An analysis of internal migration in Bihar, North India

By Lisbet de Castro Lopo

Abstract

A quantitative description of population movements in Bihar based upon census figures for birthplace. Attention is particularly paid to the detailed patterns of these movements, and linear programming technique is employed to estimate the "most economic migration" and the "waste" in migration.

Migration may be studied at several different levels. One can pay attention to the large general movements of international migration, as well as to the particular people travelling to and from a city.

The movements of people in India have been treated by many authors and in many different ways. Among the quantitative descriptions of migration in India one could mention the chapter on migration in *Davis* (1951), and also the analysis by *Gosal* (1961), as well as the very penetrating study of internal migration in India in the first 30 years of this century, by *Zachariah* (1964). *The National Sample Survey* (1962) gives a great deal of information about migration in India, but this information cannot be regionally applied. At a lower level there are many studies of migration in smaller regions of India. For Bihar particularly, one could mention *McPherson* (1931) and *Geddes* (1938); but also the article by *Mitra* about migration in West Bengal in the census report of West Bengal 1951, sheds light on migration in Bihar, as do several other census report articles.

The present study of the internal migration in Bihar is an attempt at a quantitative description of the migration in that parti-

cular state, special interest being taken in the great complexity of the actual movements which take place. Also it is an attempt at using the linear programming technique in analysis of migration. As far as I know this has not been done before.

The study is based upon the Census of India figures for birthplace from the three censuses 1921, 1931, and 1951. The appropriate figures from the 1941 census were never published, and the 1961 figures are not yet available.

At the time of a census any person enumerated in a district, which is not his place of birth, will be entered as an immigrant, and he will at the same time be regarded as an emigrant with respect to his district of birth. It is not possible to detect the particular moves which a person may have made between the time of his birth and his enumeration as a migrant, and it is likewise impossible from the census to learn for how long the immigrant has been staying in the district of enumeration. Further it is not possible to trace one particular migrant from one census to the next.

The figures to be analysed constitute merely the number of immigrants to any Bihari district, specified from all other Bihari districts, and the number of emigrants from any district, specified to all other districts. The migrants may be classified according to sex.

Migration in the state of Bihar

The population of the state of Bihar (as of 1951) was:

1921	*1931*	*1951*
29.177.296	32.556.239	40.225.947

In 1921 1.204.057 persons in Bihar were enumerated in a district different from that in which they were born, and of these immigrants 866.327 persons, or 74 %, came from other districts in Bihar. In the same year there were 2.490.526 persons who were born in Bihari districts but enumerated away from their place of birth. Of these again 866.327 persons, or 36 %, were counted in other Bihari districts, while the remainder had left for more distant parts, notably Bengal and Assam.

The overall migration in and out of Bihar thus resulted in an outward headed net-migration.

The censuses of 1931 and 1951 give fewer details, but in the table below the comparable figures are shown as far as possible:

	1921	*1931*	*1951*
Total immigrants to Bihari districts	1.204.057		1.646.860
Total emigrants from Bihari districts	2.490.526		
Internal migrants	866.327	897.538	1.129.527
Internal migrants as % of immigrants	74 %		70 %
Internal migrants as % of emigrants	36 %		
Internal migrants as % of population	3.0%	2.8%	2.8%

In spite of the deficient figures it seems safe to say that among the immigrants coming to Bihari districts those coming from other Bihari districts dominate, while the majority of emigrants leaving Bihari districts leave for more distant parts.

The number of internal migrants has increased in absolute terms, but as a proportion of the population the internal migration has been constant.

It is the patterns of the internal migration which will be analysed in the following, but it should not be forgotten that the ignored external migration may well play a rôle on the particular patterns of the internal migration which may be discerned, nor that movements occur which do not result in the crossing of a district border, and that this intra-district migration will be larger in comparison to movements across the border in big districts than in small, other things being equal.

