ON THE USE OF MOTOR VEHICLES IN CROP-CUTTING SURVEY AND A SAMPLING OF THE ROAD-SIDE PLOTS ONLY

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SUMMARY. Analysis of the crop-cutting material collected by the Indian Statistical Institute in the three years 1947-48 to 1949-50 on winter paddy relating to 50 Police Stations in West Bengal, did not reveal the existence of any trend in the yield rate of paddy in individual fields with their distances from the nearest road sides.

In absence any such trend, sampling of the road-side plots only which may be easily approached on wheeled vechicles, may enable us to get practically unbiassed estimates of yield rate and thus solve the greatest difficulty in crop-cutting experiments, where speed and mobility is an essential requirement. This however calls for further studies and on other crops in different types of terrains, before a reasonable conclusion can be arrived at.

A crop-cutting scheme adopting three types of units, namely, (a) a foot-unit, where the investigators operate on foot, (b) a cycle-unit, employing cyclist investigators, (c) a motor-unit, the investigator being equipped with a motor vechicle, were tried out in Birbhum district of West Bengal. The weather and prevailing road conditions were abnormally bad and the scheme could not be completed exactly as planned. And yet, the results broadly indicate that against about 6 villages per month on foot and 10 villages per month on a cycle within a coverage of 500 sq. miles, a motor unit can cruise over an area of 2000 sq. miles and deal with 25 villages in the same time with a similar load of work to be attended to per village.

Obviously, such a mechanised scheme has to be integrated into a multi-purpose one, to be economic and effective over the entire year. A collaboration with the government in utilising the services of departmental vechicles may be a possible solution for this important problem, namely, a quick ascertainment of the food position.

1. Introduction

Crop-cutting experiments to be carried out by a small number of mobile staff, has ever been a serious problem in the planning of yield estimating surveys on an extensive scale. For, unlike a survey for the estimation of area under specified crops, where a reasonable interval of time between sowing and harvesting is generally available, harvesting is usually confined within a narrow spread of time. The investigator, who is on the move, travelling from one sampling unit to another, is likely to miss a crop if he happens to reach his sample plot just a bit too late, the cultivator having harvested his field immediately before his arrival. The proper harvesting period varies from locality to locality and in fact from season to season, the date of sowing and hence the due date for harvesting largely depending on the actual rainfalls in that particular season.

Even within a small locality, like a village, all the plots do not mature at the same time, certain varieties maturing very early for harvesting while others are quite late. Notwithstanding this, the majority of plots mature within a short spread of time and are harvestable within a week or two. This is usually termed as the 'peak' period. During the peak-period, which may often be indentical for a large number of localities, the investigator is confronted by a simultaneous demand for his presence

at too many points at a time. With his assignment of a given number of sample plots scattered over a large number of localities he has hardly any choice or an opportunity of revisiting a place and trying it a second time in case his first visit had proved to be too early. It is thus extremely difficult, if not impossible, to have a pre-planned scheme of movements which would be satisfactory.

To cope with these difficulties, the following alternatives have been thought of, the suitability of any one of them depending ultimately on the specific circumstances and the type of organisation employed for the survey:

(i) having a large number of stationary staff, one posted at each locality selected in the sample;

(ii) to allow substitution of the sample plot with another in the list or with an adjoining one, in case the plot originally selected has been missed;

(iii) to sample over time, so as to obtain an estimate of the mean yield rates which would represent all the phases of the crop season along with the estimates of the corresponding acreages for the different crops;

(iv) to mechanise the movements and increase the mobility of the investigator, so that he can move quickly from one point to another and if necessary come back and revisit a second time.

The first of these alternatives need not perhaps be discussed here and we shall confine ourselves to organisations employing a small number of whole-time investigators moving from one point to another over an extensive coverage.

In the large number of surveys conducted by it, the Indian Statistical Institute has so far been forced to adopt the second alternative. The validity of a sample when a considerable number of sampling units are either missing or replaced, is at least theoretically impaired. In practice, such failures, though not inconsiderable have been ignored and taken to be the best that can be achieved under the circumstances. The extent of bias accruing on this account will however depend upon the differential in yield rate between the early maturing varieties and the late maturing ones within the same localities, which is believed to be small.

Alternative (iii) consists in sampling of those plots only which are harvestable at the time of visit. In this scheme, plots which have not matured at the time of visit need not be revisited. The season is split up into a number of sub-rounds. In each sub-round, an independent sub-sample of plots are selected for crop-cutting sectors all over the season, and the over-all yield rate would take due account of all the varieties maturing early or late in the season. A plot on the border of maturity at the time of visit would present some difficulty, but such ambiguities are not likely to be of serious consequences any way. The greatest difficulty will arise when a plot is found to be already harvested by the cultivator himself, as it is extremely difficult to ascertain in such cases whether the harvesting was done within the current sub-round period or earlier in the season. Improvements may however be attempted by increasing the mobility of the investigator with the help of improved conveyances as suggested in alternative (iv).

USE OF MOTOR VEHICLES IN CROP-CUTTING SURVEY

The use of motor vehicles for purposes of field work is likely to be of great help, specially in cutting down the time of journeys from one sample village to another. The main consideration in this respect is the extremely heavy capital expenditure to be incurred, and also the considerable running expenses. Besides, inadequacy of motorable roads is also a problem which has seriously to be reckoned with. In a large proportion of areas in rural India, the sample plots will often lie far in the interior at considerable distances from the road-side and thus inaccessible to direct approach on four wheels. On the other hand sampling from plots directly from the road-sides could be very convenient and quick.

