area can be broadly divided into the following four rainfall regions (monthly normal rainfall data were used for the analyses).

1. A low rainfall region, receiving about 60 cms annual rainfall: This region has its axis from South Mahboobnagar to Nalgonda districts. The effect of drought is most severe in August in this region.

2. Region with an annual rainfall of 75 to 85 cms: The axis of this region extends from North Mahboobnagar to Medak and Karimnagar districts.

3. Region with rainfall ranging between 100 to 110 cms: The Nizamabad and Adilabad districts fall under this group. More than 24 cms of rain are received every month in this area between July and September.

4. Region with an annual rainfall of 90 to 120 cms: The Eastern strip of Telengana falls under this region.

From an analysis of the rainfall data relating to the Telengana area, Banerji and Chabra (1963) suggested that the run off dry days (rainfall less than 4 mm/day) may provide a better index of drought than the departure from seasonal rainfall. This suggestion receives support from the data on soil characteristics, since the moisture availability to crops is poor due to low water retention in the red soils and low water infiltration in the black soils. The average day temperature during August may exceed 27°C (Maximum temp. 31°C) in much of this region and hence prolonged dry spells result in severe atmospheric as well as soil drought.

IV. CROPPING PATTERN

The most widely grown crops in this region are Jowar, maize, castor, groundnut, cotton and pulses like redgram and greengram. In the tank-fed areas, rice and tobacco are cultivated. Since the tanks get filled up only by rains, the fate of the rice crop is also linked up with the rainfall pattern. Cotton is mainly grown in the black soils, while 60 per cent of the area of castor in India occurs in the red (chalka) soils of the Telengana region. Most of the currently grown varieties of these crops need a long duration (e.g., castor and redgram take over 240 days) and since only a single crop is raised, there is a severe economic set-back in years when there is a prolonged dry spell.

V. FERTILITY OF SOILS

Soil tests carried out in the laboratories located at Hyderabad and Rajhamundry revealed the following situation concerning the availability of nitrogen, phosphorus and potash:

District	Soil type	% alkali soils	N	P	K
Khammam	Black 50% Red 50%	36	M	TM	H
Nalgonda	Red	42	JL	JL	-
Warangal	Red	30	M	TM	H
Hyderabad	Medium black 30% Red 70%	30	JL	TM	-
Mahboobnagar	Black 60% Red 40%	36	TM	TM	-
Medak	Black 15% Lateritic 15% Red 70%	23	L	M	-
Nizamabad	Black 50% Red 50%	17	M	L	-
Karimnagar	-do-	23	M	L	-
Adilabad	Black 66% Red 33%	6	M	JL	-

H = High; M = Medium; T.M.= Tending to be medium; J.L.=Just low land; L=Low

Thus, the nutrient status of the soils in this area requires to be corrected and the alkali condition removed for getting better yields.

VI. DEVELOPMENT AND APPLICATION OF A NEW TECHNOLOGY

The development of a new technology for this drought-prone area has to be based on (a) improvements in tillage leading to better soil structure and root penetration, (b) addition of organic matter in the form of plant residues with a view to improving the physical and biological characteristics of the soil, (c) adoption of water-harvesting procedures resulting in storing as much of the precipitation as possible for the use of crops, (d) addition of plant nutrients through deep placement of fertilizer and foliar feeding, (e) improving the biological fixation of nitrogen through the use of efficient strains of rhizobia, particularly those which are tolerant to salt, (f) the introduction of photo-insensitive and quick maturing crops which are less affected by drought, (g) development of a series of single, double and mixed crop rotations from which the farmer can be advised to adopt the one which is most suited to the likely weather pattern during a season (advances in weather forecasting render such planning possible), (h) popularization of crops like soyabean, high-protein maize, macroni wheat, short-duration varieties of castor and cotton and perennial crops like cashewnut and dates which can form the base for small scale food industries and export earnings, (i) the saturation of irrigated areas with high yielding varieties of rice and multiple cropping patterns so that the yield and income potential of the 7,00,000 hectares of irrigated land gets greatly enhanced and (j) the popularisation of grasses like lemon grass, Panicum andCenchrus. While the above would constitute the major ingredients of an immediate action plan, a systematic survey and development of ground water resources should be initiated so as to gradually reduce the effects of weather on cropping and to increase the income potential of agriculture.

