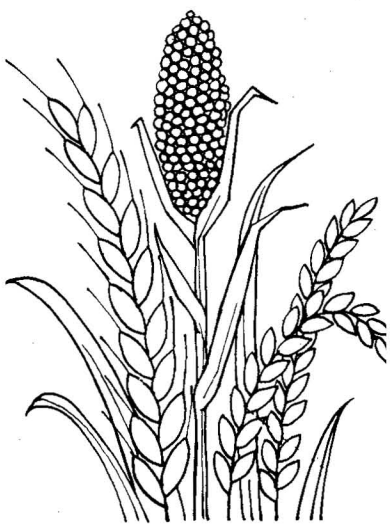
Vol XXIII
No. 2

APRIL-
JUNE
1968

ISSN 0019-5014

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS



INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

THE CONCEPT OF UNEMPLOYMENT IN A DEVELOPING ECONOMY

J. N. Sinha

Analytically, unemployment implies, in the absence of market imperfections, a situation in which labour supply is perfectly elastic at the current wage rate. Following the neo-classical approach, if we assume a normal production function, the proximate cause of unemployment would be the tenacity of the floor to wage rates. Like the sellers of other commodities, the labourer may have a reservation price below which he prefers involuntary idleness to employment. Where marginal productivity of labour falls below this price, we have an excess labour supply situation. It is the purpose of this paper to examine the level and significance of the reservation price in the context of labour markets in a developing economy and the form in which labour supply and demand imbalances express themselves here.

Unemployment is essentially a market phenomenon which is contingent on the growth of labour market and of a sizable class of 'wage labour.' So far as the rise of 'wage labour' is necessarily implied in the process of economic change and modernization, a very concrete problem of unemployment may soon arise in the developing countries. However, so long as there exists a sizable traditional sector with households as the units of production which give to their members a natural right to work irrespective of their marginal productivity, it may continue to provide a cushion against unemployment of those exposed to the risks of competition in the modern sector.

THE VULNERABLE CLASS

It has been pointed out that in India three major factors have been in operation over the last century which "led to a rapid proletarianisation of the working force, and thus to the emergence of unemployment as an open phenomenon .... These are the rights to individual property recognized by the British legal system which facilitated the break-up of joint families; the emergence of a market for land, which led to the gradual dispossession of small peasant proprietors and technological changes which caused the displacement of labour from traditional occupations. The people uprooted in these ways have either migrated to the towns in search of employment or joined the ranks of a new class of landless agricultural labourers, also in search of work."[1]

Agricultural labourers form the most vulnerable section of the rural community. In the words of the I.L.O. Report, they "constitute the core of the employment problem in the rural sector, because they are actively seeking employment in the employment market."[2] Some of them have cultivating rights in tiny bits of land where they are employed for a part of the year, but the extent of employment and earnings secured on their farm is so limited that they are

1. K. N. Raj: Employment Aspects of Planning in Under-developed Economies, National Bank of Egypt, Cairo, 1957, p. 8.
2. I.L.O. : Employment Objectives in Economic Development, 1961.

compelled to supplement it by hiring out their labour on others' holdings. Landless agricultural labourers obviously depend exclusively on wage employment in agriculture or such other employment as they can manage to procure. Agricultural labourers are classified into two categories : attached and casual. Attached workers, about 10 per cent of all, are bound by a contract which generally ensures them regular employment, though at lower wage rate. Casual labourers, on the other hand, are employed on a daily wage basis in holdings which are often small and scattered. They have little chance of making an organized effort to secure an improvement in the terms and conditions of their employment. They do not have many assets on which to fall back in lean periods. They are generally conservative and custom bound but inexorable economic necessity impels them to move from place to place in search of employment, or higher wages. In short, they are exposed to all the hazards of a competitive market and provide interesting laboratory material for testing well-known hypotheses regarding determination of wage and employment levels in a competitive situation.

WAGE DETERMINATION : SUBSISTENCE MINIMUM OR MARGINAL PRODUCTIVITY

In the neo-classical model of perfect competition unemployment is a short run phenomenon which appears only on account of frictions and rigidities in the labour market. Given wage flexibility and normal production function, market forces would always tend to establish a state of full employment. In this model, excess labour supply is reflected in a downward adjustment of wage rates which tends to correct the initial imbalance. No doubt, "the inelasticities of the time patterns of primary production"[3] as well as rigid resource complementarities in agriculture limit the effectiveness of wage flexibility as a tool of adjustment in agricultural economies. But wage reductions could stimulate employment in several ancillary agricultural functions related to hedging or general upkeep of the farm and buildings or livestocks as well as non-agricultural occupations into which the agricultural workers are always willing to move. However, there may exist in all societies a floor to the wage rate corresponding to the classical notion of a subsistence wage. This floor may be conventionally or institutionally determined or, as is more likely in countries with chronically overcrowded agriculture, it may be a physiological minimum. Whatever the factors which determine the level of the floor, once it is established and wages refuse to fall below it, however considerable the pressure in the labour market, excess labour supply tends to assume the form of open unemployment.

The chronic imbalance between labour supply and complementary resources in agriculture is normally expected to result in the setting up of wage floors at subsistence levels over large parts of the country. We do not have a long term series of wages and cost of living to examine this hypothesis. The first Agricultural Labour Enquiry (ALE), however, gives data on wages and prices of foodgrains (on which the labourer spends the major part, about 60 per cent, of his income) at two points of time, 1938-39 and 1950-51. It shows that while wages have gone up three to five times, they have generally lagged behind the rise in foodgrain prices. What is more interesting for our purpose is that wages in terms of foodgrains given in Table I show a decline even in the most poverty-

3. L. E. Howard : Labour in Agriculture, Oxford University Press, London, 1935.

striken States of Bihar and Orissa where they are very likely to have touched the subsistence minimum even in 1938-39. Such a decline appears to suggest that there is no rigidity about the subsistence floor and wages have probably adjusted to changing levels of marginal productivity.

The hypothesis of wage sensitivity to relative demand and supply variation may also be verified with the help of cross-section data of various States, by fitting a regression equation of the form :

$$W = \alpha + \beta_1 x_1 + \beta_2 x_2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Where W is the average wage rate, x_1 is the value of output per holding, x_2 is number of agricultural labourers per holding, β's are coefficients and α is a constant.

Assuming rigid complementarity between land and labour, x_1 demand factor in equation (*i*) could be measured by average size of holding and x_2 by the number of labourers per holding. But, as we know, labour requirements in agriculture also vary with the intensity of farming. Hence we take the value of output per holding, *i.e.*, the size of holding adjusted for productivity per acre, as our measure of demand.