Except perhaps at the very borders of the roads, where the crop may get injured by trampling or otherwise, there are no reasons to believe that yield rate nearer the roads would in any way be different from yield rate in more distant plots. This was, however, to be tried out in practice. In April 1950, during his visit to India, Dr. F. Y. Yates advised that experiments should be carried out with mechanised conveyances for exploring the possibilities of attaining greater operational efficiency. He had also suggested a study of the inter-relation between yield rate in fields with their distances from roads. In the event of yield rate being practically independent of the nearness of a road, *almost* unbiassed estimates might be obtained by sampling of plots lying on the road-side in which case a motor-unit could be very fruitfully employed during the crop-cutting operations.

2. YIELD RATE IN ROAD-SIDE PLOTS

The Institute has carried out a continuous series of surveys for the estimation of acreage under crops and their yield in each of the three principal crop seasons, namely (1) bhadoi or autumn, (2) aghani or winter and (3) rabi or spring since the year 1943-44. The survey had covered the whole of undivided Bengal (70,000 sq. miles) up to 1946-47 and for West Bengal alone (28,000 sq. miles) thereafter till the year 1949-50. This represented a total of seven rounds for each of the three crop seasons, bhadoi, aghani and rabi and offered an excellent material for purposes of the proposed studies.

The selection of sample plots for all these years had been a three-stage one, individual Police Stations[1] being treated as stratum. Within each Police Station, a number of localities representing a cluster of villages were selected in the first stage and a number of paddy fields were selected within each locality in the second stage. Within the selected fields, a concentric system of circular cuts with radii 2', 4' and 5'-8" were located in the third stage. The task was to classify these fields according to their distances from the nearest road head, measured as in a crow flight journey and to estimate the specific yield rates for each class. To start with, data relating to 50 Police Stations representing a sample of 28% of the Police Stations of West Bengal randomly chosen for the three consecutive years 1947-48 to 1949-50 on aman

[1]A Police Station in West Bengal is an administrative unit with an average area of 120 sq. miles and consisting of 150-200 villages.

paddy (winter) was taken up for analysis. Location of the plots were marked off on the village maps of a scale sixteen inches to the mile. If a particular type of road was not found within the village, neighbouring villages had to be referred to, with the help of Police Station maps which are drawn with scale of one inch to the mile. The least distances of each individualplot from the (a) nearest metalled road, (b) metalled or unmetalled road whichever was nearest and (c) metalled and unmetalled roads and cart-tracks whichever was nearest, were ultimately measured on the relevant village maps correct to the nearest half of a chain (one chain=66 ft.). All these measurements were practically confined within the Police Stations in which the sample plots fell, but in a small number of cases where the sample plot happened to fall on the borders of a Police Station, the roads of the adjoining Police Stations had also to be referred to.

Tables 1 and 2 give the mean yield rates of aman paddy in maunds per acre for groups of plots and number of plots respectively in each of the three years classified under different intervals of distances measured from three types of roads enumerated above for all the Police Stations combined. There seems to be no marked trend in yield rate with increasing distances, in contrast to its variation between years.

TABLE 1. ESTIMATED YIELD RATE OF AMAN PADDY IN GROUPS OF PLOTS CLASSIFIED ACCORDING TO THEIR DISTANCES FROM THE NEAREST ROADHEADS WEST BENGAL, 1947-48 TO 1949-50
(Based on 50 Police Stations in West Bengal)

"crow-flight" distance from nearest road-head (0.0) furlongs	mean yield rates in plots at distances specified in col. (1) measured from								
	nearest metalled road			nearest metalled or unmetalled road			nearest metalled and unmetalled road or cart-track		
	47-48	48-49	49-50	47-48	48-49	49-50	47-48	48-49	49-50
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0.0 — 0.5	17.4	20.8	19.2	20.3	19.0	18.7	19.4	18.3	19.0
0.5 — 1.0	18.4	23.5	19.2	17.8	18.4	20.1	17.6	16.8	20.3
1.0 — 2.0	19.9	22.9	19.4	17.1	20.3	18.7	17.5	18.0	19.0
2.0 — 3.0	22.8	18.8	20.3	20.4	17.5	19.3	19.9	18.5	18.7
3.0 — 4.0	15.7	21.3	18.4	15.2	19.2	18.5	13.6	18.8	18.6
4.0 — 6.0	19.2	17.1	18.3	17.8	16.2	18.2	18.0	16.2	17.9
6.0 — 8.0	17.4	17.7	17.7	17.4	14.8	17.9	17.8	16.4	17.7
8.0 — 12.0	19.4	17.3	17.5	18.6	16.6	18.5	19.1	16.6	18.7
12.0 — 16.0	17.3	17.6	19.0	18.8	16.4	19.1	18.6	16.5	18.0
16.0 — 20.0	20.7	18.4	20.4	19.2	19.7	17.9	21.0	17.1	17.6
20.0 — 24.0	17.1	15.6	16.9	19.4	18.2	17.1	19.5	16.8	19.3
24.0 — 32.0	16.4	15.2	18.4	16.0	14.8	16.5	16.0	12.5	19.7
32.0 and above	18.3	16.9	16.3	21.1	17.5	15.9	21.7	17.1	16.5
total	18.4	17.4	18.5	18.4	17.4	18.5	18.4	17.4	18.5