VII. CONSTITUENTS OF THE NEW TECHNOLOGY

1. Soil Management: (a) Structure: There is ample data now to suggest that deep ploughing helps to produce a type of soil structure in unirrigated areas which is conducive to both moisture preservation and root penetration. For enabling the farmers to adopt this practice, suitable soil-inverting ploughs should be made available. Also, a little better feeding of bullocks will be necessary to enable them to handle such ploughs. Both red and black soils will benefit from the incorporation of organic matter. Since it may be difficult to get adequate quantities of farm yard manure and to grow a crop entirely for green manure, the practice of incorporating into the soil all plant residues should be fostered. Studies at the I.A.R.I. have shown that maize stalks, when ploughed into the soil, help to improve dramatically the structure of the soil. For facilitating rapid decomposition, it would be desirable to use a chopper and cut the stalks into small bits before they are ploughed in.

(b) Fertility: As mentioned earlier, soil tests have shown that in most of the Telengana soils the content of both nitrogen and phosphorus is either low or moderate. If good crops are to be raised it would be essential that more nutrients are supplied. Until recently, there was a notion that no response is obtained from fertilizer application in many unirrigated crops. Recent experiments have, however, shown that if fertilizer application is done scientifically after soil tests, the yields can be increased greatly. Unlike in irrigated crops where the differences in growth and yield caused by applying the fertilizer either on the surface or in the deeper layers of the soil (about 10 cms below) are not marked in many crops, the deep placement of fertilizer in dry areas is a must for helping the roots to go deep and for promoting

seedling vigour. The extraction of moisture from the deeper layers is particularly important in view of the salt content in the upper layers.

In addition to deep and band placement of fertilizer, foliar feeding at the time of grain formation is a potent method of supplying nutrients under dry conditions. While the data on soil application versus foliar feeding of fertilizer under irrigated conditions show wide variations, foliar application is an invaluable method under dry conditions, since soil application is both difficult and risky. Foliar feeding of crops can be organised on a large scale and where the terrain permits it, aerial spraying of fertilizer offers a good method of ameliorating the hunger for nutrients in crops grown in dry areas. Studies at the I.A.R.I. have shown that by using a low volume sprayer, 35 to 40% concentrations of urea can be sprayed on crops. The cost-benefit ratio of such practices deserves to be worked out immediately through pilot studies in the Telengana area.

(c) Correction of alkalinity: In drought areas, high salt concentration, in addition to the non-availability of adequate moisture, hampers crop growth. In addition to selection of salt-tolerant varieties, it is also necessary to develop salt-tolerant strains of Rhizobia for addition to pulse crops. Studies at the I.A.R.I. in gram (Cicer arietinum) have shown that there is considerable varietal variation in salt tolerance and that it should be possible to select both suitable varieties and Rhizobial strains for alkaline soils. Field trials at the I.A.R.I. Regional Centre at Hyderabad have shown that the yield of unirrigated groundnut crop can be increased by 50% through the use of effective cultures of Rhizobium. Thus, there is an urgent need for popularising the use of efficient and salt-tolerant strains of Rhizobia for increasing the production of pulse crops as well as leguminous fodder plants like lucerne.

2. Harvest of water: Most of the rainfall in the Telengana area is received during the South-West monsoon period and because of the soil characteristics already referred to and the undulating land topography, much of the moisture is lost. Urgent steps are hence needed for the development and popularisation of modern water harvesting procedures. The use of bentonite clay, polyethylene film, aluminium foil and other methods should be tried for the widespread installation of small water reservoirs. If water can be stored for 1 or 2 irrigations during the August drought, great progress can be made in increasing yield.

3. New crop varieties: (a) Cereals, Pulses, Millets & Oilseeds: The development of dwarf and fertilizer-responsive rice varieties like Jaya, Padma and Hamsa has opened up new vistas in the yield of tank-fed rice in Telengana. For the unirrigated areas also, the breeding of photo-insensitive, short-duration varieties of Castor, arhar and jowar has enabled the initiation of double-cropping (Tables 6 to 9). ----). The duration of the new castor variety "Aruna" developed at the IARI Regional Research Centre, Hyderabad, can be reduced to 95-100 days from 130-150 days by nipping the lower auxillary buds, thus allowing only a single main spike to develop. This procedure leads to the development of a single long spike with 120 to 150 capsules. The entire produce can be harvested at one time within 100 days. The new short duration arhar and moong varieties developed at the IARI would also facilitate double cropping.