Analysis of the internal migration

For the analysis of the internal migration pattern in Bihar in 1921, 1931, and 1951, the number of persons born in one district but enumerated in another has been cross-tabulated for all districts (fig. 1). The location of the districts is shown on the map (fig. 3a). The numbers in the chart indicate the number of migrants to the nearest thousand. In the horizontal rows the emigration from any district to all other districts is shown, and in the vertical columns the immigration to a district from all others is shown. The system is a closed one and the sum total of the columns equals the sum total of the rows, being the total number of migrants. The discrepancy between these totals, and the numbers of internal migrants given in the table page 3, is due to the rounding of the figures.

Total Migration

1921

	P	G	Sh	Sa	C	Mu	D	Mo	Bh	Pu	SP	Pa	H	R	M	S	
P		18	7	4	1	3	3	13	2	2	2		1		3	1	60
G	27		9			1		5	1	2	2	13	10	3	19	2	94
Sh	8	6		4				2	3	4	4	4	1	1	4	1	42
Sa	9	1	4		12	5	3	2	2	3	1				1	1	44
C				3		17				1							21
Mu	7		1	8	21		28	3	3	6	1						78
D	4			1	1	25		14	16	15	1						77
Mo	16	7				1	16		28	24	12		3		23	1	131
Bh	1						4	19		88	16				1		129
Pu								1	3		1						5
SP								3	15	28			2		7		55
Pa		4	4								1		2	2			13
H		4						2			6	4		6	36	1	59
R	1									1		2	3		4	10	21
M											3		4	4		6	17
S													1	1	2		4
	73	40	25	20	35	52	54	64	73	174	50	23	27	17	100	23	

P 850
PM 1074
M 1.26

1931

	P	G	Sh	Sa	C	Mu	D	Mo	Bh	Pu	SP	Pa	H	R	M	S	
P		20	13	4	1	4	3	12	2	2	1		1		3		66
G	37		11	4				6	1	1	1	9	13	2	21	3	109
Sh	12	6		3		1		1	3	2	2	3	1	1	4	1	40
Sa	11	1	5		10	6	2	1	2	4	1		1		2	1	47
C	1			3		21				1							26
Mu	11		1	12	26		32	2	3	6							93
D	5			1	1	29		15	17	14							82
Mo	25	8				1	17		27	15	3		4		24	1	125
Bh	2						5	22		77	13				2		121
Pu								1	6		3						10
SP								3	15	25			3		7		53
Pa		4	5										2	2	1		14
H		5						2			1	3		5	33	1	50
R	1									1		2	5		5	9	23
M											1		8	5		6	20
S													2	2	3		7
	105	44	35	27	38	62	59	65	76	148	26	17	40	17	105	22	

P 886
PM 1097
M 1.24

1951

	P	G	Sh	Sa	C	Mu	D	Mo	Bh	Pu	SP	Pa	H	R	M	S	
P		27	14	4	1	2	4	12	2	3	1	2	3	2	7	4	88
G	51		12	1			1	4	2	2	1	8	17	3	36	6	144
Sh	21	9		2		1	1	2	1	3	1	4	4	1	7	4	61
Sa	14	4	5		8	5	7	3	3	6		1	3	1	4	3	67
C	1			4		13	2			2			1				23
Mu	15	1	2	9	25		37	7	3	9	1		1		3	1	114
D	7	1	1	2	1	25		19	14	14	1		1	1	2	1	90
Mo	28	10				2	19		27	15	4		4	1	4	3	117
Bh	4	1	1			1	10	37		58	22		1		34	1	170
Pu	1						1	3	9		2		1				17
SP	1							4	11	18			5		7	1	47
Pa		4	6										4	4	3	1	22
H	1	8						2	1		3	8		5	45	3	76
R	1	1								1	1	7	10		9	9	39
M	1		1					1			7		10	7		10	37
S											1		6	2	4		13
	146	66	42	22	35	49	82	94	73	131	45	30	71	27	165	47	

P 1125
PM 1548
M 1.38

Fig. 1. The figures in the horizontal rows indicate the out-migration (in 1000 persons) from each district to the others. In the vertical columns the in-migration to each district from each of the others is shown. P = all migrating persons. PM = "person-miles" i.e. migrants multiplied by distance travelled (fig. 2). M = average distance travelled. The framed figures indicate the most heavily travelled routes.