TABLE 2. NUMBER OF PLOTS CLASSIFIED ACCORDING TO THEIR DISTANCES FROM THE NEAREST ROADHEADS : WEST BENGAL, 1947-48 TO 1949-50
(Based on 50 Police Stations in West Bengal)

"crow-flight" distance from nearest road-head (0.0) furlongs	number of plots at distances specified in col. (1) measured from								
	nearest metalled road			nearst metalled or unmetalled road			nearest metalled and unmetalled road or cart track		
	47-48	48-49	49-50	47-48	48-49	49-50	47-48	48-49	49-50
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0.0 — 0.5	20	15	24	60	67	80	75	88	96
0.5 — 1.0	4	5	18	32	30	61	41	43	76
1.0 — 2.0	16	19	35	63	67	114	80	82	141
2.0 — 3.0	21	30	73	84	129	180	110	162	232
3.0 — 4.0	12	16	20	41	38	77	65	50	91
4.0 — 6.0	43	50	97	108	91	207	109	100	220
6.0 — 8.0	21	39	50	59	62	98	53	56	95
8.0 — 12.0	72	92	135	65	122	156	72	113	111
12.0 — 16.0	56	68	124	63	94	104	25	50	56
16.0 — 20.0	54	69	101	30	37	52	10	16	35
20.0 — 24.0	38	55	64	18	25	28	10	21	18
24.0 — 32.0	66	71	110	34	25	47	23	15	39
32.0 and above	258	276	377	24	27	44	18	18	36
total	681	814	1246	681	814	1246	681	814	1246

Analysis of variance of the mean yield in plot groups (without regard to the group size) in specific classes of distances from all motorable roads in the three different years has been given in Table 3. The variances between the distance-levels are not significant against the residual, the years being treated as replicates.

TABLE 3. ANALYSIS OF VARIANCE OF MEAN YIELD RATES OF AMAN (WINTER) PADDY IN DIFFERENT GROUPS OF PLOTS CLASSIFIED ACCORDING TO THEIR DISTANCES FROM THE NEAREST METALLED OR UNMETALLED ROADS : WEST BENGAL 1947-48 TO 1949-50

sources of variation	d.f.	variance	ratio
(1)	(2)	(3)	(4)
between distance levels	12	2.36	0.959
within distance levels between years	26	2.46	
total	38		

The average yield rates for each group of plots classified under the various distance levels were computed for each individual Police Stations. The number of such groups taken over the fifty Police Stations came to a total of 254 in 1947-48, 271 in 1948-49 and 302 in 1949-50. Table A.1 in the appendix gives a two-way frequency distribution of these groups according to their yield rates under each of the distance-classes. This has been shown for each of the three years separately. The distribution seems to be more or less indifferent to the distance levels, there being no special shift or crowding of the frequencies towards increasing or decreasing distances.

As the general level of yield varies from Police Station to Police Station, it is possible that in pooling up over the different Police Stations, the differentials in yield rate at different distance intervals, if any, have been supressed. The mean values of the individual plot groups within each Police Station were therefore expressed as indices to the respective Police Station-mean and a two-way frequency distribution of plot groups by intervals of these index values under the various distance-levels was prepared as shown in Table A.2 in the appendix. It was expected that the low yielding Police Stations would no more be suppressed by the high yielding ones and all of them would have now received a fair i.e., an equal representation. The frequency pattern does not however show any noticeable shift as the distance gradually increases. This is observed in each of the three years for which the frequency distribution have been observed.

Finally, linear regression fits in the form $y=a+bx$, where y represents the mean yield rates and x represents the distances from the nearest 'motorable' (metalled or unmetalled) roads, were worked out on each individual Police Station for each of the years. The ratios of variances due to linear fit to the residual were calculated for each individual Police Station. These ratios with $n_1 = 1$ while n_2 varies, correspond to the distribution of t^2 with n_2 degrees of freedom. The Police Stations were accordingly classified under probability levels of $P(F)=P(t^2)$ and the frequency distributions obtained have been shown for each of the three years separately in columns (2)-(4) of Table 4. The frequencies expressed as proportions to total have also been shown in columns (6)-(8). The $P(\chi)^2$ between the expected and observed distributions have been obtained as 3.67 for all the three years combined, which is found to be insignificant. This indicates a lack of linear trend for the data taken as a whole.

The above study on aman paddy based on only three years' data from 25% of Police Stations of a single Province, namely, West Bengal with its relatively homogenous yield contours, does not however give any conclusive results. Examination of the data on a larger scale have got to be made for different crops over a number of years, before conclusions can even be tentatively drawn. Besides, the task of preparing a frame for sampling confined within the proximity of a net-work of roads

all over the countryside, is tremendous. For this purpose most up-to-date road maps for the whole of rural India have to be collected in advance.