The heterozygote advantage associated with hybridity confers on the plant some degree of plasticity to environmental changes. This coupled with their short duration (less than 100 days) enables hybrid jowar (CSH.1) and hybrid bajra (H.B.3) to perform relatively better than

the local varieties during normal as well as drought years. Safflower and soybean can be introduced in this area with profit. Wheat can be grown well in the northern parts of Telengana during the rabi season. Dwarf wheat varieties like Kalyan Sona and Lerma Rojo have given yields ranging from 3 to 4 tonnes per hectare in 100 days when grown with a fertilizer dose of 50 Kgs Nitrogen/hectare. Since Triticum durum is relatively more drought resistant than T. aestivum and since fertilizer-responsive varieties of T. durum are now available, they can be grown with deep placement of fertilizer and foliar feeding. The short-duration cotton variety, PRS-72, would be another useful introduction in this area.

Thus, the development of quick-yielding and photo-insensitive varieties of crop plants has opened up altogether new possibilities in avoiding drought and in taking two crops where only one grew before.

(b) Fodder crops: There is need for extensive trials in this area with drought resistant forms of Panicum and Cenchrus grasses. The strains developed in Australia for the dry areas could be tried with profit. Drought resistant fodder legumes should also be tried.

(c) Perennial plants: The introduction and popularisation of good varieties of date palm, cashewnut and mango would help to increase the economic prosperity of the rural population. Grapes are already popular.

(d) High protein crops: Pellagra, a nutritional disease associated with the excess of leucine in Jowar (Gopalan, 1967) is prevalent in the areas where Jowar is the staple. It is necessary to introduce a corrective in the diet and for this purpose the high lysine maize composite developed at the IARI may be useful. Unless a primary product with good protein quality is introduced into cultivation, the malnutrition problem cannot be easily banished.

4. New Agronomy: The new agronomy for Telegana would consist of:

(a) Better tillage and improvement of soil structure.

(b) Supply of nutrients through deep placement of fertilizer, foliar feeding and use of bacterial fertilizers.

(c) Adoption of mixed cropping, multiple and relay cropping. Relay cropping is important for sowing the second crop when there is moisture in the soil (for example, soybean should be sown in the standing crop of Jowar).

(d) Incorporation of plant residues in the soil and fighting alkalinity problems.

5. Conclusions: The suggestions contained in this paper are based on the available data and if implemented, can help to enhance the production potential and agricultural economy of the drought-prone regions of Telengana. The implementation of the suggestions does not involve any high capital investment. What is immediately needed is the organisation of the supply of the needed inputs and the requisite amount of credit as well as an efficient and well-informed extension agency which can convey the new technology to the farmers. The National Demonstration Programme of the ICAR could be an important vehicle for showing the new cropping patterns to farmers in their own fields. There is need for very close coordination between the agricultural and meteorological departments, since an important new concept is the selection of alternative crop sequences, depending upon the predicted pattern of weather. For example, if the monsoon is expected on time, castor or groundnut or arhar or maize may be sown; if it is likely to be delayed, moong may be sown. Another important ingredient of the strategy for agricultural transformation is the replacement of the

single long-duration crop with two short-duration crops. Keeping a crop-cover through most of the year would not only help to tap solar energy to the maximum possible extent but also to minimise the accumulation of salts in the top soil. The alternative crop choices and double cropping would tend to minimise or even avoid the economic ruin caused by drought.

The emphasis on a package of immediate steps to improve the economic position of farmers in the area does not imply that other long term and capital intensive measures like extending the area under irrigation from the Tungabadra project area and the exploitation of ground water resources should not be undertaken. Our aim is only to suggest measures which would tend to increase the wealth of the people in the area, so that more money would become available for investment in agriculture. The motivation to the farmer for putting more effort is the net return and not total yield per hectare. Hence, attention to post-harvest technology such as storage, processing, marketting and pricing is equally important. The cropping patterns suggested in this paper would also provide scope for starting new protein food and processing industries in the area.

