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Slow Growth Crops—Pulses, Oilseeds and Coarse Grains—Technological, Economic and Environmental Constraints

FACTORS CONSTRAINING GROWTH OF COARSE GRAIN CROPS IN SEMI-ARID TROPICAL INDIA

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Stagnation or very slow growth of coarse cereals and pulses in recent years[1] has become a serious concern of planners and policy makers in India. Heavy dependence on rainfall, lack of new technology, poverty of farmers and the absence of infrastructural support are often cited reasons for the slow growth of these crops. Nevertheless, the poor performance of these crops at the macro level is the result of farmers' decisions and actions vis-a-vis these crops. The farmer's approach to these crops in turn is conditioned by their characteristics, which are (1) low value status, (2) adaptation to poor habitat and resource base, and (3) production and consumption by the poorer members of society. These traits acquire differential significance in varying contexts but reinforce each other in creating a complex of constraints for coarse cereals and pulses.[2] This paper illustrates the manner in which the constraints operate at the farm level. The paper concludes with possible directions to relax these constraints.

DATA

The paper is based on farm level data collected since 1975 under the village level studies (VLS) programme of ICRISAT.[3] The data relate to a panel of 60 farmers each from three agro-climatic regions represented by Akola and Sholapur districts in Maharashtra State and Mahbubnagar district in Andhra Pradesh State. The data are collected regularly on a plot basis by resident investigators, and this paper is based on data from 1975-76 to 1977-78.

We focus on sorghum, pearl millet, pigeonpea (*tur*), chickpea (Bengal gram) and a few other pulses and minor millets most of which form part of the mixed crops. We refer to these commodities as coarse grain crops in this paper. An important characteristic of cropping patterns in the study areas

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1. T. N. Srinivasan, "Trends in Agriculture in India, 1949-50 to 1977-78", *Economic and Political Weekly*, Vol. XIV, Nos. 30, 31 and 32, Special Number, August 1979.
2. N. S. Jodha, "Prospects for Coarse Cereals: Permanent Constraints of Jowar and Bajra", *Economic and Political Weekly*, Vol. VIII, No. 52, December 29, 1973.
3. N. S. Jodha, M. Asokan and J. G. Ryan: Village Study Methodology and Resource Endowments of the Selected Villages in ICRISAT's Village Level Studies, ICRISAT Economics Program Occasional Paper 16, ICRISAT, Patancheru, A. P., 1977.

is that the bulk of these rainfed coarse grain crops are planted as intercrops or mixtures. So much so that except for sorghum, and to a limited extent for pulses, it is hard to find sole cropping systems of coarse grain crops. Hence, for the present paper, besides sole crops the intercrops of coarse grain crops have been considered as categories for discussion. This treatment is essential because farm management decisions relate to a cropping system such as intercrops rather than a single component of the system. Depending upon which crop dominates we have grouped the systems as cereal-based or pulse-based intercrops.

In order to highlight the constraints to production, coarse grain crops or their intercrops are contrasted with high value crops in a number of dimensions.

LOW VALUE STATUS OF SLOW GROWTH CROPS[4]

The low value status of sorghum, millet, minor millets and (until recently) pulses is a well known fact. How these crops stand vis-a-vis other high value crops[5] of the respective regions (*i.e.*, cotton and wheat in Akola, wheat and sugarcane in Sholapur, paddy and groundnut in Mahbubnagar) is illustrated by the ratio of net returns per hectare of coarse grains to net returns per hectare of the high value crops. According to Table I, except in the case of sorghum and pulse-based intercrops in Akola, the ratios did not exceed 0.5. In most cases, the ratio ranged between 0.1 to 0.3, suggesting that coarse grains' net return per hectare is only 10-30 per cent of net returns

TABLE I—RATIO OF NET RETURNS PER HECTARE OF LOW VALUE CROPS TO NET RETURNS PER HECTARE OF PROMINENT HIGH VALUE CROPS OF THE RESPECTIVE REGIONS[a]

Crop	Regions with their high value crops					
	Akola		Sholapur		Mahbubnagar	
	Cotton	Wheat	Wheat	Sugarcane	Paddy	Groundnut
Sorghum	0·54	0·90	0·54	0·10	0·30	0·21
Pigeonpea	—b	—	0·26	0·05	—	—
Chickpea	0·20	0·33	0·40	0·07	0·19	0·13
Coarse cereal-based intercrops	0·31	0·51	0·43	0·08	0·16	0·11
Pulse-based intercrops ..	0·35	0·57	0·24	0·05	0·20	0·14

a. *Source:* ICRISAT's Village Level Studies. Jodha *et al.*, *op. cit.* All tables in the paper are based on data of 180 sample farms, 60 each from Akola, Sholapur and Mahbubnagar districts for the agricultural years 1975-76 to 1977-78. Net returns are arrived at by subtracting total input costs excluding the cost of family labour and owned bullock labour from total value of the main and by-products of the crop.

b. Pigeonpea is not commonly planted as a sole crop in the Akola and Mahbubnagar villages.