TABLE 4. DISTRIBUTION OF POLICE STATIONS BY LEVELS OF $P(F)$ CORRESPONDING TO RATIOS OF VARIANCE DUE TO A LINEAR REGRESSION TO THE RESIDUAL : WINTER PADDY, 1947-48 TO 1949-50

$P(F)$	number of Police Stations by levels of $P(F)$				proprtion to total			
	47-48	48-49	49-50	all	47-48	48-49	49-50	all
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.00—0.05	6	1	5	12	.122	.020	.100	.081
0.05—0.20	4	9	12	25	.082	.184	.240	.169
0.20—1.00	39	39	33	111	.796	.796	.660	.750
total	49	49	50	148	1.000	1.000	1.000	1.000

χ^2 value of $P(F)$ between observed and expected number of Police Stations over all the three years is 3.67. The probability of getting the value of χ^2 or greater is seen to be just below 0.20.

3. Mechanised units for investigation work

Apart from the question of sampling confined to the road-side fields, it was decided to try out the relative merits of the use of mechanised conveyances in area-cum-crop cutting surveys.

An experiment was accordingly planned in 1956, employing three types of field units with three different mechanisms for travelling from one sample unit to another: (1) foot-units operating on foot, (2) cycle-units operating on bicycles, both availing of railway and bus services as far as available and (3) motor-units operating on motor cars. These three types of units were to cover an area of approximately 2000 sq. miles, comprising the whole of Birbhum district in West Bengal. Four investigators constituted a foot-unit and four investigators constituted a cycle unit, each investigator of a unit working within an exclusive zone of about 500 sq. miles. The motor-unit consisted of two investigating units instead of four, but each had a coverage of the full area of 2000 sq. miles.

Work with the foot and cycle-units started in July and the same set of sample village were visited a number of times, there being altogether four rounds of pre-harvest survey and a harvest round in December. The motor-units were however introduced very late in the season, due to the heavy floods sweeping over the major portion of the district in the early stages of the season. For this season, the two-motor-units engaged on a daily rental basis, were able to complete barely one round, and even then much of harvesting was already over and a large number of sample plots were missed.

4. PLAN OF THE EXPERIMENT

Foot-units. Within each zone of approximately 500 sq. miles six villages selected at random with a probability proportionate to the geographical area were assigned to one investigator. Within each village land utilisation survey on 5 clusters of 10 plots was to be carried out in the pre-harvest rounds. During the harvest round in December, land utilisation in 3 clusters of 10 plots were to be observed and a total of 3 cuts of radius 2'-3" from these clusters were to be taken. The size of cut was intentionally made very small, so that the investigator could make a quick harvest with the least objection from the cultivators. In fact, cuts of this small size could be dealt with by the investigator himself, in case a labour hand was not readily available. A small circular cut duly balanced by a method described in an earlier note,[2] was considered to be very suitable when an investigator had to move about fast. The investigators did not experience much trouble in getting permission of the cultivator specially as the cuts to be taken were so small. In the subsequent rounds, the same villages and the same clusters were re-visited but the workers were rotated from one zone to another after every round.

For the selection of sample plots in which crop-cutting was to be done, all paddy field harvestable on the day of visit were serially numbered from the first cluster to the third taken in order. Three fields were chosen at random from all the harvestable fields and within each field, one cut was located at a point x, y representing two random numbers along two coordinates at right angles to each other and parallel to the cardinal directions.

The following gives a plan of this rotation between the workers W_1—W_4 from round to round :

round	samples of six villages			
	(1)	(2)	(3)	(4)
preharvest 1st (July)	W_1	W_2	W_3	W_4
,, 2nd (August)	W_4	W_1	W_2	W_3
,, 3rd (Sept.)	W_3	W_4	W_1	W_2
,, 4th (October)	W_2	W_3	W_4	W_1
harvest 4th, in December	W_4	W_1	W_2	W_3

Cycle-unit. The sampling procedure for the cycle-unit was exactly similar to the foot-units and the working zones adopted for the foot-unit were maintained

[2] J. M. Sengupta (1954) : On perimeter bias in sample cuts of small size. Series B, *Sankhyā*, 26, 53.

for the cycle-unit also. But unlike the foot-unit, 12 villages were allotted to each investigator within his zone of 500 sq. miles and within each zone, 3 clusters instead of 5 were allotted per village during the pre-harvest rounds as well as the harvest round in December.

Motor-unit. Both the motor units were to cover the entire area of 2000 sq. miles, each being allotted a random sample of 24 villages. The work-programme was identical to that assigned for the cycle-unit, namely, 3 clusters of 10 plots per village for land utilisation survey with a total of 3 cuts from these three clusters taken as a whole.

As already mentioned, work with the motor-units was started very late in the season, as a result of which crops in many of the clusters were already harvested before the investigator reached there. In spite of these handicaps, the experiment has proved useful in many respects. The preliminary operations involved in crop-cutting, namely, identification and selection of the plots, were gone through in every case, leaving only the stages of harvesting and threshing unattempted, which after all represented only a small additional time. It may be remembered, that the principal object of the experiment was to study the operational costs, the yield data in itself being of a secondary importance.

One other most useful and somewhat bitter experience of this preliminary commoitre is the knowledge, that the so-called metalled or non-metalled roads indicated on the Thana maps are not always in a condition suitable for motor traffic, and sometimes are little better than mere cart-tracks. It seemed that roads once metalled and suitable for motor driving have deteriorated since the last maps were prepared. This points out to the great need for ascertaining in advance about the general condition of each important road shown on the maps. This can be easily ascertained from the subdivisional and Thana officials, Union Board offices etc.