The demand for labour may be met either from the family or the hired labour. To arrive at a precise measure of demand for hired labour, due adjustment must be made for the extent of family labour available for operations on the farm. However, we observe that as between different States the size of family varies only between 5 and 6, and further, if account is taken of the inhibiting effects of prosperity on economic activity rates among women and children in bigger families which are generally associated with larger holdings, the range of variations in the volume of family labour per holding as between different States would be lower still. Thus, output per holding may be related to the number of hired labourers per holding to indicate the relative demand and supply situation.

The regression coefficients derived from fitting equation (*i*) to the Indian data at two points of time, 1951 and 1961 are given below :

$$W_{1951} = 37.69 + \underset{(.022)}{.093x_1} - \underset{(16.24)}{17.25x_2} \quad \ldots\ldots R^2 = .84$$

$$W_{1961} = 120.74 + \underset{(0.01)}{.06x_1} - \underset{(27.65)}{41.98x_2} \quad \ldots\ldots R^2 = .68$$

The values of R^2 indicate that inter-State variations in agricultural wages are significantly explained by value of output and supply of labour per holding. The regression coefficients of output per holding are significant both in 1951 and 1961: they point out that a rise of 100 paise (one rupee) in output would secure an increase of 9 paise in 1951 and 6 paise in 1961. As expected, the regression coefficients of labour supply are negative, but they are not statistically significant. But these values relate to average wages which conceal a large amount of seasonal

variation. It appears likely that in the off-peak season when there are labour surpluses, wage rates touch the floor determined by subsistence levels. If this floor is a physiological minimum, it should exhibit a smaller regional spread. Wages for lowest paid agricultural operations show, according to first ALE data, a wide range from 60 paise in Madhya Pradesh to Rs. 1.61 in Punjab; in terms of foodgrains, they vary from 3.5 lbs. to 10 lbs. A wage which, when spent entirely on cereals, procures less than one pound for each member of the family (assuming a family size of 4) evidently falls short of a bare subsistence minimum. It might be labelled as 'distress wage,' not a subsistence wage, which the workers accept under compulsions of economic necessity. At the other limit, a wage which provides 1.5 pounds of foodgrains per family member, when the worker spends only 60 per cent of it on cereals, is clearly above the bare physiological minimum, though not satisfactory by other standards. If the workers succeed in resisting further wage reductions in spite of sizable off-season unemployment, it only shows their waiting capacity acquired through higher earnings at the peak which leave them a margin to cover periods of unemployment.

It is, indeed, interesting to note that like average daily wage rates, minimum wages also move in close association with value of output and supply of agricultural labour per holding. If minimum wages were rigid and determined by subsistence levels, they should show an asymptotic tendency at the lower levels. The values of regression coefficients given below are, however, statistically significant for both 1951 and 1961, suggesting wage flexibility in areas of low productivity.

$$W'_{1951} = 30.83 + \underset{(.015)}{.083x_1} - \underset{(11.09)}{18.76x_2} \quad \ldots\ldots\ldots R^2 = .90$$

$$W'_{1961} = 109.80 + \underset{(.015)}{.05x_1} - \underset{(22.37)}{41.40x_2} \quad \ldots\ldots\ldots R^2 = .65$$

where W′ stands for minimum wages.

WAGE FLEXIBILITY AND UNEMPLOYMENT

Assuming that aggregate demand consideration (in the Keynesian sense) are not quite relevant for developing countries, that market for agricultural labour is broadly competitive and that production function over a wide range of occupations taken in their aggregate is normal, wage flexibility would ordinarily ensure full employment. Whether open unemployment persists in the Indian context in the face of observed wage flexibility in backward areas may be seen from a review of the unemployment data. Data on unemployment for 1951 and 1961 (for which wage rates have been presented) available from the first Agricultural Labour Enquiry and 1961 Census respectively are presented in Table III. In South India and Bombay, the first ALE reveals the expected relation between concentration of agricultural labour families, low productivity and wage levels and high rates of unemployment. But in other States notably Uttar Pradesh, Bihar, Orissa and Madhya Pradesh, where demand and supply conditions are equally unfavourable and wage rates are very low, the incidence of unemployment is also significantly low. In these States low wages seem to encourage a liberal and perhaps irrational use of labour. At the same time, when we observe heaviest

incidence of unemployment in a prosperous State like Punjab, wage rigidity suggests itself as a plausible explanation. Our findings are also confirmed by 1961 Census data on unemployment as given in Table III. It includes, among the rural unemployed, persons who have not had some regular work of more than one hour a day throughout the greater part of the working season but were available for work. It reveals that the proportion unemployed in rural areas (which may give a broad indication of the incidence of unemployment among agricultural labourers) varies directly with wage rates, the heaviest incidence being observed in States like Punjab, West Bengal, Assam and Kerala which report highest wage rates. While there are limitations of unemployment data from both the sources cited and not much reliance may be placed on the magnitudes obtained, the regularity with which we observe the same relation between pages and unemployment rates gives a measure of confidence in our results.

The coexistence of a large volume of unemployment and high wage rates (both average and minimum) in areas of high agricultural productivity appears anomalous at first sight. But the fact of the matter is that it is in these areas that workers are in a position to fix a reservation price below which they refuse to offer their services for employment. Wages do fall in off-season in prosperous areas, but they remain substantially higher than the peak in other areas and seem to discourage employment in periods when labour cannot be utilized at high levels of productivity. Low wages coupled with some measure of flexibility perhaps ensure longer duration of employment in areas of low productivity.

Dr. Raj is of the view that the amplitude of seasonal variation in wage rates would provide "a rough index of the extent of unemployment and of the magnitude of surplus labour in a region."[4] This subsumes (1) a rigid floor determined by subsistence minimum and (2) a competitive wage determined by labour scarcity at the peak. In prosperous areas, off-season wages appear to be relatively high, and perhaps rigid, and excess demand does lead to a rise of competitive wage during the busy season. In the backward areas, however, our analysis reveals that minimum wage itself is flexible. There is thus a two way adjustment mechanism. The amplitude may rise due to upward revision of wages during periods of labour shortage in areas of high productivity and downward adjustment of the floor in areas of distress. It is no accident then if the data show significant seasonal variation in wage rates even in backward States (see Tables IIA and IIB).