4. The term 'slow growth' connotes the production performance of coarse grain crops in India. It does not relate to the physiological growth habits of the crops.

5. The high or low value of a crop is a relative term, but the traditional cash crops and superior cereals (wheat and rice) invariably fetch higher prices per unit as compared to coarse grains. On this basis, the two categories of crops have been called high value and low value crops in this paper.

per hectare offered by prominent high value crops of the respective regions. Low relative profitability is a strong enough factor to induce farmers not to be more favourable to coarse grains.

The reasons for low value status of coarse grain crops are rooted in the nature of demand for these crops and are briefly discussed in one of the later sections. Low relative output prices imply that these crops suffer from very poor competitiveness vis-a-vis other crops grown by the farmer. As a consequence, coarse grain crops are discriminated against in inter-farm and intra-farm allocation of resources. This is particularly so when high quality or high cost inputs are allocated.

Of the total plots under sole stands or intercrops of coarse grain crops 49-80 per cent were planted on inferior soils—shallow, eroded, gravely or even medium deep soils in largely deep soil villages. The corresponding figures for high value crops (excluding groundnut planted in shallow soils) were 0-34 per cent.

Other resources like water, fertilizer, and manure were also very scantily applied to coarse grain crops. Most coarse grain crops received little if any irrigation, fertilizer or manure (Table II). In contrast, irrigation and fertilizer were applied liberally to high value crops. Be it number of times the plot was irrigated, or rupees of fertilizer per hectare, allocations to high value crops were generally two to five times greater than those to coarse grain crops.

TABLE II—PROPORTION OF TOTAL AREA UNDER DIFFERENT CROPS RECEIVING IRRIGATION, FERTILIZER AND MANURE IN THREE REGIONS[a]

Crop	Percentage of area receiving following inputs in the regions: (A) Akola, (B) Sholapur, (C) Mahbubnagar								
	Irrigation			Fertilizer			Manure		
	A	B	C	A	B	C	A	B	C
Low value crops									
Sorghum	0	8	4	0	3	17	0	7	0
Pulses	1	5	0	0	0	4	7	4	8
Coarse cereal-based intercrops	1	6	0	6	3	0	2	14	6
Pulse-based intercrops	8	2	..c	7	1	..	0	0	..
High value crops									
Paddy[b]	0	17	100	23	35	96	12	1	32
Wheat[b]	91	82	100	91	36	0	0	7	0
Groundnut and intercrops	6	29	94	21	20	74	30	10	4
Cotton and intercrops	2	..	..	19	..	..	6	..	..
Sugarcane	..	100	..	..	56	..	..	34	..
Vegetables	49	93	30	32	47	24	35	19	8

a. *Source:* See footnote 'a', Table I.
b. Paddy in the case of Akola and Sholapur, and wheat in the case of Mahbubnagar are quite insignificant crops to offer meaningful comparisons.
c. Blank or dotted spaces indicate that the cropping system is not commonly grown in the region.

Moreover, the low priority faced by coarse grain crops in intra-farm resource allocation did not stop with material inputs. The average number

of bullock labour days per hectare was 32-91 per cent greater for high value crops. This gap was even wider with regard to the allocation of human labour. A more extensive use of human and bullock labour in coarse grain crops *per se* may not be bad. But behind this quantitative difference lies the most crucial qualitative difference in the management of two sets of crops. The data revealed frequent pre-sowing ploughing of field beds, multiple weeding and interculturing for high value crops compared to coarse grain crops. In some cases, the ratio of specific operations between coarse grain crops and high value crops was 1:3. The implications of this situation become clear once it is realised that coarse grain crops can also respond to higher input use[6] and intensive management practices.[7] Responsiveness is particularly apparent in dryland agriculture where some of the labour intensive operations like better soil preparation, weeding, interculturing, etc., can enhance the effective utilization of scarce moisture.

Furthermore, intensive labour use on high value crops is often at the expense of low value coarse grain crops. The farmer often allocates less labour to these crops at the farm, village, and regional levels. Small and medium farmers leaving their coarse grain crops uncared for and working for wages on irrigated farms within or outside the village is common.