In order to save time wasted on fruitless journeys for seeking a shelter for the night and procuring food, it was felt that jeeps fitted with trailers should be the ideal outfit for such work. The car should also carry a bicycle, with which the investigator could travel from the road-head to sites nearest to his plots.

5. Results

Performances of the different types of investigating units, based on the harvest time rounds only, were worked out in terms of gross working days per village unit. The quantum of work per village in the harvest rounds were identical in all the three types, and hence these were directly comparable. The results are given in Table 5.

TABLE 5. RELATIVE PERFORMANCES OF THE DIFFERENT TYPES OF INVESTIGATION UNITS : HARVEST ROUND : BIRBHUM: DECEMBER 1956

investigation units	total number of villages surveyed	enumeration time (hrs). per village including cluster to cluster journeys	number of villages according to gross working days per village					average number per village	
			0.5 day	1.0 days	2.0 days	3.0 days	4.0 days	gross working days	sample cuts
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
foot	24	8.2	—	1	8	10	5	2.8	2.7
cycle	48	7.8	—	15	32	1	—	1.7	2.4
motor	32	4.3	12	20	—	—	—	0.8	1.4

It will be seen that net enumeration time per village excluding village to village journeys on a cycle as given in column (3) is nearly the same as on foot, while with a motor unit the time spent is considerably less. It appears that the cycle came to be of very little use for journeys within a village. Reduced time taken by a motor car may have been partially due to the smaller number of cuts that had to be harvested per village on the average.

Columns (4)-(8) give the distribution of villages according to number of gross working days spent per village; total number of days taken per village varied between 1·4 on foot, between 1·3 on cycle and ½ to 1 day on the motor car. Column (9) gives the average number of days spent per village. It will be seen that a cycle has taken 1.7 days per village which is 60% of time taken on foot, while a motor-unit takes 0.8 days per village which is about 30% of time taken on foot. Although based on a small number of observations, these results nevertheless give an indication of the broad order of relative costs.

Column (10) gives the average number of sample cuts harvested per village by the different units. But as already stated, the real load of work was not in proportion to the actual number of successful cuts, the initial stages of selecting the plots out of all the three clusters taken as a whole had to be gone through in any case.

On the basis of experience already gained, it appears that with a bicycle at one's disposal, the number of villages in the first stage could be increased to 10 per month provided the load of work per village is small as can be covered in a day and within a geographical coverage of 500 sq. miles or say a tehsil. This level of output can however be maintained for a short spell of time, say for one month during the peak periods. With a motor-unit, the number of villages in the first stage may be increased to 25 per month, with an opportunity also to revisit some of the villages

for crop-cutting work as necessary. The work-load in both cases should be so designed as to take one gross working day per village inclusive of journeys from village to village. In other words, net working time within a village should be reduced to 2-3 hours, so that the investigator is not compelled to stay overnight in that village and may proceed to the next sample village. In fact, with a motor-unit, after the day's work is finished and after the evening meals are over, at least some part of the journey to the next sample village can be covered on the same day. Performance of the two motor-units was however much lower than could be expected under normal circumstances. The roads were so much damaged that on quite a number of trips, the workers had to fight their way through sticky mud and over pot-holes with which the roads were strewn. This will be evident from the low mileage per hour and per gallon of petrol scored by the motor-units A and B as worked out from Tables A.3 and A.4. It may also be noted, that an average of 3 miles had to be covered on foot to reach a village and back to the car.

The two cars were engaged on a daily rental basis temporarily for one fortnight. The rentals were quite high while an outright purchase of the vehicles would have involved a huge capital expenditure. But a battalion of motor-units manned with an investigator and a driver-cum-general assistant who could help also in crop cutting, might be put on an economic basis, if these units were utilised not merely for the crop cutting operations alone but also for land utilisation in general and other enquiries throughout the year.

6. Different models of field investigation units

A dimensional estimate of field cost per month for a land-utilisation survey combined with crop-cutting with three different models or types of investigation units, namely, foot, cycle and motor units has been given in Table A.5. Salaries of investigators and overhead staff have been taken on the experiences of large scale operations carried out in recent years. The special components of cost of the mechanical equipments towards rentals and the running expenses have been separately shown. In type (3) i.e., the motor units, rentals for the vehicle, driver's pay and petrol represent approximately two-thirds of the total cost.