However, even if we assume a rigid floor, seasonal rise of wages would be an index of overall labour surplus or shortage, not of open full time unemployment *per se*. Unemployment in the western sense implies a perfectly elastic labour supply at the going wage rate. If it persists even at the peak, there should be no rise in wage rates. Actually, we observe a significant gap between the minimum and the maximum even in economically depressed States. While this may be attributed to market imperfections, it is very likely that there is no open full time unemployment and higher wage rates have to be paid to convert the latent reserves of manpower in tiny holdings into open employable surpluses for meeting the peak demand of the bigger farms. However, the distinction is a matter of theoretical nicety. The fact remains that there exists in poor States a

4. K. N. Raj : Employment Aspects of Planning in Under-developed Economies, *op cit.*, p. 11.

large number of workers whose employment and earnings are inadequate to keep them going throughout the year.

Judged by the time worked criterion, the worker appears to be more fully employed in low wage–low productivity areas. But considering that his earnings are inadequate to keep him going throughout the year, he is *virtually* unemployed for a good part of the year. He is, therefore, forced to supplement his earnings by taking up all kinds of odd jobs; working as a petty trader in an already overcrowded market or going to service industry, for example, by joining the row of people who offer to shine shoes or work as domestic servants. In each case the characteristic feature is that the activities are already overcrowded, but that he can hope to divert part of the business to himself and so earn something. This implies that the pressure in overcrowded areas also goes to swell the ranks of what we may call the pseudo-employed.

Excess labour supply in backward areas may thus be reflected in downward adjustment of wage rates, and in overcrowding in those areas of self-employment (outside agriculture) in which capital and skill requirements are too low to prevent the entry to new workers. In such areas wages are hardly above the subsistence limit even at the peak, leaving the workers little margin for their maintenance out of season. They are, therefore, forced to accept any work that is available, and at any place, regardless of the rate of return which it yields. Their flexibility gives them more work, but it is work at 'distress wage rates.' Unemployment for long periods under these conditions, though theoretically conceivable, would imply nothing short of absolute misery and starvation, a comparatively rare occurrence.

The phenomenon of open unemployment emerges with the 'proletarianisation' of labour, the growth of a class of committed labour force which is willing to accept work only of particular types, in particular areas, and at specified levels of remuneration. Expropriation of peasants and artisans has led to 'pauperisation,' not 'proletarianisation' of labourers. For the pauperised workers, there is no choice but to work 'at any level of remuneration.' As economic development gets under way, however, there grows a class of workers that is conscious both of the range of jobs and of the minimum rates of return acceptable to it. This is particularly true of educated and skilled workers. It is this class which is most exposed to the risk of unemployment. But in prosperous areas, as observed in Punjab, even unskilled labourers seem to prefer a state of unemployment or 'no work' to work below what we might call 'the reservation price' of their labour. It is not expropriation alone but expropriation accompanying minimum levels of economic well-being and development with concomitant rise of wage-paid jobs and consciousness among the people of their right to work and minimum wages which leads to the phenomenon of open unemployment. It goes without saying, of course, that if a high rate of economic development is sustained for long, the incidence of unemployment would decline.

APPRAISAL OF NATIONAL SAMPLE SURVEY APPROACH TO UNEMPLOYMENT

Employment and unemployment data are now being regularly collected through the National Sample Survey in India. The survey is based on the opera-

tional definitions of 'employment' and 'unemployment' given by the Central Statistical Organisation.[5] Among the 'employed' are included all persons who report work for pay or profit on at least one day in the reference week, unpaid family helper and all persons with jobs or own enterprises, professions or vocations, but temporarily absent from work during the reference week. The 'unemployed' in urban areas are said to comprise all persons "who, having no jobs or enterprises of their own, had not worked even on a single day and were earnestly looking for full time work." For the rural areas, however, "looking for full time work" criterion is replaced by that of "availability for work *at current rates of remuneration* in prevailing conditions of work."

A serious complication is introduced because current wage rates have been highly flexible both over time and space. More persons may "report work for pay" but it may be work at 'distress' rates which neither meet their conventional needs nor satisfy our concept of a 'technical minimum.' From the individual point of view, therefore, a true measure of employment can only be obtained by deflating the number of days employed by a suitable wage-index, as follows :

$$E' = E \times \frac{W}{W_S} \qquad \ldots\ldots\ldots\ldots (ii)$$

where E′ is the standard time-units of work, E is the actual time-units worked, W is the average daily rate in the reference period and W_S is the 'standard wage.' We may take for the 'standard' a 'technical wage,' determined by such considerations as the minimum nutritional requirements and the needs for clothing, housing, etc. This minimum would obviously vary with change of place and climate. Its serviceability as a 'standard' is, however, restricted. Where off-peak wages lie above the technical minimum, as is likely in more developed States, it is unfair to abandon the 'current wage' in favour of the latter. At the same time, where peak wage itself lies below the technical minimum the latter has to be rejected in favour of the former on grounds of economic feasibility. The 'technical minimum' could be used to determine the standard only in areas where the peak is above it, but the off-peak wages lie below it. Unemployment would then be measured as follows :

$U = A - E'$, where U is the number of time-units unemployed, A is the number of time-units a person reports as employed plus the time for which he is available for work, and E′ is as in equation (*ii*).

CONCLUSION

Our analysis brings out adjustability of wages of agricultural labourers (who form the most vulnerable class) to levels of agricultural productivity. In the backward areas wages at the peak appear too low to leave any surplus for the off-peak. Workers are, therefore, compelled to seek work in the off-season at any level of remuneration. Excess labour supply in this situation finds its expres-

5. Standards for Surveys on Labour Force, Employment and Unemployment, Central Statistical Organisation, Government of India, 1961.

sion in the prevalence of what we may call 'distress' wage rates and overcrowding in 'self-employed trades,' not in open unemployment. In the relatively prosperous areas, however, workers can afford to wait so long as the wages offered to them remain below their reservation price. This serves to explain the anomaly of direct association between wages and unemployment rates. In view of the divergent adjustment mechanisms, any measure of employment in time-units would be irrelevant until it is deflated by a suitably determined standard wage rate.

TABLE I—WAGES AND PRICES OF FOODGRAINS—1938-39 AND 1950-51

States	Weighted wage (*Naye Paise*)		Weighted price per lb. of foodgrains (*Naye Paise*)		Wages in terms of foodgrains (lbs.)	
	1938-39	1950-51	1938-39	1950-51	1938-39	1950-51
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Uttar Pradesh	24	121	3	18	6.36	6.54
Assam	49	182	6	25	7.71	7.34
Bihar	25	126	4	26	5.25	4.94
West Bengal	43	172	5	25	7.76	6.93
Orissa	17	74	3	18	4.75	4.11
Madras	33	95	5	23	5.99	4.16
Mysore	35	91	4	11	8.54	8.29
Travancore-Cochin	37	133	5	30	7.82	4.38
Bombay	34	100	4	15	7.82	6.79
Saurashtra	39	139	—	—	—	—
Madhya Pradesh	27	84	3	9	7.63	8.74
Madhya Bharat	21	89	3	16	6.73	5.62
Hyderabad	35	89	5	20	6.34	4.34
Rajasthan	25	127	3	18	8.15	7.28
Punjab	69	199	4	16	18.56	12.34
Pepsu	42	277	15	18	8.43	16.31

Source : Agricultural Labour Enquiry—Report on Intensive Survey of Agricultural Labour, Vol. I—All-India, 1950-51, Ministry of Labour, Government of India, 1955.