For location of districts see fig. 3a.

Fig. 1. Tallene i de horisontale rækker angiver emigrationen fra ethvert distrikt til ethvert andet (i 1000 personer). I de lodrette søjler ses immigrationen til ethvert distrikt fra ethvert andet. P = antal migranter. PM = „person-km" d.v.s. migranter ganget med den afstand, de har rejst (fig. 2). M = gennemsnitlig rejseafstand. De indrammede tal angiver de mest berejste ruter. Distrikternes beliggenhed ses fig. 3a.

P = Patna
G = Gaya
Sh = Shahabad
Sa = Saran
C = Champaran
Mu = Muzaffarpur
D = Darbhanga
Mo = Monghyr
Bh = Bhagelpur
Pu = Purnea
SP = Santal Parganas
Pa = Palamau
H = Hazaribagh
R = Ranchi
M = Mahnbhum
S = Singhbhum

Cart of Distances

	P	G	Sh	Sa	C	Mu	D	Mo	Bh	Pu	SP	Pa	H	R	M	S
P	0	1	1	1	2	1	1	1	2	3	2	2	2	3	3	4
G	1	0	1	2	3	2	2	1	2	3	2	1	1	2	2	3
Sh	1	1	0	1	2	2	2	2	3	4	3	1	2	2	3	3
Sa	1	2	1	0	1	1	2	2	3	4	3	2	3	4	4	5
C	2	3	2	1	0	1	2	3	3	4	4	3	4	5	5	6
Mu	1	2	2	1	1	0	1	2	2	3	3	3	3	4	4	5
D	1	2	2	2	2	1	0	1	1	2	2	3	2	3	3	4
Mo	1	1	2	2	3	2	1	0	1	2	1	2	1	2	2	3
Bh	2	2	3	3	3	2	1	1	0	1	1	3	2	3	2	3
Pu	3	3	4	4	4	3	2	2	1	0	1	4	3	4	2	3
SP	2	2	3	3	4	3	2	1	1	1	0	2	1	2	1	2
Pa	2	1	1	2	3	3	3	2	3	4	2	0	1	1	2	2
H	2	1	2	3	4	3	2	1	2	3	1	1	0	1	1	2
R	3	2	2	4	5	4	3	2	3	4	2	1	1	0	1	1
M	3	2	3	4	5	4	3	2	2	2	1	2	1	1	0	1
S	4	3	3	5	6	5	4	3	3	3	2	2	2	1	1	0

Fig. 2. The figures indicate the distance from each district to the others. The figures are relative. The distance between neighbouring districts is given as 1, two districts separated by one district are 2 apart, when separated by two districts 3 apart etc.
Location of districts is given in fig. 3a.

Fig. 2. Tallene angiver afstanden fra ethvert distrikt til ethvert andet. Det er relative tal. Afstanden mellem to nabostrikter angives som 1. Adskilles to distrikter af et mellemliggende distrikt bliver afstanden mellem dem 2, adskilles de af to distrikter bliver den 3 o.s.v. Distrikternes beliggenhed ses på fig. 3 a.

In order to get an expression of the total amount of movement in the state, the distances from each district to the others have been estimated by simple figures, ranging from 1 to 6. These distance values have been entered in the chart (fig. 2.).

By multiplying the number of migrants by the distance travelled, as given by the distance figures, it is possible to obtain for each census a figure for the total "person-miles" travelled, the PM value, and by dividing the PM value by the total number of migrants (P), the average distance travelled (M) is obtained. In the table below the values of P, PM, and M are shown for the total internal migration in 1921, 1931, and 1951.