Cost of the mechanical equipments have all been computed on a rental basis, including the maintenance costs. If purchased outright, the capital cost may possibly be distributed over a number of years on a hire purchase scheme. If the motor-units are not utilised for the rest of the year, the cost of garaging the machines and their rentals shall in any case have to be borne, only the cost of petrol and maintenance and a part of the services of the drivers could be economised. The increased power of the motorised units which is roughly three or four times that of an investigator operating on foot, could be fully utilised for a quick land-utilisation survey and efficiently linked up with a scheme of multi-purpose enquiries. The relative costs per thousand square miles and the respective performances per unit per month have

been worked out and shown below. It will be seen that with 100 units employing 400 motor cars, 800,000 sq. miles of rural India can be covered in a month's time surveying 10,000 villages and 30,000 clusters of 10 plots, at a field cost of Rs. 6.87 lakhs per month approximately.

type of investigation units	total covered per unit per month				cost per unit per month (in Rs)			cost per (000) sq. miles per month (in Rs)		
	square miles	number of villages	number of clusters of 10 plots	number of cuts	rentals and driver's pay	salaries and other running expenses	total	rentals and driver's pay	salaries and other running expenses	total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. foot unit	2000	24	72	72	—	2200	2200	—	1100	1100
2. cycle unit	3200	40	120	120	125	2200	2325	40	687	727
3. motor unit	8000	100	300	300	4670	2200	6870	584	275	859

In case the motorised units of type (3) are employed only for lightning surveys like land-utilisation and yield estimation surveys, the ideal solution seems to be to have such vehicles requisitioned from the various government departments, specially the Army. The running expenses, including salaries, petrol and other auxiliary equipment will have to be borne by the field organisation, rentals, maintenance and the driver's pay being procured as borrowed services. A large number of vehicles equipped with drivers could possibly be released for this work of a great national importance, namely, a quick ascertainment of the food position.

Even if such a scheme is practical, the success would ultimately depend on how effectively the specific timings of the sowings and harvesting of the major crops in individual districts can be ascertained in advance and requisitions for motor vehicles planned out, so that a most fruitful survey could be carried out within the shortest span of time.

ACKNOWLEDGEMENTS

I am indebted to my colleagues for their ungrudging help in preparing this note, Sri P. Dey Sarkar, Sri R. Nath and Shri Subir Roy for the statistical analysis, and Sri Subir Roy and Sri Ananta Banerjee for the field trials. Special mention may be made of Sri Subir Roy who took the general initiative in organising and conducting the motor experiments, without whose energetic efforts, the experiments could not have been carried out under the unusually bad conditions this year in the field.

Appendix

TABLE A.1. TWO-WAY FREQUENCY DISTRIBUTION OF PLOT-GROUPS BELONGING TO DIFFERENT DISTANCE LEVELS AS MEASURED FROM THE NEAREST MOTORABLE ROADS IN INDIVIDUAL POLICE STATIONS ACCORDING TO THEIR YIELD RATES

(West Bengal Paddy)

crow-flight distance in furlong measured from the nearest metal/un-metal roads	average yield rate in maunds per acre of plot groups belonging to different distance levels specified in column (1) in individual Police Stations											
	upto 3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27 and above	total	mean yield rate in mds. per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1947-48												
upto 0.5	—	1	—	—	4	4	3	5	2	1	20	20.3
0.5— 1.0	—	1	—	2	1	6	—	2	2	—	14	17.8
1.0— 2.0	—	1	2	1	5	6	3	4	1	2	25	17.1
2.0— 3.0	—	—	2	3	6	4	4	4	6	3	32	20.4
3.0— 4.0	—	—	1	2	7	2	2	5	—	1	20	13.2
4.0— 6.0	—	—	—	2	7	6	9	7	1	1	33	17.8
6.0— 8.0	—	—	1	1	5	7	4	1	2	2	23	17.4
8.0—12.0	—	—	1	1	4	5	6	4	2	2	25	18.6
12.0—16.0	—	—	—	2	2	4	7	3	—	3	21	18.8
16.0—20.0	—	—	—	1	3	3	—	4	2	1	14	19.2
20.0—24.0	—	—	—	1	1	3	1	2	1	1	10	19.4
24.0—32.0	—	—	1	1	2	3	1	2	—	1	11	16.0
32.0 & above	—	—	—	—	—	1	2	3	—	—	6	21.1
total	—	3	8	17	47	54	42	46	19	18	254	18.4
1948-49												
upto 0.5	—	3	—	1	3	4	5	2	4	3	25	19.0
0.5— 1.0	—	3	1	1	3	2	2	5	1	1	19	18.4
1.0— 2.0	—	—	4	1	—	2	6	7	4	1	25	20.3
2.0— 3.0	—	—	2	3	6	4	12	7	2	2	38	17.5
3.0— 4.0	—	2	1	—	1	3	—	7	—	2	16	19.2
4.0— 6.0	—	1	1	7	5	6	6	3	4	—	33	16.1
6.0— 8.0	—	2	1	5	2	5	3	2	—	1	21	14.8
8.0—12.0	—	3	1	3	9	6	4	3	5	—	34	16.6
12.0—16.0	—	1	1	1	9	2	3	2	2	1	22	16.4
16.0—20.0	—	—	—	1	3	5	2	1	1	1	14	19.7
20.0—24.0	—	—	—	1	4	—	1	1	2	1	10	18.2
24.0—32.0	—	1	—	—	3	1	1	1	—	—	8	14.8
32.0 & above	—	—	—	—	1	3	1	1	—	—	6	17.5
total	—	10	12	24	49	43	46	42	25	14	271	17.4
1949-50												
upto 0.5	—	—	—	2	5	5	7	3	—	6	28	18.7
0.5— 1.0	1	1	1	1	3	4	3	6	6	2	28	20.1
1.0— 2.0	—	—	1	1	5	7	3	3	6	1	29	18.7
2.0— 3.0	—	—	3	1	3	9	9	6	3	2	36	19.3
3.0— 4.0	—	—	—	2	3	4	7	3	3	1	23	18.5
4.0— 6.0	—	1	1	3	3	13	9	4	3	2	39	18.2
6.0— 8.0	—	—	—	3	1	9	8	3	1	1	26	17.9
8.0—12.0	—	—	—	3	5	6	8	5	2	2	31	18.5
12.0—16.0	—	1	—	1	7	8	—	2	1	3	23	19.1
16.0—20.0	—	—	—	2	4	4	2	1	1	1	15	17.9
20.0—24.0	—	—	—	1	1	4	4	—	—	—	10	17.1
24.0—32.0	—	—	—	1	1	2	4	—	—	—	8	18.5
32.0 & above	—	—	—	—	1	4	1	—	—	—	6	15.6
total	1	3	6	21	42	79	67	36	26	21	302	18.5