Notes : 1. Weighted wage rate relates to ploughing, transplanting, weeding and harvesting operations. The rates of wages are weighted according to man-days worked on these operations as revealed by the Intensive Family Survey.

2. Weighted retail price relates to rice, wheat, gram and other cereals. The prices are weighted according to the intake of ounces of these foodgrains per consumption unit as revealed by the family budget data of the Intensive Family Survey.

TABLE IIA—WAGE RATES, VALUE OF OUTPUT AND SUPPLY OF LABOUR PER HOLDING : 1950-51

States	Average daily wage† rates (*Naye Paise*)	Minimum† wage rates (*Naye Paise*)	Coefficient of variation Max.—Min. / Min.	Value of agricultural output per holding (Rs.)	Agricultural labour per holding
(1)	(2)	(3)	(4)	(5)	(6)
Assam	203	185	0.24	1,872	0.18
Bihar	113	93	0.75	691	1.19
Bombay*	112	88	0.23	1,129	0.66
Madhya Pradesh*	86	64	0.50	782	1.30
Orissa	77	76	0.03	913	1.23
Punjab	215	167	0.74	1,572	0.31
Rajasthan	118	107	0.31	934	0.28
South Indian* States (combined)	113	88	0.39	1,102	1.77
Uttar Pradesh	115	100	0.55	995	0.33
West Bengal	184	168	0.15	1,769	0.55

Sources : 1. Columns 2 to 4 and 6 from Agricultural Labour Enquiry—Report on Intensive Survey of Agricultural Labour, Vol. I—All-India, 1950-51, *op. cit.*

2. Value of agricultural output in 1951 was estimated by deflating 1961 output by the index numbers of production for the period 1951-61 given in Growth Rates in Indian Agriculture, Ministry of Food and Agriculture, Government of India, 1965. For sources of data for 1961 output, see footnote to Table IIB.

† Since output data are given at 1961 prices, wages have also been raised by cost of living index in 1961 with 1951 as the base.

* Each asterisk marked State includes two or more States (as of 1951 boundaries) pooled together to make it comparable to a State or groups of States as formed after organization of boundaries.

TABLE IIB—WAGE RATES, VALUE OF OUTPUT AND SUPPLY OF LABOUR PER HOLDING: 1961

States	Average daily wage rates (*Naye Paise*)	Minimum wage rates (*Naye Paise*)	Coefficient of variation Max.—Min. / Min.	Value of agricultural output per holding (Rs.)	Agricultural labour per holding
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	134	117	0.25	1,074	1.37
Assam	218	213	0.07	1,702	0.12
Bihar	140	127	0.19	700	0.76
Bombay	181	172	0.12	1,273	1.02
Kerala	184	167	0.22	2,434	0.97
Madhya Pradesh	134	128	0.14	972	0.66
Madras	132	122	0.25	1,378	0.87
Mysore	154	140	0.21	1,094	0.70
Orissa	126	118	0.20	743	0.54
Punjab	245	221	0.21	1,898	0.33
Uttar Pradesh	127	102	0.50	870	0.34
West Bengal	186	170	0.18	1,436	0.58

Sources : 1. Average daily wage rates have been computed from Agricultural Wages in India, 1960-61 and 1961-62, Ministry of Food and Agriculture, Government of India, 1962 and 1965. Since the wage rates for Rajasthan are not given in the source around 1961, it has been dropped.

2. Data on agricultural output of 41 crops obtained from Estimation of Area, Production and Yield per Acre of Principal Crops in India, 1961-62, Ministry of Food and Agriculture, Government of India, and farm harvest prices obtained from *Agricultural Situation in India*, Vol. XX, No. 10, January, 1966 were used to estimate the total value of agricultural output in different States. Some gaps in data were filled by figures obtained from the Ministry of Food and Agriculture, Government of India.

3. Numbers of agricultural labourers were obtained from Census of India, Paper No. I of 1962, 1961 Census—Final Population Totals, Government of India, 1962.

TABLE III—EXTENT OF UNEMPLOYMENT

States	Man-days unemployed per agricultural labourer, Agricultural Labour Enquiry 1951	Unemployed per 1000 of male labour force in rural areas Census 1961
Assam	70	7.94
Bihar	85	3.28
Bombay*	128	3.88
Madhya Pradesh*	76	0.69
Orissa	53	2.61
Punjab*	162	7.10
Rajasthan	100	0.94
South Indian States* (combined) ..	113	
Andhra Pradesh		1.97
Kerala		28.08
Madras		4.80
Mysore		1.78
Uttar Pradesh	48	1.77
West Bengal..	94	18.12
All-India	90	4.78

Source : Agricultural Labour Enquiry—Report on Intensive Survey of Agricultural Labour, Vol. I—All-India, 1950-51, *op. cit.* Census of India, 1961, Volume I, Part II-B (i) and Part II-B (ii)—General Economic Tables, Government of India, 1965 and 1966.

* Asterisk marked States are formed by combining groups of States according to 1951 boundaries. Figures for each group are weighted in proportion to the respective number of agricultural labourers in constituent units.

PROJECTIONS OF SHIFTS IN CROPPING PATTERN OF PUNJAB

K. S. Mann, S. S. Johl and C. V. Moore

The cropping pattern in Punjab has enjoyed a fair degree of stability over the last few decades. Whatever minor changes that occurred during this period were mainly due to the extension in cultivated area and provision of additional irrigation facilities. The farmers responded to price changes also to some extent. There occurred, however, no major technological developments or violent changes in the relative price structure of agricultural commodities. No discernible adjustments in the cropping pattern of the State through this time could, therefore, be located.

The New Forces

The last two years witnessed some developments with possibilities of major adjustments in the cropping pattern of the State. The evolution of high yielding varieties of wheat, paddy, bajra and maize was a major breakthrough brought about in Indian agriculture during the past few years. With the enormous yield potentials of these varieties, the cultivation of these crops became relatively more paying. The increased availability of chemical fertilizers, increasing awareness of the improved technology, the enhanced irrigation facilities, and the recent advances in the production technology are some of the forces that demand new optima in the production programme of the farmers. The Punjab farmers have been found to be fairly rational in their farming decisions and production programmes.[1] They will not, therefore, be found wanting in switching over to a crop-mix that would maximize net returns to their fixed resources under the changed situation with regard to resources and production alternatives.