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Table 1: Comparative performance of CSH-1, Swarna & Local

Location	CSH-1	Swarna	Local improved
Hyderabad**	5411(3)*	5495(2)	2769(2)
Warangal	2573(3)	2562(1)	1150(3)
Adilabad	3097(2)	2342(2)	3216(2)
Mudhol	1984(2)	--	1390(2)
Rudrur	4066(1)	3683(1)	2296(1)
Mean	3426	3520	2164
% Local	158	162	100

*No. of trials averaged per location **Irrigated

Table 2: Performance of bajra hybrids (1967-68)

Location	H.B.1	H.B.3	Local
Hyderabad	1034	1766	869
% Local	119	203	100

Table 3: Characteristics of Aruna and H.C. 6 Castor

Character	Aruna	H.C.6
Seed yield (Kg/ha) (Irrigated)	3083	2005
Oil yield (Kg/ha) (Irrigated)	1622	1024
Seed yield (Kg/ha) (Rainfed)	965	834
Days to maturity	130-150	240-250
Plant height (cms)	190	310
Oil %	52.3	50.9

Table 4: Response of wheat to Nitrogen (Rajendranagar, 1967)

Rates of N (Kg/ha)	Grain yield (Qtl/ha)		
	Kalyan Sona	Sonalika	Chhoti Lerma
0	20.7	21.1	20.9
40	30.4	29.3	28.4
80	37.9	31.8	35.7
120	43.0	34.5	37.7
160	43.6	35.3	39.5
200	44.5	35.6	38.1
Mean	36.7	31.3	33.4

Table 5: Response of some improved varieties of rice to nitrogen in Telengana - Kharif 1968*

N	IR8		IR5		Padma		IR 262		Local	
(Kg/ha)	Raj.	Rud.	Raj.	Rud.	Raj.	Rud.	Raj.	Rud.	Raj.	Rud.
0	2698	1175	2288	1541	1804	1236	2191	1526	2115	1419
50	3721	3663	3322	4579	2933	3022	2869	2946	3235	3175
100	4152	4365	3875	5617	3727	3343	3570	3816	4047	4808
150	4661	5067	4537	6426	4256	4152	4226	4808	4577	4426
200	5059	5861	4964	6182	4732	4426	4603	4518	4874	5831
Mean	4058	4026	3797	4869	3490	3236	3492	3523	3770	3932

*Data from Progress Report of the All India Coordinated Rice Improvement Project, Vol. 3, Kharif 1968. Raj - Rajendranagar; Rud - Rudrur.

Table 6: Crop Rotations for Telengana
Region I: Average rainfall : 60 cms (August drought common)
Area : Southern part of Mahboobnagar, Nalganda and eastern half of Hyderabad

Sl.No.	First Crop	Second crop
1.	Castor (Aruna) mixed with horse gram	--
2.	Early Red gram with strips of Hybrid Bajra or Hybrid Jowar	--
3.	Moong (H.B. 45)	Bajra (H.B. 3)
4.	Moong (H.B. 45)	Early Safflower

Table 7: Crop Rotations for Telengana
Region II: Average rainfall: 80-85 cms (random drought spells)
Area : Western half of Mahboobnagar, Western Karimnagar, Western half of Warangal and Medak

Sl.No.	First Crop	Second Crop
1.	Castor (Aruna) mixed with horsegram	--
2.	Groundnut	Castor (Aruna)
3.	Groundnut	Early Red Gram
4.	Hybrid Jowar (CSH.1)	Soyabean (in relay with Jowar)
5.	Moong (H.B. 45)	Bajra (H.B. 3)

Table 8: Crop Rotations for Telengana
Region III: Average rainfall : 110 cms
Area : Adilabad, Nizamabad and Western Karimnagar

Sl.No.	First Crop	Second Crop
1.	Cotton (PRS.72)	Dwarf wheat
2.	Moong or Soyabean	Dwarf wheat
3.	Groundnut	Safflower*
4.	Moong	Maize (High Protein)
5.	Hi-starch Maize	Dwarf wheat

*Selection 7-13-3 (105 days) (From Annigere Local x unknown Exotic)

Table 9: Crop Rotations for Telengana
Region IV : Average rainfall : 90-120 cms
Area : Eastern half of Adilabad, Karimnagar and Warangal and Khammam

Sl.No.	First Crop	Second Crop
1.	Groundnut	Bengal gram
2.	Hybrid Bajra	Bengal gram
3.	Groundnut	Early Red gram or hybrid jowar
4.	Moong	Hybrid Jowar

Regions I, II and IV are predominantly light soils and Region III is mostly a heavy black soil area.

production of seedless mango, sex attractants in insects raising rice seedlings from pollen grains cultured on suitable media, getting protein dispersed in the entire endosperm of rice as in wheat, rendering plants resistant to salt and sea waters, physiological basis of drought tolerance making Jowar hybrids produce maternal seeds, electron microscopic and serological analysis of viruses, reducing the transport of oxygen from leaves to roots in upland rice and development of synergists for pesticides.