	1921	*1931*	*1951*
P	850	886	1125
PM	1074	1097	1548
M	1.26	1.24	1.38

As already mentioned the number of internal migrants has increased, and also the total amount of movement as measured by the PM value has grown, but while the increase in the PM value from 1921 to 1951 is due both to an increase in the number of migrants, and to the increase in the average distance travelled, M, the increase in the PM from 1921 to 1931 results only from the growing number of migrants, as the average distance travelled actually is shorter in 1931 than in 1921.

To proceed further with the analysis, the migration for each year

as charted in the three diagrammes (fig. 1) has been divided into two components which shall be called the balancing migration and the location specific net-migration.

By balancing migration is meant the migration into a district from another district which is exactly counterbalanced by the migration from the second into the first. If, theoretically, it is assumed that any migrating person equals any other migrating person, then the outward headed group of migrants can be exactly replaced by the entering group, and the migration will have no effect on the final situation, it will not result in any change in the supply of labour in the two involved districts.

What is left over from the balancing migration between two districts is the location specific net-migration, or simply the net-migration, as opposed to the total net-migration, which is here taken to mean the balance of all migrants entering and leaving a district, irrespective of their origin and destination. The net-migration will alter the size of the population in the involved districts, and may be assumed to be of economic significance.

On plate 1 (inside the back cover) each of the original diagrammes of fig. 1 has then been divided into two new diagrammes, one showing the balancing migration, the other the net-migration. For each the P, PM and M values have been computed, these figures being shown in the table below:

	Balancing migration				Net-migration		
	1921	*1931*	*1951*		*1921*	*1931*	*1951*
P	428	496	606	P	422	390	519
PM	438	514	680	PM	636	583	868
M	1.02	1.04	1.12	M	1.51	1.50	1.67

It is seen that the balancing migration involves more people than the net-migration. This is true in all three years, the balancing migration being most strongly dominant in 1931, least so in 1921. However the PM value for the net-migration is always larger than that for the balancing migration. This is the result of the longer average distances travelled by the net-migrants, as compared to the balancing migrants.

The balancing migration has increased steadily from one census to the next, but the number of net-migrants has decreased from 1921 to 1931, then increased again, so that in 1951 the number was larger than in 1921. This decrease in the figure for 1931 is most likely

explained by the slightly earlier time of the year at which the census of 1931 was carried through. This meant that many seasonal migrants had not yet started from home. As there is no deflation to be seen in the number of balancing migrants, one might conclude that the balancing migration is less affected by the seasonality of migration than is the net-migration.

The average distance travelled – for the balancing as well as for the net-migration – shows a general tendency to increase from one census to the next. 1931 shows an exception for the net-migration, which again probably has to do with the timing of the census, the seasonal migrants not yet started for their distant goals.

Patterns of internal migration

The pattern of migration may be understood simply to mean the net-result of the total movement, i.e. the regional distribution of the total net-migration. This has been mapped (fig. 3 b, c, d), the circles being proportional in size to total net-migration of the district, an empty circle representing a net-out-migration, a filled in circle a net-in-migration.

The similarity between the three maps is striking. The attractive districts are seen to be the same at all three censuses, although the ranking of them does change: the leading rôle of Purnea was lost to Mahnbhum in 1951, and Patna moved up from the fifth place in 1921 to a third place already in 1931. It is not difficult to explain in a general way the attraction of these districts. In Purnea a great deal of agricultural colonization has been taking place, particularly rather early in the century, and in Champaran the same has been the case. In Mahnbhum the attraction lies in the coal-fields and the industries which developed based upon the coal; the attraction of Singhbhum is explained by the iron mining, and the rapidly growing city of Jamshedpur with its Tata iron and steel works. The net-in-migration to Patna is probably due to the attraction of the city of Patna, which is the capital of Bihar and the largest city in the state. The immigration to Palamau is the result of colonization in this rather thinly populated district.