The restraints:—There are several restraints, however, which restrict the scope of this adjustment. The adoption of high yielding varieties and other improved techniques involves a high level of consumption of scarce farm resources such as fertilizer, irrigation, labour and capital.

The problem:—The problem, therefore, is to work out rational farm production plans that would yield maximum net returns to the farmers within the framework of production possibilities and resource restraints that would obtain over the next few years. These production plans aggregated would represent estimated future cropping pattern of the State. The farmers, the policy-makers, the extension workers and the traders, all will be deeply interested in this information.

The Objectives

The objectives of this study are (i) to find out the existing production plans of the farmers representing different type of farming regions of the State ; (ii) to work out optimum cropping plans for each representative holding under different re-

1. Raj Krishna, "The Optimality of Land Allocation : A Case Study of the Punjab," *Indian Journal of Agricultural Economics*, Vol. XVIII, No. 1, January-March, 1963, pp. 63-73.

source situations likely to obtain over the Fourth Plan period; and (iii) the aggregation of these optimum plans so as to estimate cropping patterns for the State under given conditions of input supply.

Methodology

Based on the classification of Singh and Johl,[2] the State was divided into ten type of farming regions as shown in Appendix I. It was not practicable to take a sufficiently large random sample representative of the 12,891 villages in the State. A purposive sample of one typical village representing soil, irrigation facilities, etc., from each region was, therefore, taken in consultation with the agricultural extension workers of the area. The operational holdings in each selected village were divided into three categories, *viz.*, small, medium and large, so that each category covered one-third of the total cultivated area of the village. From each group five holdings were selected at random in each village. Thus the sample included 150 farmers in ten villages.

Detailed information was collected in respect of the fixed resources including land with different use capabilities, irrigation, permanent labour, bullock power and liquid capital, cropping plans followed, pattern of operations and the level of technology used for different crop enterprises, variable costs and net returns to fixed farm resources.[3] Data were pooled and averaged to obtain synthetic typical holdings representing small, medium and large farms in each region. Budgets were worked out for each synthetic holding for different crop enterprises using (1) existing varieties with existing technology, (2) existing varieties with recommended technology, and (3) high yielding varieties with recommended technology. Optimum production plans were then developed through linear programming analysis for each typical holding under different levels of technology and resource availability.

In this analysis the objective function

$$Z_0 = P_1X_1 + P_2X_2 \quad \ldots\ldots\ldots + P_nX_n \text{ was to be maximized}$$

subject to :

$$\begin{aligned} &a_{11}X_1 + a_{12}X_2 \quad \ldots\ldots\ldots + a_{1n}X_n \leqslant C_1 \\ &a_{21}X_1 + a_{22}X_2 \quad \ldots\ldots\ldots + a_{2n}X_n \leqslant C_2 \\ &\quad\vdots \qquad\quad \vdots \qquad\qquad\qquad\quad \vdots \\ &a_{m1}X_1 + a_{m2}X_2 \quad \ldots\ldots\ldots + a_{mn}X_n \leqslant C_m \\ &\text{and } x_1 \geqslant 0,\ x_2 \geqslant 0, \quad \ldots\ldots\ldots x_n \geqslant 0 \end{aligned}$$

where Z_0 represents returns to fixed farm resources, P_1, P_2....,P_n are the returns from crop activities x_1, x_2 ....,x_n respectively, and a_{11}....a_{1n}....a_{m1} ....a_{mn} are inputs of resources C_1, C_2...., C_m.

2. B. Singh and S. S. Johl, "Generalised Types of Farming Areas in the Punjab Plains," *Journal of Research*, Punjab Agricultural University, Ludhiana, 1967.
3. Appendix II presents the prices of different commodities and inputs used.

Resource Restraints

The resource restraints for this analysis included land with its use capability classes, irrigation from different sources, permanent family and hired labour, liquid capital and availability of scarce inputs such as fertilizers. A part of the land and other resources was set aside to meet the fodder needs of the farm animals. Only the balance was considered available for raising commercial crops.

PROGRAMMING SITUATIONS

In order to analyse the possible shifts in cropping patterns, normative production plans were worked out under six assumed situations with respect to the varieties of crops (high yielding or indigenous), level of technology, fertilizer supplies and availability of capital, land, labour and irrigation. The characteristics of these situations are summarized in Table I.

TABLE I—PROGRAMMING SITUATIONS FOR PROJECTING CROPPING PATTERNS IN PUNJAB

Situation	Crop varieties	Technology	Fertilizer supply	Land, labour and irrigation supply	Liquid capital supply
A	Existing	Existing	1966-67 level	1966-67 level	1966-67 level
B	Existing and high yielding	Improved	1966-67 level	1966-67 level	1966-67 level
C	Existing and high yielding	Existing and improved	1966-67 level	1966-67 level	1966-67 level
D	Existing and high yielding	Improved	1970-71 level	1966-67 level	No restraint
E	Existing and high yielding	Existing and improved	1970-71 level	1966-67 level	No restraint
F	Existing and high yielding	Improved	No restraint	1966-67 level	No restraint

Fertilizer availability at the 1966-67 level was only 19 kgs. of calcium ammonium nitrate (C.A.N.) and 1.4 kgs. of superphosphate equivalents, while at the 1970-71 level, it is expected to be 80 kgs. of C.A.N. and 40 kgs. of superphosphate equivalents per acre.[4]

Aggregation of Data

The normative cropping plans for the different synthetic holdings under the above situations provided the basis for working out the proportion of the total cropped area under different crops. An average percentage was then worked out for each crop for the State. This percentage was used to estimate the acreage of different crops under these situations. At the existing level of technology

4. The estimates are based on the quantities of fertilizers supplied during the year 1966-67 and the expected allocation during the year 1970-71.

production estimates were based on the current yield levels of the State as a whole, while in the case of improved technology the yield levels were worked out in conference with the specialists of the Punjab Agricultural University.

