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ECONOMIC EVALUATION OF DRY FARMING IN PUNJAB

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Conceptually 'Dry Farming' refers to the technique of crop cultivation in such regions that are marked by scarce rainfall and absence of irrigation. Most important among the factors that contribute to the success of 'dry farming' are : (1) conservation of moisture in the soil, and (2) choice of crops having low water requirements. Several soil management practices are recommended by soil scientists for moisture conservation, such as field-bunding, green manuring, mulching, and suitable crop rotations. Work on selection of suitable varieties of crops such as millets (bajra, jowar), pulses (*mong* and *moth*), oilseed (rape and mustard), cereals (barley and wheat), and other legumes (gram and *guar*) is in progress by agronomists on some research stations in India and abroad. But crop yields in the dry regions continue to be substantially low as compared to irrigated lands because of scarcity, uncertainty, and untimeliness of rainfall.

Since about 78 per cent of the cultivated area in India does not receive irrigation, and most of it does not have assured rainfall, the situation of agricultural production continues to be unstable and grave in the country. This obviously is the cause of frequent crop failures on dry farmed lands. Though several technical studies have been conducted to make dry farming productive, yet no serious attempt at economic evaluation of the problem of dry farming has been made so far to attract the attention it deserves. This paper is an attempt to bring out some economic aspects of dry farming as they exist in the Punjab. The paper equally represents conditions in the adjoining districts of Rajasthan in the south, Haryana in the south-east, and Himachal Pradesh in the north.

Dry farming is much handicapped as compared to irrigated farming, and assured rainfall farming in the matter of full exploitation of land and other available resources. On dry lands, multiple cropping is not possible, the level of fertilizer input is extremely low, and the labour and animal power for most of the period in the year remains idle or under-employed. Consequently productivity per unit of land, labour, and power and other capital resource is low.

The present study was, therefore, undertaken to assess the productive capability of dry farmed lands in the Punjab, and to determine the cost-return ratio of the same in relation to irrigated farming. More precisely, the study focusses its attention on three specific objectives, *viz.*, (*i*) to identify distinct dry farming areas based on natural resource characteristics; (*ii*) to examine the pattern of dry farming practices; and (*iii*) to study the input-output ratios, and profits from dry farming.

Methodology

The Punjab was distinguished into three more or less climatically homogeneous zones in respect of rainfall and humidity on the basis of meteorological records. They are : (*a*) northern zone; (*b*) central zone; and (*c*) southern zone.

From each zone three representative villages were purposively selected, and from each village two to three cultivated holdings were selected randomly on the basis of area under dry farming. These holdings were partly irrigated and partly dry farmed.

The required data pertaining to dry farming practices, and costs, yield and returns on the cultivation of various crops were obtained by survey method on suitably constructed schedules. The period of study was two years 1969-70 and 1970-71, and average of the data for both the years was taken. The data were then averaged out zonewise, and analysed for determining net returns from various enterprises.

Zonal Characteristics

Northern zone comprises the districts of Gurdaspur, Hoshiarpur and Rupar. The average annual rainfall varies between 80 and 155 centimetres. The soil is mostly loam, with few exceptions of clayloam. Though rainfall is apparently enough, yet most of it being confined to the two monsoon months of July and August, it is really scarce for the remaining months of the year. This zone, however, is less dry. Dry farming extended over 51 to 78 per cent of the total cultivated land.

Central zone comprises the districts of Amritsar, Kapurthala, Jullundur, Ludhiana and Patiala. The rainfall varies between 54 and 70 centimetres. The soil is mostly loam, and sandyloam. Dry farmed land varied between 19 and 35 per cent of the total cultivated area.

The southern zone, comprising of Ferozepur, Bhatinda and Sangrur districts, has an annual rainfall varying between 35 and 47 centimetres. This zone is really the low rainfall belt of the State typical of western Haryana, and north-western Rajasthan. The soil is mostly sandy, and sandyloam in texture. Dry farmed land occupied 19 to 26 per cent of the total cultivated land.

Moisture Conservation Methods

Because of the fact that natural water resource received through rainfall is limited and is unpredictable, its judicious use for growing of crops is very important. It is, necessary, therefore, that this moisture is properly conserved for efficient utilization by growing crops. The moisture conservation practices depend upon soil type, gradient, and the extent of rainfall, temperature, and winds.