The supply of migrants comes from the densely populated agricultural districts of the Ganges floodplain. In 1921 and 1931 Gaya and Monghyr are the chief suppliers, while in 1951 Bhagelpur has moved into the first position followed by Gaya and with Muzaffarpur as a strong number three. The importance of Monghyr and Hazaribagh as suppliers of migrants has decreased rather sharply.

A comparison between the maps and the migration as charted in plate 1 reveals, however, the extent to which they represent a generalization of the migration pattern. Many districts are at the same time important receivers and suppliers of migrants, Monghyr, Bhagelpur and Muzaffarpur being striking examples of this.

It would be very difficult to map the total information given by the charts in plate 1 in a satisfactory way. Also it can be claimed that the charts themselves give a graphic description of the migration pattern, revealing the general tendency of the western and northwestern districts to be suppliers of migrants, the eastern and southern districts to be receivers. Further, even a casual glance at the charts reveals the general similarity between the patterns of migration as observed in 1921, 1931, and 1951.

In the following a verbal description of the patterns of the total migration shall be given, based upon a study of plate 1.

In 1921 the largest numbers of migrants are seen to have travelled from Bhagelpur to Purnea, and this route remains the most heavily travelled also in 1931 and 1951, although the actual number of migrants from Bhagelpur to Purnea decreases. The second-most travelled route in 1921 is that from Hazaribagh to Mahnbhum, but this route drops to a third place in 1931 and 1951, while the importance of migration from Gaya to Patna increases. Other important routes of migration are in 1921 those from Muzaffarpur to Darbhanga, from Monghyr to Baghelpur and from Santal Parganas to Purnea. On plate 1 the most heavily travelled routes have been framed to give a clearer picture. Four of the six most heavily travelled routes are the same in all three years. Migration from Santal Parganas to Purnea is large in 1921, but drops from a leading rôle already in 1931. The route from Monghyr to Bhagelpur is still represented in 1931 whereas it drops out in 1951. In 1931 the new route among the six most heavily travelled is that from Darbhanga to Muzaffarpur, but this route drops out again in 1951, where the two new routes are those from Bhagelpur to Monghyr and from Gaya to Mahnbhum.

It is seen that several of the central districts experience a heavy balancing migration, and that the districts of heavy balancing migration basically are identical at all three censuses.

When the balancing migration has been subtracted from the total migration the pattern of the net-migration is revealed, and this pattern seems less stable than that of the total migration. Again the route from Bhagelpur to Purnea is the most travelled at all three censuses, but the dominance of this route drops; in 1921 it accounts