RESULTS

The normative cropping pattern obtained for different situations through linear programming analysis, and the estimates of production are presented in Table II. Some major characteristics of these cropping patterns are shown in

TABLE II—ESTIMATED ACREAGE AND PRODUCTION OF CROPS UNDER DIFFERENT PROGRAMMING SITUATIONS IN PUNJAB

Crop	Situation						
	Actual (1964-65)	A	B	C	D	E	F
	(Percentage of cropped area)						
(*a*) Foodgrains							
Wheat	30.9	28.5	1.3	19.8	27.3	23.5	24.8
Maize	7.5	9.3	—	7.1	2.2	7.6	10.3
Rice	5.7	2.8	0.4	3.4	0.3	2.7	1.4
Bajra	3.1	3.2	13.9	6.8	23.8	16.0	33.8
Gram	14.8	8.4	1.5	8.2	10.0	12.7	11.8
Barley	2.0	1.8	27.6	10.7	5.5	1.8	0.1
Wheat and Gram	0.0	5.0	0.0	2.4	—	0.8	0.0
Total foodgrains ..	64.0	59.0	44.7	58.4	69.1	65.1	82.2
(*b*) Non-foodgrain crops							
Cotton	9.7	9.0	—	8.3	0.4	7.5	0.0
Sugarcane ..	2.4	5.1	0.3	2.5	1.7	2.9	0.9
Oilseeds ..	4.7	6.2	16.0	10.0	9.6	8.0	1.9
Others	19.2	20.7	39.0	20.8	19.2	16.5	15.0
Total	36.0	41.0	55.3	41.6	30.9	34.9	17.8
Grand Total ..	100	100	100	100	100	100	100
	(Area in thousand acres)						
(*a*) Foodgrains							
Wheat	3,861	3,210	76	2,190	3,047	3,145	3,689
Maize	946	1,048	0	786	245	1,007	1,536
Paddy	709	315	22	376	33	357	209
Bajra	395	360	812	752	2,656	2,129	5,040
Gram	1,838	947	89	907	1,116	1,703	1,759
Barley	251	203	1,609	1,184	614	242	15
Wheat and Gram	—	563	—	266	—	110	—
Total foodgrains ..	8,000	6,646	2,608	6,461	7,711	8,693	12,248
(*b*) Non-foodgrain crops							
Cotton	1,202	1,013	0	918	45	1,008	0
Sugarcane ..	301	575	18	277	190	389	134
Oilseeds ..	595	698	933	1,106	1,071	1,077	283
Other crops ..	2,531	2,333	2,276	2,301	2,143	2,206	2,237
Total	4,629	4,619	3,227	4,602	3,449	4,680	2,654

(Contd.)

Crop	Situation						
	Actual (1964-65)	A	B	C	D	E	F
	Production in thousand tons						
(*a*) Foodgrains							
Wheat	2,360	2,134	46	1,458	4,300	4,118	8,146
Maize	488	541	0	406	278	669	3,072
Paddy	351	160	26	186	40	177	564
Bajra	61	55	491	408	1,597	2,305	6,012
Gram	666	445	67	405	670	1,043	1,301
Barley	72	104	2,327	880	550	146	9
Wheat and Gram	0	0	0	0	0	0	0
Total	3,998	3,439	2,957	3,743	7,435	8,458	20,004
(*b*) Non-foodgrain crops							
Cotton ..	146	122	0	111	14	123	0
Sugarcane ..	444	874	54	407	570	780	402
Oilseeds ..	215	242	561	315	664	567	179
Other crops ..	—	—	—	—	—	—	—

TABLE III—MAIN CHARACTERISTICS OF PROJECTED CROPPING PATTERNS IN PUNJAB UNDER DIFFERENT PROGRAMMING SITUATIONS

Characteristics	Situation						
	Actual (1964-65)	A	B	C	D	E	F
Cropped area ('000 acres)	12,629	11,265	5,835	11,063	11,160	13,373	14,902
Intensity of cropping (%)	133	117	58	115	116	139	155
Seasonal distribution (% acreage)							
(*a*) *Rabi*	52.8	55.5	60.1	56.9	58.6	50.3	43.9
(*b*) *Kharif*	47.2	44.5	39.9	43.1	41.4	49.7	56.1
Net returns per acre (Rs.)	388	395	172	415	617	745	1,219
Cash needs (Rs. per acre)	67	37	130	38	92	96	245
Fertilizer needs per acre (kg.)							
Calcium ammonium nitrate	19	19	19	19	80	80	268.2
Superphosphate ..	1.4	1.4	1.4	1.4	40	40	114.0

Table III. The salient features are as follows.

Situation A

In this situation programming was done on the basis of the existing crop activities followed by the farmers with their own technology and the current resource supplies. The fertilizer availability was restricted to the 1966-67 level of 19 kgs. of C.A.N. and 1.4 kgs. of superphosphate per acre. This situation was designed to see if returns to fixed farm resources could be increased through a reallocation of the available resources without introducing new varieties or new technology. The results of this situation when compared with the actual cropping pattern of the State indicated that the existing land use pattern was reasonably

rational. The total cropped area of the State under this optimum dropped from the actual acreage of 12,629 thousand to 11,265 thousand acres with a consequent fall in cropping intensity from 133 to 117 per cent. This could be partially accounted for in the restriction of land use in the programming analysis in respect of unirrigated areas. Here an assumption was made that unirrigated land cannot be double cropped. In actual practice, however, this might be done in the event of a good rainfall. Foodgrains claimed a major part of the land in this situation. The results indicated the need for some adjustments. For example, the net returns could be increased by increasing area under maize, sugarcane and oilseeds slightly. Cotton acreage could be decreased to some extent. The increase in farm returns to fixed farm resources per acre was Rs. 7 per acre for the State as a whole. In some regions, however, the increase appeared to be possible to the extent of 27.36 per cent through a more rational allocation of farm land resources.

The major restraint under the existing technology was found to be the supply of nitrogenous fertilizers. The use of phosphatic fertilizers was not very high. Neither irrigation nor labour appeared to be a restraint during any of the peak work periods.

Situation B

This situation assumed a complete replacement of the existing technology with improved technology as recommended by crop specialists, without, however, increasing the supplies of crucial inputs such as fertilizers.

The normative solutions indicated that insistence on a switch-over to improved technology without augmenting fertilizer supply would lead to a tremendous fall in cropped acreage under a rational allocation of resources. The cropped area would drop to only 5,835 thousand acres from the current level of 12,629 thousand acres. The cropping intensity would be only 58 per cent against the existing intensity of 133 per cent. Foodgrains acreage would fall to the extremely low level of only 2,608 thousand acres. Wheat which is the major crop of the State would retain only 76 thousand acres out of its present area of 3,861 thousand acres. Maize would be eliminated, while paddy and gram would figure in only marginally. Bajra and barley would, however, occupy a larger acreage. Among the non-food crops, cotton would be the worst casualty, retaining no area; and sugarcane acreage would decline to only 18 thousand acres. But oilseeds would gain substantially. Thus Punjab would emerge as a highly deficit State in foodgrains and sugar, with no cotton or paddy to export. Farmers' net income would fall from the current level of Rs. 388 to only Rs. 172 per acre. This would happen in spite of the fact that cash input would be Rs. 130 per acre which is nearly twice the current needs of only Rs. 67 per acre. The major restraint in this situation turned out to be fertilizer supply. These results demonstrate clearly that forcing a complete switch-over to the recommended technology with the present level of fertilizer resource supply is irrational and unrealistic and carries no chances of success.