Information collected from the selected farmers in different zones indicated that the management practices were considerably different in different zones. Important soil management practices for conservation of moisture on dry farmed lands in the different zones for Punjab State are presented below.

Northern zone	Central zone	Southern zone
1. Bunding of fields	1. Contour bunding	1. Ploughing before rains
2. Ploughing and planking after rains	2. Ploughing and planking after rains	2. Planking heavily after rains to bind loose soil
3. Green manuring with Sannhamp and burying the same in the end of August	3. Harrowing with disc harrow to produce mulch	3. Strong bunding wherever possible to check run-off water
4. Clod breaking by manual labour or repeated planking	4. Breaking clods with planker or roller	4. Disc or bar harrowing with animal or tractor power

The soil and water management practices must ensure that whatever rainfall was received, it was stored in the soil and the loss of moisture through evaporation was minimized. Contour bunding was practised on land to check run-off water, and the accompanied soil erosion. Cultural practices like ploughing and planking at the proper time, are given as a common practice to retain water in the same field to prevent loss through evaporation.

Crops and Crop Rotations

Information obtained on types of crops and crop rotations practised on dry farming areas by farmers indicated that both the crops and the rotations differed from zone to zone depending upon the moisture availability. Fallowing of land occupies an important position in the cropping system, particularly in the central and southern zones. Except the northern zone the selected crops are invariably those that have low water requirement. Sugarcane and maize, whose water requirement is high, find place in the dry farming system, only in the northern zone. Zonewise crop rotations as observed in practice are given in the next page.

The intensity of cropping varied from 130 to 150 per cent in the northern zone, 110 to 130 per cent in the central zone and 100 to 110 per cent in the southern zone. The intensity is high or low in the respective zones depend-

ZONEWISE CROP ROTATIONS

Northern zone	Central zone	Southern zone
1. Mash—fallow	1. Groundnut—fallow	1. *Guara*—fallow
2. Fallow—wheat	2. Bajra—fallow	2. Bajra—fallow
3. Maize—barley	3. *Guara*—fallow	3. Cotton—fallow
4. Jowar—gram (fodder)	4. Fallow—gram	4. Fallow—*sarson*
5. Groundnut—wheat	5. Fallow—barley	5. Fallow—barley
6 Sannhemp—wheat (green manure)	6. Fallow—wheat	6. Fallow—gram
7. Sugarcane	7. Mash—barley	7. Fallow—wheat
	8. Mash—wheat	8. *Guara*—wheat/gram

ing upon the extent of fallowing, and varies in inverse relationship with the same. The varying patterns of crop rotations in the respective zones indicate the comparative diminishing levels of land utilization from the northern to the southern zone.

Productivity Rates

The productivity on dry farmed lands is expressed in terms of yields of crops. The average productivity under dry farming is shown in Table I. The productivity on irrigated land, other factors remaining the same, is also given by way of comparison.

TABLE I—PRODUCTIVITY OF MAJOR CROPS UNDER DRY FARMING AND IRRIGATED FARMING IN PUNJAB : 1969-71

[*quintals per 0·40 hectare (acre)*]

Crop	Northern zone			Central zone			Southern zone		
	Dry farming	Irrigated farming	Yield on dry as % of irrigated	Dry farming	Irrigated farming	Yield on dry as % of irrigated	Dry farming	Irrigated farming	Yield on dry as % of irrigated
Wheat ..	6·04	14·55	42·4	6·00	21·61	47·7	3·25	9·66	33·6
Barley ..	6·50	10·00	65·0	—	—	—	5·50	9·00	61·0
Gram ..	3·00	—	—	3·88	12·00	32·3	4·10	7·85	52·2
Sarson ..	—	—	—	—	—	—	3·50	8·25	42·5
Maize ..	7·00	12·75	54·9	—	—	—	—	—	—
Bajra ..	—	—	—	6·00	11·58	51·8	3·25	8·32	39·00
Groundnut ..	5·00	—	—	5·81	6·75	86·7	—	—	—
Mash ..	4·00	—	—	3·75	—	—	—	—	—
Guara ..	—	—	—	—	—	—	3·41	5·00	68·2
Sugarcane (*gur*)	14·00	23·00	60·00	—	—	—	—	—	—