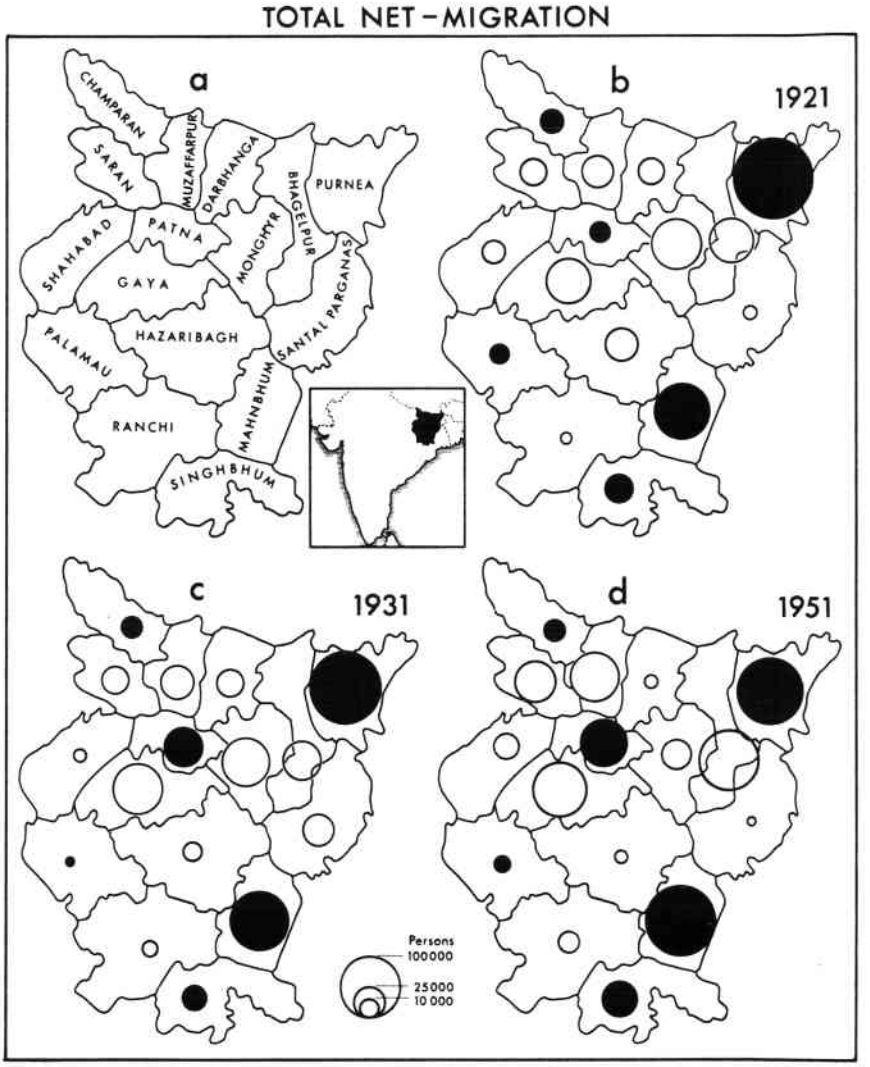

Fig. 3. a. Shows the location of the Bihari districts. The abbrevations of the district names as they are used in the charts are given in the text of fig. 1.
b, c, d. Total net-migration of Bihari districts. The size of the circle is proportional to the number of total net-migrants, an empty circle indicates a total net-out-migration, a filled-in circle a total net-in-migration.

Fig. 3. a. Viser beliggenheden af de biharske distrikter. De på matricerne anvendte forkortelser er forklaret i teksten til fig. 1.
b, c, d. Den totale netto-migration for biharske distrikter, d. v. s. slutresultatet af alle bevægelser ud eller ind af et distrikt, uanset rejsemål eller oprindelsessted. Cirklernes størrelse er proportional med antallet af migranter, en tom cirkel angiver en udvandring, en udfyldt cirkel en indvandring.

for 20 % of all net-migrants, in 1951 for 9 %. Two more routes remain among the top six in all three years, namely that from Gaya to Mahnbhum and that from Hazaribagh to Mahnbhum. The route from Monghyr to Purnea, among the top six in 1921, drops out already in 1931, being replaced by the route from Gaya to Patna; and by 1951 two more routes, from Santal Parganas to Purnea and from Monghyr to Mahnbhum, are replaced by the routes from Bhagelpur to Mahnbhum and from Monghyr to Patna.

Changing patterns of migration around particular districts may also be observed. Thus migration around Monghyr seems to have changed in a characteristic way. In the early years this district sent the majority of its migrants to the east, to Bhagelpur, Purnea, and Mahnbhum. By 1951 this had changed. Migration to Mahnbhum had almost stopped, to Purnea stagnated, and to Bhagelpur it was counterbalanced by a heavier traffic in the opposite direction, from Bhagelpur to Monghyr. Instead the main current of migrants in 1951 moved to the west, to Patna, but the total out-migration from Monghyr had decreased significantly.