TABLE A.2. TWO-WAY FREQUENCY DISTRIBUTION OF PLOT-GROUPS BELONGING TO DIFFERENT DISTANCE LEVELS AS MEASURED FROM THE NEAREST MOTORABLE ROADS IN INDIVIDUAL POLICE STATIONS BY PERCENTAGE INTERVALS OF THEIR YIELD RATES (PERCENTAGES BEING CALCULATED ON THE OVERALL MEAN YIELD RATE OF RESPECTIVE P.S.)

(West Bengal Paddy)

crow-flight distances in furlong measured from the nearest metal/unmetal roads	percentage levels of yield rate								total	average index	median
	upto 25%	25%–50%	50%–75%	75%–100%	100%–125%	125%–150%	150%–175%	175% and above			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1947-48											
upto 0.5	—	1	—	7	9	3	—	—	20	99.0	101.8
0.5— 1.0	—	1	2	5	5	1	—	—	14	94.3	92.6
1.0— 2.0	—	2	3	12	6	1	1	—	25	92.6	94.2
2.0— 3.0	—	1	5	10	11	4	1	—	32	100.1	100.2
3.0— 4.0	—	1	5	8	4	2	—	—	20	99.0	91.2
4.0— 6.0	—	—	4	12	13	4	—	—	33	98.2	100.3
6.0— 8.0	—	1	3	9	7	2	1	—	23	100.5	99.6
8.0—12.0	—	1	2	9	9	3	1	—	25	101.6	102.4
12.0—16.0	—	—	3	7	8	2	—	1	21	105.9	100.8
16.0—20.0	—	1	—	4	6	1	1	1	14	113.8	100.5
20.0—24.0	—	—	1	1	5	2	1	—	10	113.0	113.6
24.0—32.0	—	—	1	6	4	—	—	—	11	94.1	93.1
32.0 & above	—	—	—	—	3	3	—	—	6	121.6	123.1
total	—	9	29	90	90	28	6	2	254	—	—
1948-49											
upto 0.5	—	3	—	8	5	6	2	1	25	107.2	102.6
0.5— 1.0	—	3	4	4	—	7	—	1	19	96.5	91.7
1.0— 2.0	—	1	3	3	9	5	4	—	25	112.6	118.6
2.0— 3.0	—	—	4	15	13	4	1	1	38	103.3	100.3
3.0— 4.0	—	3	—	4	7	1	1	—	16	97.6	102.4
4.0— 6.0	—	1	3	16	9	4	—	—	33	90.9	97.8
6.0— 8.0	1	1	7	7	3	1	—	1	21	86.1	80.9
8.0—12.0	—	3	2	15	11	2	1	—	34	94.0	97.0
12.0—16.0	—	—	4	9	7	2	—	—	22	96.6	95.7
16.0—20.0	—	—	1	1	8	3	—	1	14	117.9	118.6
20.0—24.0	—	—	2	4	1	2	1	—	10	101.4	89.4
24.0—32.0	—	—	1	3	3	—	1	—	8	106.2	100.6
32.0 & above	—	—	—	3	1	2	—	—	6	105.7	99.3
total	1	15	31	92	77	39	11	5	271	—	—
1949-50											
upto 0.5	—	—	1	10	11	3	2	1	28	107.8	103.0
0.5— 1.0	1	1	4	5	9	7	1	—	28	101.3	103.6
1.0— 2.0	—	—	2	12	12	3	—	—	29	100.0	97.1
2.0— 3.0	—	—	5	12	10	2	1	—	30	99.4	99.7
3.0— 4.0	—	—	4	9	9	1	—	—	23	98.4	97.9
4.0— 6.0	—	1	4	21	11	1	1	—	39	94.6	93.2
6.0— 8.0	—	—	2	11	11	1	1	—	26	99.3	100.4
8.0—12.0	—	—	5	11	9	5	1	—	31	101.7	101.1
12.0—16.0	—	1	5	6	8	3	—	—	23	98.4	98.6
16.0—20.0	—	—	1	6	6	2	—	—	15	99.5	100.1
20.0—24.0	—	—	1	5	3	1	—	—	10	98.1	97.0
24.0—32.0	—	—	1	1	6	—	—	—	8	99.3	105.3
32.0 & above	—	—	1	2	2	1	—	—	6	100.9	99.1
total	1	3	36	111	113	30	7	1	302	—	—