Situation C

Since the current supply of fertilizers does not permit the adoption of improved technology over the entire available land, it is obvious that a rational

cropping pattern must include cropping activities at the traditional level of technology also. In situation C, therefore, the restraint on technology was relaxed so that the analysis included both the existing and the recommended technology. Fertilizer and other resource restraints, however, were retained at the current level.

The optimum cropping pattern under this situation gave a total cropped area of 11,063 thousand acres which is nearly twice the cropped acreage possible under situation B. The intensity of cropping rose to 115 per cent. This was, however, lower than the existing intensity of 133 per cent. Foodgrains claimed 58.4 per cent of the total cropped area, about one-third of which was under wheat. Maize retained its normal acreage. The position of bajra and barley improved, whereas gram acreage declined. Among the non-foodgrains, oilseeds covered nearly twice their present acreage. Sugarcane and cotton both suffered a decline in area. These adjustments slightly reduced the production of foodgrains, cotton and sugarcane, but considerably added to oilseeds production as compared with the existing level of production. Farm income improved to Rs. 415 per acre as against the current level of Rs. 388 only.

The major restraint in this situation also was fertilizer supply. In the presence of fertilizer restraint none of the other resources like labour, irrigation or cash acted as a restraint.

Situation D

With the serious efforts being made by the Government to increase production of fertilizer, one should expect substantial improvement in the fertilizer supply position. It is estimated that by the end of the Fourth Five-Year Plan, the availability of fertilizers would increase to 80 kgs. of C.A.N. equivalent and 40 kgs. of superphosphate equivalent per acre. It was, therefore, considered desirable to work out optimum cropping pattern at this higher level of fertilizer supply, which was treated as an operative restraint in situation D. In this situation the choice of enterprises was restricted to crop activities at the recommended level of technology only, in order to see how far a complete adoption of improved technology was possible with the improved fertilizer supply. Restraints in respect of labour, land and irrigation applied at the present level, but cash restraint was removed with the assumption that sufficient credit would be forthcoming.

The optimum cropping pattern under the conditions assumed in this situation estimated a total cropped area of 11,160 thousand acres which is a little below the present level. The intensity of cropping worked out to 116 per cent which was almost twice that obtained under the comparable situation B, which assumed a low fertilizer supply. Foodgrain acreage rose to 7,711 thousand acres which is slightly below the current area; production of foodgrains, however, was nearly twice the present production because of higher per acre yields under the improved technology. This increase was mainly in wheat, bajra and gram. Cotton acreage fell to 45 thousand acres only, with production falling to 14 thousand tons from the 1964-65 level of 146 thousand tons. Sugarcane retained only 190 thousand acres compared to its present area of 301 thousand acres. Its production, however, increased to 570 thousand tons against the current level of 444 thousand tons. Oilseeds acreage almost doubled itself and their production

increased to 644 thousand tons which is about three times the present production of 215 thousand tons.

As a consequence of these adjustments, returns to fixed farm resources rose to Rs. 617 per acre as against the present level of Rs. 388 only. In this situation the requirements of liquid capital also increased to Rs. 92 per acre as against the current needs of Rs. 67. The additional requirement was mainly due to the higher level of fertilizer use.

Even with the increased availability of fertilizers assumed in this situation, fertilizers would still remain as the principal restraint. A large part of the available land and other resources such as labour and irrigation would remain idle.

Situation E

As brought out in situation D, it would not be possible to fully utilize the land with improved technology even at the fertilizer availability expected at the end of the Fourth Plan. It is, therefore, obvious that the existing technology would continue over a large area. In situation E, therefore, the restraint of technology was relaxed so as to include crop activities with the existing production technology also. Fertilizer supply was assumed at 80 kgs. of C.A.N. and 40 kgs. of superphosphate per acre as in the last situation. Labour and irrigation restraints were taken at the current level. Capital was not kept as a restraint, but was estimated from the optimum plans to assess the capital needs.

The analysis showed that it would be possible to raise foodgrain acreage to 8,693 thousand acres which would be higher than the current level by 693 thousand acres. Production of foodgrains worked out to 8,458 thousand tons as against the current production of 3,998 thousand tons only. Bajra appeared to be the major crop responsible for this increase. Cotton regained a large part of its acreage lost under situation D, and its production improved to 123 thousand tons, which was still lower than the current production of 146 thousand tons. Sugarcane acreage was estimated at 389 thousand acres which is slightly higher than the present area. Its production was, however, much higher—780 thousand tons against the present production of 444 thousand tons only, because a large part of it was under improved technology. Oilseeds acreage was approximately the same as in situation D, although their production slightly fell. In comparison to the present situation, however, the acreage as well as production of oilseeds was much higher in this situation.

Since the conditions assumed in this situation appear to approximate very nearly with those likely to prevail in the State at the end of the Fourth Five-Year Plan, the cropping pattern described above would appear to be the normative cropping pattern at that time. It would permit a cropping intensity of 139 per cent and would yield an income of Rs. 745 per acre to the farmers. The cash needs would be only Rs. 96 per acre. The enterprises would be distributed between *rabi* and *kharif* season almost evenly. Fertilizer supply would be the chief restraint limiting the use of land, labour and other resources in this situation also.

Situation F

The analysis made under the different situations brought out that the most crucial input determining and influencing the production plans of the farmers is

fertilizers. With the concerted efforts being made to increase fertilizer production it is logical to visualize a time in the future when fertilizer supply would become abundant not to act as a restraint. It would, therefore, be useful to project an optimum cropping pattern for such a situation and to estimate the actual fertilizer needs for carrying out such production plans. Accordingly in situation F, the fertilizer restraint was removed. The only restraints that applied in this analysis were land, labour and irrigation. There was no cash restraint either, as in some earlier situations. Cash needs were rather considered to be a resultant and were estimated.