Thus, coarse grain crops suffer a sort of backlash from high value crops in several ways. The farmer may not be termed irrational in according low priority to coarse grain crops which are unable to compete with high value crops. However, as a long-term consequence their low value status tends to block any opportunity for these crops to be exposed to high cost inputs and intensive management. The new technologies which can help these crops express their potential under high input management and thereby significantly compensate for their low value status are often rejected by the farmer. This is partly evident from the scant allocation of irrigation and fertilizer to these crops (especially cereals) despite evidence from experimental and on-farm trials about the positive response of these crops to the modern inputs.[8]

CROPS OF POOR RESOURCE BASE

Most coarse grain crops are capable of yielding at least some returns even under the most adverse environmental conditions. This important feature not only makes them useful low cost, low risk options for the farmer but encourages their concentration in regions, districts, or even plots characterized by natural resource deficiencies—low soil fertility and paucity of moisture.[9]

6. D. Jha, S. K. Raheja, R. Sarin and P. C. Mehrotra: Fertilizer Use in Semi-Arid Tropical India: The Case of High Yielding Varieties of Sorghum and Pearl Millet, ICRISAT Economics Program Progress Report 22, ICRISAT, Patancheru, A.P., 1981.
7. B. K. Rastogi: A Study of Economics of Recommended Practices for Dryland Agriculture, All India Co-ordinated Research Project for Dryland Agriculture (ICAR), Hyderabad, 1981.
8. S. L. Chowdhury, "Fertilizer Management in Dryland Regions for Increased Efficiency", *Fertiliser News*, Vol. 24, No. 9, September 1979.
9. Jodha, *Economic and Political Weekly*, December 29, 1973, *op. cit.* and D. Sharma and N. S. Jodha: Constraints and Opportunities of Pulse Production in Semi-Arid Regions of India, 1982 (forthcoming).

The performance of coarse grain crops under adversity distorts the farmers' approach to these crops. Since they can perform (compared to other crops) even in marginal situations the farmer pushes them to more and more marginal situations. For instance, in fields where practically nothing except thorny grass can grow, farmers do not hesitate to plant coarse grain crops particularly pearl millet, minor millets, and minor *kharif* pulses. Similarly, when rains at sowing time are not adequate for planting most crops, farmers plant coarse grain crops in the plots usually reserved for high value (more moisture requiring) crops. This is illustrated in Table III. The proportion of plots where coarse grain crops followed high value crops increased during low rainfall years. Moreover, high value crops were seldom planted after coarse grain crops when rainfall was below normal (last column, Table III).

TABLE III—DISTRIBUTION OF PLOTS INVOLVING ROTATION BETWEEN HIGH VALUE CROPS AND COARSE GRAIN CROPS AS INFLUENCED BY SOWING PERIOD RAINFALL IN THREE REGIONS[a]

Region	Percentage of rainfed plots with rotations involving			
	High value crops[b] followed by coarse grain crops during		Coarse grain[c] crops followed by high value crops during	
	Normal rainfall	Below normal rainfall	Normal rainfall	Below normal rainfall
Akola	21	-[d]	37	-[d]
Sholapur	10	58	39	3
Mahbubnagar	15	63	42	9

a. *Source:* See footnote 'a', Table I. The table is based on more than 400 cropping sequence observations in each region.

b. High value crops included here are paddy, wheat, groundnut, cotton, oilseeds (excluding castor), sugarcane, vegetable crops and intercrops based on cotton and groundnut.

c. Coarse grain crops included here are sorghum, pearl millet, minor millets and pulses along with intercrops of these crops.

d. No below normal rainfall during the sowing season was recorded by rain gauges in the Akola villages in any year.

The coarse grain crops' comparative advantage in marginal environments and consequent further marginalisation of those crops may be a rational strategy in the whole farm context. But it has two other implications. Firstly, their contribution as a strategy to manage marginal situations is seldom appreciated when evaluating their poor performance in aggregate statistics. Secondly, and more importantly, their capacity to yield under adverse environmental conditions is misjudged as evidence of their inability to perform better under improved environmental situations. Consequently, the coarse grain crops are permanently deprived of a more productive resource base.

If the resource base of the area traditionally allocated to coarse grain crops improves (*e.g.*, through a new irrigation facility), rather than harness the potential of these crops farmers replace them with high value crops. At

the macro level, Chopra and Swamy,[10] and Jodha[11] have documented this tendency for pulses and coarse cereals respectively. Table IV reveals similar changes in the case of about 50 plots which received irrigation for the first time during the reference period in the study villages.