Table I indicates that the productivity on dry farming was substantially low as compared to irrigated farming. Expressing yield on dry farmed land as a percentage of yield on the irrigated land, it varied between 33.6 per cent and 47.7 per cent for wheat, the minimum being in the southern zone, and maximum in the central zone. For barley it varied between 61 and 65 per cent for the respective zones. In respect of bajra it was 39 per cent in the southern zone and 51.8 per cent in the central zone. In the northern zone for maize it was 54.9 per cent and for sugarcane 60 per cent. The percentage was the highest (86.7) in respect of groundnut in the central zone followed by 68.2 for *guara* in the southern zone. In respect of gram it was 52.2 per cent in the southern zone, and 32.3 per cent in the central zone. Absence of irrigation, therefore, accounted for a large decline in the productivity of land.

Input Levels

The level of inputs used, particularly of improved seed, chemical fertilizers, and pesticides indicates the degree of progressivity in farming techniques attained by the farmers. Disuse of these elements of production reflect lack of change in the outlook of the farmers in favour of increased production, or absence of the necessary conditions of supply of irrigation for increased production. Low level use of the same is indicative of the risk involved in these types of investments due to the element of uncertainty in the expected output—a conspicuous characteristic of dry farmed lands. This aspect of dry farming in the Punjab is considered below.

(*a*) *Seed:* Mostly seed of traditional low-yielding varieties was being used on dry farming areas. The high-yielding hybrid varieties of bajra and maize, and dwarf Mexican wheat which have stepped up production manifold in Punjab, were not grown under dry farming. It was stated that traditional varieties were able to stand dryness of climate and soil better than the high-yielding hybrids and dwarf varieties.

(*b*) *Fertilizer:* The use of fertilizer on dry farmed land was also insignificant. In the northern zone, fertilizer was not applied to the wheat crop under dry cultivation by farmers of Hoshiarpur and Rupar districts, but in the Gurdaspur district fertilizer was in some cases applied, but its level was low hardly to the extent of one-fifth of the quantity for irrigated crop. In the other two zones wheat crop was not fertilized with the sole exception of Jullundur district where the quantity used was very meagre. Other crops which received small quantities of fertilizers under dry farming conditions were sugarcane, maize, groundnut, jowar (fodder) in the northern and central zones, but the quantities reported were very low as compared to irrigated areas. In the southern zone there was no evidence of the use of fertilizer on dry farmed lands.

(*c*) *Insecticides:* The use of insecticide was also not reported from any area throughout the Punjab. Obviously, the crops grown were not getting the needed attention by way of protection measures. Partial failure of crops, or of low productivity could also be attributed to this neglect.

Cost-Returns Analysis

An assessment of economic performance of the various crops on dry farmed lands necessitates analysis of the magnitude of input costs, and returns. For this purpose gross returns from crops were calculated by taking average yield of the sample farmers in each zone, and by applying the average post-harvest period prices. Input costs were calculated from the actually used quantities of all production elements used including labour and power utilized at the market rates. The variable costs were deducted from gross returns to determine the returns from cultivation (over variable input costs). The comparative position of gross returns, variable costs and returns (over variable input costs) from different crops in the respective zones are presented in Table II.

TABLE II—GROSS RETURNS, VARIABLE COSTS AND COST-RETURN RATIOS FROM DIFFERENT CROPS UNDER DRY FARMING CONDITIONS IN PUNJAB : 1969-70 AND 1970-71

[*Rs. per 0·40 hectare (acre)*]