Bhagelpur has also changed. This district used to be a large receiver of migrants; at the same time it was a large supplier, but the district's rôle as a receiver has weakened relatively, and while the district in the early years sent migrants almost exclusively to Purnea, many can now also be found in Monghyr and Mahnbhum, this last destination being almost new for 1951.

Muzaffarpur shows some of the same changes as does Monghyr. Earlier a quite important receiver of migrants as well as a supplier, the rôle of the district as a supplier is dominant in 1951, and the supply of the district mainly goes to Patna.

Hazaribagh, always an important supplier of migrants to Mahnbhum, in 1951 also received large numbers of migrants, mostly from Gaya, but also from Ranchi and Shahabad.

The degree of concentration in the migration may be measured as the percentage of the migration accounted for by the three largest receivers and the three largest suppliers. The table below shows the degree of concentration for the total migration and for the net-migration:

	Total migration			Net-migration		
	1921	*1931*	*1951*	*1921*	*1931*	*1951*
3 largest receivers	41 %	40 %	39 %	68 %	70 %	62 %
3 largest suppliers	42 %	40 %	37 %	51 %	52 %	50 %

For the total migration, concentration is seen to be about the same on the receiving and the supplying side. The degree of concentration has weakened slightly on both sides, most on the supplying side.

The figures for the net-migration, however, reveal a much stronger concentration, particularly on the receiving side. The degree of concentration has weakened in 1951 after a slight strengthening in 1931. The difference here in degree of concentration between the receivers and the suppliers means that the large suppliers of migrants are at the same time important receivers, while the large receivers are of smaller importance as suppliers. Bhagelpur, a net-supplier, is a striking example of this, in 1921 being the second-largest supplier of migrants, but at the same time the third-largest receiver. On the other hand, Purnea and Mahnbhum, the largest receivers, are quite unimportant as suppliers.

The most economic migration

Yet, another approach will be employed in this analysis. The total net-migration as mapped on fig. 3 b, c, d may be taken to represent the final result of all the movements charted on fig. 1. If again it is assumed as a premiss that any migrant is able to substitute for any other migrant, then – knowing the total net-migration of each district and the distance of any district from any other district – it should be possible to compute the least expensive way, in terms of person-miles, in which the total net-migration situation may be arrived at.

As before, the districts have been entered in a chart, fig. 4. Letting the sum-column for the rows show the total net-migration for those districts which have experienced a net-out-migration, and the sum-row for the columns show the net-migration for those districts with a net-in-migration, all values being ≥ 0, the problem will be to fill in the empty squares in such a way that the PM value is minimized. This is what is called a "transportation problem" in linear programming, *Gass* (1964). The problem can be solved by computer or by hand by the method devised by *Danzig, Gass* (1964). In the present case the hand method was used, and the solutions shown in fig. 4 were arrived at. It should be stressed that it is not the actual solution which is of interest in the present case, but rather the PM value of the solution, which then represents the cheapest way, in terms of person-miles travelled, by which the final situation could have been arrived at.

A comparison between the PM values of this theoretically most

economic migration and the PM value for the total migration as it has actually taken place, shows that the PM(total) has been growing more rapidly from census to census than has the PM(econ.), as can be seen in the table below:

	1921	*1931*	*1951*
PM(total)	1074	1097	1548
PM(econ.)	527	451	618
PM(total)/PM(econ.)	2.04	2.43	2.50

This means that the total migration has become increasingly "wasteful" towards the middle of the century. The "waste" is represented by the difference between the PM(total) and the PM(econ.). Part of this waste is obviously accounted for by the balancing migration, but also the net-migration is wasteful. The table below shows the waste, the PM value for the balancing migration, and the percentage of the waste which is made up by the balancing migration:

	1921	*1931*	*1951*
Waste, PM(total) – PM(econ.)	547	646	930
PM(bal.)	438	514	680
(PM(bal.)/waste)100	80 %	80 %	73 %

It is seen that in 1951 proportionally more of the waste is to be found with the net-migration (namely *not* with the balancing migration).