TABLE IV—CHANGES IN CROPPING PATTERN OF NEWLY IRRIGATED PLOTS OF SAMPLE FARMERS IN THREE REGIONS[a]

Crop	Percentage share of each crop in area	
	Before irrigation	After irrigation
Sorghum	57	15
Sorghum-based mixtures.. ..	17	..
Pulses	8	2
Other mixed crops	5	2
Castor	9	..
Paddy	1	25
Wheat	..[b]	46
Sugarcane, vegetables, etc. ..	3	10

a. *Source:* See footnote 'a', Table I.
b. Blank or dotted spaces indicate absence of relevant observation data.

COARSE GRAINS: POOR MAN'S CROPS

Coarse grains are a poor man's crops in the sense that they are largely produced and consumed[12] by the poor. While the former feature affects their production performance, the latter conditions their demand and price.

At the national level, the positive correlation of the dry habitats of these crops with the poor districts was suggested by Jodha.[13] At the farm level, we examine the relative importance of coarse grain crops in the production pattern of small and large farmers in the VLS villages (Table V).

The data in Table V clearly indicate a greater preference by small farmers for coarse grains over high value crops. If the castor dominated situation of Mahbubnagar is excluded, small farmers devote a much higher proportion (65-74 per cent) of their cropped area to coarse grains compared to large farmers. Diet surveys during four seasonal rounds suggested a higher proportion of coarse cereals in the total cereal consumption of small farmers compared to large ones in Akola and Mahbubnagar. In Sholapur, small farmers consumed more wheat, a superior cereal, received under rural employment works.

10. Kusum Chopra and Gurushri Swamy: Pulses: An Analysis of Demand and Supply in India, 1951-1971, Institute for Social and Economic Change, Bangalore; Sterling Publishers, New Delhi, 1975.
11. Jodha, *Economic and Political Weekly*, December 29, 1973, *op. cit.*, and N. S. Jodha, "Resource Base as a Determinant of Cropping Patterns", in Symposium on Cropping Systems Research and Development for the Asian Rice Farmer, International Rice Research Institute, Los Banos, The Philippines, 1977.
12. This applies less strongly to some of the pulses.
13. Jodha, *Economic and Political Weekly*, December 29, 1973, *op. cit.*

TABLE V—A PROFILE OF COARSE GRAIN CROP PRODUCERS IN THREE REGIONS[a]

Details and unit of reporting	Regions and farm size-groups					
	Akola		Sholapur		Mahbubnagar	
	Small farmer	Large farmer	Small farmer	Large farmer	Small farmer	Large farmer
Share of coarse grain crops in gross cropped area (per cent)[b]	65	47	74	58	33[c]	21[c]
Share of superior crops in gross cropped area (per cent)[b] ..	25	42	7	25	30	39
Share of coarse cereals in total cereal consumption (per cent)[d]	78	72	76	98	45	24
Average size of operational land holding (ha.)	2	14	3	12	1	10
Average net income per household (Rs.)	2,428	6,388	2,298	3,307	1,647	6,436
Average value of total assets per household (Rs.)	8,158	70,251	16,880	41,592	10,640	57,019

a. *Source:* See footnote 'a', Table I.
b. See footnotes 'b' and 'c' respectively, Table III for crops included under categories of high value crops and coarse grain crops.
c. The relatively lower proportion of coarse grains in Mahbubnagar is due to almost equally large proportion of gross cropped area allocated to castor—a crop of poor resource base but having high value.
d. Consumption data pertain to four seasonal rounds during October 1976 to January 1978 during which a detailed diet survey was conducted by nutritionists as part of the VLS. The data relate to one village each in the three districts. In Sholapur village, availability of wheat to small farmers working under rural employment works raised the proportion of superior cereals in total cereal consumption.

Small farmers have good reasons to grow relatively more coarse grain crops than large farmers. Compared to high value crops, coarse grains have lower paid-out costs, lower risk (at least for Mahbubnagar), a higher component of fodder and are better suited to mixed or intercropping systems (Table VI). The small farmer, due to his poor resource position, lower risk-bearing capacity, and persistent subsistence orientation, has stronger preferences for crops endowed with these characteristics.[14] The coarse grain crops in turn have to share the consequences of the above characteristics and the general poverty of small farmers which is partly responsible for their poor production performance.