Crop	Northern zone			Central zone			Southern zone		
	Gross returns	Variable costs	Cost-return ratio	Gross returns	Variable costs	Cost-return ratio	Gross returns	Variable costs	Cost-return ratio
Maize ..	385	288	1 : 1·3	—	—	—	—	—	—
Sugarcane ..	1,176	773	1 : 1·5	—	—	—	—	—	—
Groundnut ..	600	271	1 : 2·2	697	360	1 : 1·9	—	—	—
Mash ..	460	156	1 : 2·9	391	177	1 : 2·2	—	—	—
Guara ..	—	—	—	—	—	—	256	98	1 : 2·6
Bajra ..	—	—	—	—	—	—	260	100	1 : 1·2
Wheat ..	459	271	1 : 1·7	456	285	1 : 1·6	267	216	1 : 1·2
Gram ..	330	174	1 : 1·9	427	167	1 : 2·6	451	128	1 : 3·5
Barley ..	450	184	1 : 2·4	—	—	—	385	157	1 : 2·4
Sarson ..	—	—	—	—	—	—	665	137	1 : 4·9

In Table II we observe that wheat crop which is grown in all the three zones gives narrow cost-return ratio of 1:1.2 in the southern zone as compared to 1:1.6 in the central and 1:1.7 in the northern zone. The cost for the same in the southern zone was also the minimum as also the gross returns as compared to the other two. Gross returns in the northern and central zones were almost equal, and the difference in input costs were also marginal. Compared to the gram crop which competes with wheat on dry lands and is also grown in all the three zones, the latter's performance was far poor in the southern zone, markedly poor in central zone, and slightly poor in the northern zone because cost-return ratio of gram was 1:3.5, 1:2.6 and 1:1.9 respectively. Clearly the cultivation of gram was more profitable than wheat under dry farming throughout the Punjab.

Sarson another *rabi* season crop was even more promising with cost-return ratio of 1:4.9 in southern zone than both gram and wheat with impressive returns amounting to Rs. 528 per unit of 0.40 hectare. Even the performance of *guara*, bajra and barley as indicated by the ratios were far better than wheat. Due to poor returns wheat, therefore, should not be grown on dry lands in the southern zone.

Groundnut and mash competed with each other in the northern and central zones. Mash had an edge over groundnut in both the zones. In fact in the northern zone it had an edge over every other crop, the most nearer competitor being barley besides groundnut. The performance of maize and sugarcane was, however, poor.

Fixed-Variable Cost Ratio

The above analysis is, however, partial and short run in the sense that fixed costs which constitute a part of total costs have not been accounted for. In the long run one cannot afford to determine net profitability without reference to fixed costs. It was, therefore, imperative to take into account the share of fixed costs due to dry land from the total on the farm unit. Fixed costs included depreciation on the value of capital assets and interest on the value of capital investment. An additional item of rent paid or payable, was also taken into account, zonewise average of these costs were calculated from the actuals in the respective farm situations, and apportioned between different crops on the basis of the period of growth of the crops. Net returns from dry farming accruing from each crop enterprise could thus be determined by adding up the variable input costs (Table II) and the fixed costs, the two together being the total costs.

It would be interesting to know the ratio between variable and fixed costs to understand the relative impact of each on net returns from the various crop enterprises. The ratios are worked out in Table III.

It is clear from Table III that fixed-variable cost ratios are wider in respect of sugarcane, wheat, maize and groundnut in the northern zone and in respect of groundnut in the central zone and comparatively much narrower for all crops in the respective zones. The low level of variable costs in relation to fixed costs is particularly reflected by low ratios in the southern zone. This means that fixed costs are more predominant in the total cost structure. This is so because of the extreme dry conditions existing in this zone which do not permit the application of fertilizers and other modern inputs on dry land.

Net Returns

Net returns from dry farming provide us the index of economic gains accruing to the holders as reward for investment made and effort put in. The success or failure of dry farming as farm business proposition depends whether net returns per annum are high or low, and how the same compare

TABLE III—RATIOS BETWEEN VARIABLE AND FIXED COSTS FOR VARIOUS CROP ENTERPRISES IN THE PUNJAB

[*Rs. per 0·40 hectare (acre)*]