The analysis of the normative cropping pattern so developed indicated the need for major adjustments in this situation. All the major activities were followed at the improved level of technology. The plans leaned heavily in favour of foodgrains, claiming 12,248 thousand acres out of the total cropped area of 14,902 thousand areas. Bajra figured up as the most potential foodgrain. Wheat and gram nearly retained their present acreage. Maize doubled its area, while paddy and barley acreage declined considerably. Production of foodgrains worked out to about 20 million tons, which is a tremendous increase over the present production of 3.998 million tons only.

Among the non-food crops, cotton faced complete elimination from production plans unless relative price level moves in favour of this crop or the production technology gets improved significantly, as the farmers would find it more profitable to grow food crops under the present price structure. Sugarcane and oilseeds acreage would also suffer. Their production, however, would not fall significantly, because of the higher yields per acre resulting from the adoption of improved technology.

The cropping intensity under this situation increased to 155 per cent. The returns to fixed farm resources rose to Rs. 1,219 per acre. This shows that the income of the farmers could be raised to three times the present level, provided fertilizers could be supplied to the extent required. Such a cropping pattern did not involve any strain on the available resources of labour and irrigation. However, this would necessitate a much higher fertilizer use, *viz.*, 268.2 kgs. of C.A.N. and 114 kgs. of superphosphate equivalents of fertilizers per acre. On this basis the State as a whole would need a total supply of 2.58 million tons of C.A.N. equivalent and 1.1 million tons of superphosphate equivalent of fertilizers. Liquid capital requirements would work out to Rs. 245 per acre, which is much higher than the present average availability of Rs. 155 only. Additional credit would thus have to be provided. Action needs to be initiated on these aspects so that the possibilities of production indicated above can be exploited as soon as fertilizer supply ceases to be a restraint.

Limitations

The projections are subject to the following assumptions:

1. Relative prices of inputs and products will remain unchanged.

2. In the programming analysis, we assumed zero opportunity cost for land outside of agriculture and as such programmed the situation with zero opportunity cost.

3. No high yielding varieties will be available in the case of crops other than wheat, maize, bajra and paddy, and there will be no other major technological developments to upset the relative profitability of crops in the State during the next few years.

4. The high yielding varieties will be cultivated at the recommended level of fertilizer use.

5. There will be no expansion of irrigation in the State.

SUMMARY

The evolution of high yielding varieties of wheat, maize, paddy and bajra has made these crops relatively more paying than the other crops commonly grown in the State. There is also an increasing awareness of improved techniques of raising crops. These developments demand major adjustments in the cropping pattern of the State which has enjoyed a fair degree of stability over the last few decades. Fertilizer shortage, however, limits the scope of these adjustments. This study projects and analyses the shifts in cropping patterns that are likely to maximize returns to the farmers' fixed resources at varying levels of fertilizer availability.

Optimum cropping plans worked out for synthetic holdings representing different type of farming regions in the State indicate that the Punjab farmers are fairly rational in decisions relating to allocation of land resource. The relative acreage under different crops appeared to revolve round the availability of fertilizers. At the current level of fertilizer supply (19 kgs. of C.A.N. and 1.4 kgs. of superphosphate equivalent per acre), shifts in favour of bajra, barley, and oilseeds were indicated. With fertilizer availability improving to the expected 1970-71 level (80 kgs. of C.A.N. and 40 kgs. of superphosphate equivalent per acre), bajra acreage appeared to increase further. Other foodgrains very nearly retained their present acreage except paddy which lost nearly half of its present area. Cotton acreage declined while oilseeds cultivation continued at the previous level. Production of foodgrains almost doubled itself. Sugarcane and oilseeds production also rose substantially, whereas production of cotton appeared to fall. At the current level of fertilizer supply, the existing technology would continue side by side with the improved technology, relaxation of the fertilizer supply restraint estimated production plans highly in favour of foodgrains. Their acreage rose by 50 per cent, while production increased to almost five times the current level. Cotton faced complete elimination. Sugarcane and oilseeds lost about one-half of their present acreage, although the fall in production was not so marked.

APPENDIX I

GENERALIZED TYPE OF FARMING AREAS IN PUNJAB

Region	Annual rainfall in millimetres	Mean temperature	Areas included (tehsils)
I	High (1050 and above)	Low (below 12°C)	*Bet* areas of Gurdaspur, Pathankot and Una.
II	High	Low	*Non-bet* areas of Gurdaspur, Pathankot, Una and Batala.
III	Medium (650-1050)	Low	*Bet* areas of Dasuya, Hoshiarpur, Garhshankar and Rupar.
IV	Medium	Low	*Non-bet* areas of Dasuya, Hoshiarpur, Garhshankar, Rupar and Kharar.
V	Medium	Medium (12° - 24°C)	*Bet* areas of Ajnala, Amritsar, Kapurthala, Phagwara, Nakodar, Nawanshahr, Phillaur, Ludhiana, Jagraon, Samrala and Zira.
VI	Medium	Medium	*Non-bet* areas of Ajnala, Amritsar, Nakodar, Nawanshahr, Phagwara, Hoshiarpur, Jagraon, Jullundur, Malerkotla, Barnala, Sangrur, Patiala, Sirhind, Rajpura and Kapurthala.
VII	Low (below 650)	Medium	*Bet* areas of Ferozepur, Patti, and Tarn Taran.
VIII	Low	Medium	*Non-bet* areas of Ferozepur, Patti and Tarn Taran.
IX	Low	High (above 24°C)	*Bet* areas of Fazilka and Mansa.
X	Low	High	*Non-bet* areas of Muktsar, Fazilka, Bhatinda and Mansa.

APPENDIX II

PRICES OF DIFFERENT COMMODITIES AND INPUTS USED

A. Crops (per quintal)	Produce (Rs.)	Seed (Rs.)
Wheat	65	80
Gram	75	80
Barley	57	70
Maize	70	70
Cotton American	130	80
Cotton *Desi*	100	80
Sugarcane	5	5

(Contd.)

Crops (per quintal)	Produce (Rs.)	Seed (Rs.)
Sugarcane *Gur*	65	—
Rice	40	55
Toria	144	150
Massar	100	100
Bajra	60	60
Guar	60	60
Wheat + Gram	70	—
Peanut	100	150
B. By-products (per quintal)		
Wheat *Bhusa*	8	
Wheat + Gram *Bhusa*	5	
Gram *Bhusa*	4	
Maize *Karvi*	2	
Barley *Bhusa*	6	
Bajra *Karvi*	2	
Paddy straw	1	
Peanut *Bhusa*	4	
Cotton sticks	2	
C. Others (inputs) (Rs.)		
Compost (per ton)	6	
Calcium ammonium nitrate (per quintal)	38.50	
Superphosphate (per quintal)	34.50	
Labour (per day)	4.00	