No discussion of constraints on coarse grain crops would be complete without mentioning their demand characteristics. The demand for coarse cereals, and even some of the pulses are geographically localised to the regions growing them. Demand is largely confined to rural areas and mostly poor consumers in urban areas. These crops[15] are neither widely traded nor

14. N.S. Jodha, "Intercropping in Traditional Farming Systems", *Journal of Development Studies*, Vol. 16, No. 4, July 1980.
15. Except some pulses.

TABLE VI—SOME FEATURES OF COARSE GRAIN CROPS VIS-A-VIS HIGH VALUE CROPS INDUCING SMALL FARMERS' PREFERENCE FOR COARSE GRAIN CROPS[a]

Region/crop category	Features of different crops belonging to two categories			
	Range of proportions (per cent) of paid-out cost to total cost	Range of coefficent of variations (per cent) of net returns per hectare	Range of ratios of fodder value to main product value	Range of proportions (per cent) of area of crop planted as intercrop
Akola				
Coarse grain crops [b]	52-60	89-106	0·20-0·44	93-97
High value crops [c]	66-83	92-129	0·02-0·09	5-94 [c]
Sholapur				
Coarse grain crops	41-55	140-195	0·19-0·52	38-97 [d]
High value crops	60-82	107-224	0·03-0·12	7-24
Mahbubnagar				
Coarse grain crops	40-56	111-116	0·21-0·41	62-100
High value crops	58-82	140-281	0·02-0·10	0-36

a. *Source:* See footnote 'a', Table I.

b. See footnotes 'b' and 'c' respectively, Table III for crops included under categories of high value crops and coarse grain crops.

c. This range will be from 5-62 if cotton, often grown as dominant intercrop, is excluded.

d. This range will be 62-97 if *rabi* sorghum often planted as sole crop is excluded.

receive official patronage and support comparable to superior cereals like wheat and rice.[16] The farmer knows the demand aspect of these crops too well. Hence, he treats them more as means of subsistence and important components in his risk and resource management strategy rather than as commercial crops. Any large scale improvement in productivity of these crops may generate a glut in the market. This has already happened in the case of pearl millet-based shortlived green revolution in Gujarat in the late 1960s.[17] As long as such a situation continues, there will hardly be any incentive at the farm level to raise the production of these crops.

THE WAY OUT

The preceding discussion portrays a rather depressing picture of the current state of coarse grain crop production at the farm level. In order to alter the situation factors influencing both production and demand for coarse grains need attention.

On the production side, new technology has to play a key role. Against the general impression that no viable technology is available for coarse grains, scientists have offered a number of recommendations which can substantially raise the yields of these crops.[18] Farm level trials of these technologies have more than doubled the net returns from these crops when compared to traditional technologies in different dry farming areas.[19]

But the capacity of new technologies to compensate for the low value status of coarse grains may be limited unless sustained high demand for coarse grains is maintained. No technology can remain viable in the face of constantly declining demand, price, and finally returns from the crops. But if the demand for coarse grain crops (except some pulses) continues to maintain its present pattern, that is its use for human consumption largely by the poor and by subsistence farmers where the crops are grown, there seems little chance for yield increasing technologies to have a sustained impact on production at the national level. Hence, diversification of demand for coarse grain crops in the form of animal feeds, processed foodstuffs, and multiple products becomes imperative to help coarse grain crops.[20] The commercialisation of coarse grain crops and adoption of new technology can reinforce each other in improving the production performance of these crops. This fact should be the focal point of programmes for coarse grain crops.

16. Jodha, *Economic and Political Weekly*, December 29, 1973, *op. cit.*

17. N. S. Jodha and V. S. Dharap, "Is Green Revolution Stable ? An Illustrative Case", *Artha Vikas*, Vol. 6, No. 2, July 1970.

18. Improved Agronomic Practices for Dryland Crops in India, All India Co-ordinated Research Project for Dryland Agriculture (ICAR), Hyderabad, 1981, and H. P. Binswanger, S. M. Virmani and J. Kampen: Farming Systems Components for Selected Areas of India: Evidence from ICRISAT Research Bulletin No. 2, ICRISAT, Patancheru, Andhra Pradesh, 1980.

19. Rastogi: *op. cit.* and J. G. Ryan, S. M. Virmani and L. D. Swindale: Potential and Challenges for Increased Income from Deep Black Soils in Relatively Dependable Rainfall Regions in India, ICRISAT, Patancheru, A.P., 1982.

20. The conversion of *guar* from a second rate animal feed in desert areas to a high value cash crop became possible once *guar gum* became an important input in the textile industry and *guar* became an important ingredient of processed animal feed. Increased production of barley (a coarse cereal facing general decline) in the areas around breweries is another case in point.