Crop	Northern zone			Central zone			Southern zone		
	Variable costs	Fixed costs	Fixed-variable cost ratio	Variable costs	Fixed costs	Fixed-variable cost ratio	Variable costs	Fixed costs	Fixed-variable cost ratio
Maize ..	288	121	1 : 2·4	—	—	—	—	—	—
Sugarcane ..	773	240	1 : 3·2	—	—	—	—	—	—
Groundnut ..	271	121	1 : 2·2	360	150	1 : 2·4	—	—	—
Mash ..	156	121	1 : 1·3	177	145	1 : 1·2	—	—	—
Guara ..	—	—	—	—	—	—	93	159	1 : 0·6
Bajra ..	—	—	—	—	—	—	100	154	1 : 0·6
Wheat ..	271	102	1 : 2·6	285	157	1 : 1·8	216	175	1 : 1·2
Gram ..	174	117	1 : 1·5	167	154	1 : 1·1	128	180	1 : 0·7
Barley ..	184	121	1 : 1·5	—	—	—	157	180	1 : 0·9
Sarson ..	—	—	—	—	—	—	137	180	1 : 0·8

with alternative investments in the area. The levels of net returns in different situations also indicate the nature and extent of weaknesses in the existing system, and the possibility of providing for the same to make dry farming attractive for farmers to stay in the business.

Net returns as calculated from the above data are presented in Table IV for the various crop enterprises under discussion.

TABLE IV—NET RETURNS FROM DRY FARMING IN THE PUNJAB : 1969-71

[*Rs. per 0·40 hectare (acre)*]

Crop	Northern zone				Central zone				Southern zone			
	Gross returns	Total cost	Net returns	Total cost : gross returns ratio	Gross returns	Total cost	Net returns	Total cost: gross returns ratio	Gross returns	Total cost	Net returns	Total cost: gross returns ratio
Maize ..	385	409	—24	1 : 0·9	—	—	—	—	—	—	—	—
Sugarcane	1,176	1,013	163	1 : 1·2	—	—	—	—	—	—	—	—
Groundnut	600	392	208	1 : 1·5	697	510	187	1 : 1·4	—	—	—	—
Mash ..	460	277	183	1 : 1·7	391	322	69	1 : 1·2	—	—	—	—
Guara ..	—	—	—	—	—	—	—	—	256	252	4	1 : 1·0
Bajra ..	—	—	—	—	—	—	—	—	260	254	6	1 : 1·0
Wheat ..	459	373	86	1 : 1·2	456	442	14	1 : 1·0	267	391	—124	1 : 0·7
Gram ..	330	291	39	1 : 1·1	427	321	106	1 : 1·3	451	308	143	1 : 1·5
Barley ..	450	305	145	1 : 1·5	—	—	—	—	385	337	48	1 : 1·1
Sarson ..	—	—	—	—	—	—	—	—	665	317	348	1 : 2·1

A glance over Table IV indicates that profits for maize in the northern zone and from wheat in the southern zone were negative. Profits from *guara* and bajra in the southern zone, and wheat in the southern zone were marginal. Profits from gram in the northern zone, barley in the southern zone, and mash in the central zone were meagre. The cultivation of these crops in these zones was, therefore, economically not justified. Mash, groundnut, barley and sugarcane in the northern zone, groundnut and gram in the central zone, and *sarson* and gram in the southern zone were the crops which showed fairly good net returns. The emphasis in the matter of choice of crops should, therefore, be on the crops, rather than those which give negative or meagre net returns.

Conclusions

Having identified the characteristics of the three dry farming zones in the Punjab, it could be concluded that the problems of dry farming were different in different zones. Moisture stress in southern zone was the maximum. It was the minimum in northern zone. Only two crops, wheat and gram, were common to all the three zones. Two crops, groundnut and mash, were common to two zones—northern and central. Barley was also common to two zones, northern and southern. Maize and sugarcane were confined only to the northern zone, and *sarson* to the southern.

Maximum net return was from *sarson* in the southern zone, followed by groundnut in the northern zone, being Rs. 348 and Rs. 208 respectively per unit of 0.40 hectare. It was lower from mash, sugarcane and barley in the northern zone, and gram in the southern zone varying between Rs. 143 and Rs. 183. For the rest of the crops in different zones the net return was extremely low, and was even negative for maize in the northern and wheat in the southern zones.

This shows that the production potential of dry farmed land is extremely poor in the Punjab. The answer is expansion of irrigation. Until that is possible moisture conservation measures might be strongly developed and adopted by the farmers to render dry farming meaningful particularly in the southern and central zones.