TABLE A.3. PROGRESS OF WORK

	motor unit "A"					motor unit "B"				
date of survey	name of P.S.	name of village	number of clusters with paddy	number of cuts taken	number of clusters checked	name of P.S.	name of village	number of clusters with paddy	number of cuts taken	number of clusters checked
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15.12.56	Suri	Sirlas	2	2	3	Suri	Pathra	1	1	3
16.12.56	Rajnagar	Asner	–	–	2	Rajnagar	Jalianabad	1	1	1
17.12.56	-do-	Parsaia	–	–	1	Dubrajpur	Birori	1	2	2
		Parsaia (R)	–	–	3					
18.12.56	Dubrajpur	Hunuri	2	2	2	Suri	Bonsanka	2	2	2
19.12.56	-do-	Dubrajpur	1	2	3	Khayrasole	Manjuria	–	–	1
20.12.56	-do-	Moitzapur	1	2	3	work held up due to breakdown of car				
21.12.56	Khayrasole	Lohanagar	3	3	3					
22.12.56	Manoor	Chitgram	2	2	2	Dubrajpur	Simultari	1	2	1
23.12.56	Bolpur	Ruppur	2	2	2	Nanoor	Sakalipur	2	2	–
							Nooto	1	2	1
24.12.56	Sainthia	Paschim-sahapur	1	2	1	-do-	Debagram	–	–	–
	Labpur	Altore	2	2	2	-do-	Akupur	2	2	–
25.12.56	-do-	Kumahar	1	2	2	Bolpur	Singi	–	–	–
							Ballavpur	–	–	–
26.12.56	Md. Bazar	Bamandiha	–	–	2	-do-	Bahudhara	–	–	1
27.12.56	-do-	Gorajpur	1	2	2	Illambazer	Purbanara-yanpur	1	2	1
28.12.56	Mayureswar	Parulia	3	3	3	Sainthia	Jullo	1	2	–
							Iswarpur	1	2	–
14 days		16 villages					16 villages			

TABLE A.4. DAILY RUN BY THE MOTOR UNITS AND DISTANCE TRAVELLED ON FOOT TO REACH THE SAMPLE VILLAGE

	motor unit "A"					motor unit "B"				
date of survey	petrol purchase (gallon)	mobil oil purchase (gallon)	miles run by car	time spent in running motor car (in hrs)	miles on foot from car to village and back to car	petrol purchase (gallon)	mobil oil purchase (gallon)	miles run by car	time spent in running motor car (in hrs)	miles on foot from car to village and back to car
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15.12.56	8.0	0.25	33	2.8	3	5.0	0.50	25	2.2	—
16.12.56	—	0.66	33	5.2	1	1.0	—	38	3.4	1
17.12.56	4.0	0.50	37	3.8	2	4.0	0.50	27	2.7	1
18.12.56	—	—	13	2.9	—	2.0	—	24	4.7	2
19.12.56	—	—	22	2.4	—	4.0	—	15	2.2	6
20.12.56	8.0	—	24	3.2	3	—	—	76	6.0	2
21.12.56	—	0.25	37	2.8	4	—	—	—	—	—
22.12.56	5.0	0.50	80	4.5	5	9.0	—	—	—	—
23.12.56	5.0	0.50	55	3.5	4	3.0	0.50	16	2.3	2
24.12.56	3.0	0.50	33	3.5	4	—	—	21	2.8	6
25.12.56	—	—	32	3.2	6	3.0	—	40	3.2	7
26.12.56	4.0	0.25	23	2.2	3	3.0	0.50	18	1.4	6
27.12.56	5.0	0.50	34	3.0	3	3.0	—	58	5.4	6
28.12.56	1.0	—	0	1.0	7	—	—	51	4.8	2
14 days	43.0	3.75	462	43.8	45	37.0	2.00	417	41.1	41

TABLE A.5. A DIMENSIONAL ESTIMATE OF COST PER MONTH WITH INVESTIGATING UNITS OF DIFFERENT TYPES

Items	cost in rupees per month for items as in column (1)	cost in rupees per month per investigation units at 3 clusters of 10 plots and 3 cuts per village		
		(1) foot-unit	(2) cycle-unit	(3) motor-unit
		2 investigators on foot in 1000 sq. miles. 1 inspector over 2000 sq. miles [6 villages]	2 investigators on cycle in 1600 sq. miles 1 inspector over 3200 sq. miles [10 villages]	2 investigato for 4000 sq. miles. 1 inspector over 8000 sq. miles. [25 villages]
(1)	(2)	(3)	(4)	(5)
1. investigator with FTA	250	1000	1000	1000
2. inspector with peon and T.A.	500	500	500	500
3. staff upto Inspector	—	1500	1500	1500
4. overheads @ 50% of (3)	—	700	700	700
5. total excluding mechanised conveyance	—	2200	2200	2200
6. *mechanical equipment*				
(a) motor rental and maintenance	500	—	—	2000
(b) motor-driver	150	—	—	600
(c) motor-fuel	400	—	—	1600
(d) garage and camp	—	—	—	200
(e) rentals of motor-cycle for the Inspector	90	—	—	90
(f) motor cycle fuel	80	—	—	80
(g) bicycle rentals and maintenance	25	—	125	100
7. total conveyance	—	—	125	4670
8. grand total per unit per month	—	2200	2325	6870

Paper written : November, 1957.
Paper received : June, 1964.