It has thus been shown, on the one hand, that the final results of the total migration as observed in 1921, 1931, and 1951 are fairly similar, with the same districts remaining receivers or suppliers of migrants; but on the other hand it has been demonstrated that these fairly similar results have been obtained through increasingly complex patterns of movements, where out-balancing bi-polar or polygonal migrations with no net-results have become more common, and where "broken" trips increase the PM value more than is justified in the net-results.

Before an attempt is made to explain this increase in waste in the migration, the precondition upon which the analysis was made must be tested. The premiss was that any migrant could be replaced by any other migrant, and this assumption is naturally false to some unknown extent. It is not possible to distinguish between migrants with respect to age or skills or other such pertinent factors, but it is possible to separate the migrants according to sex.

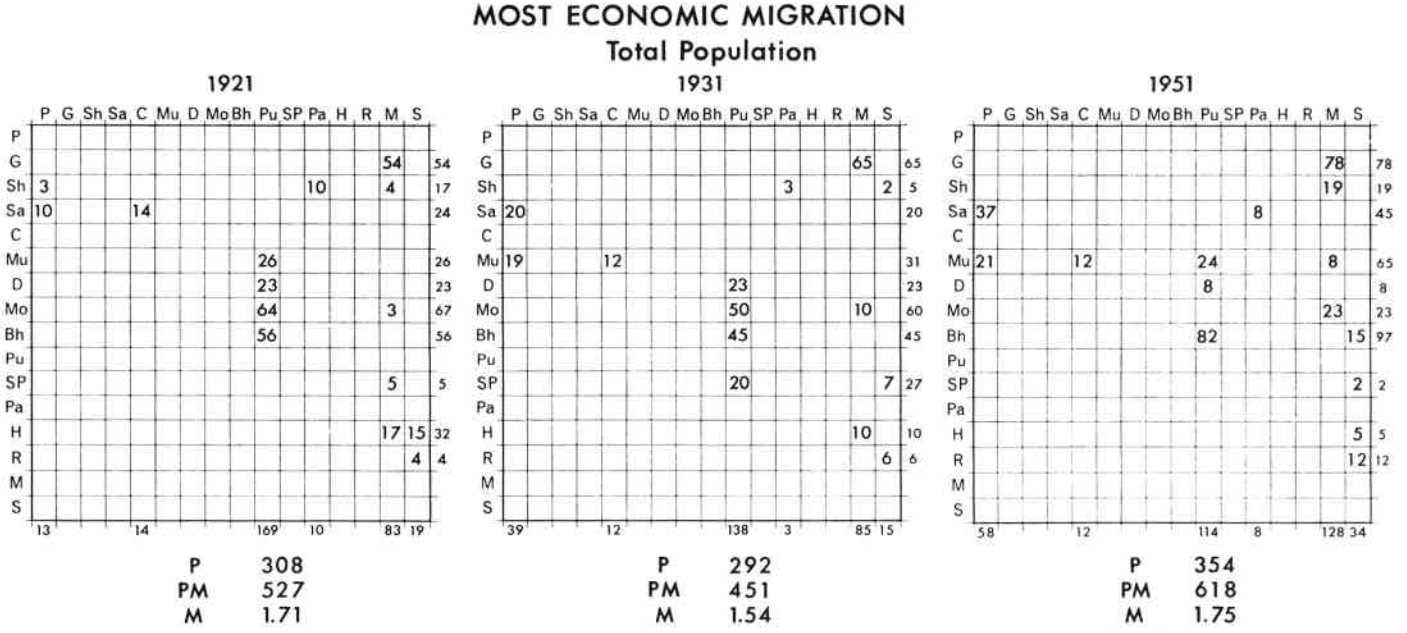

Fig. 4. Shows the most "economic" way by which the final situation of the total net-migration (as mapped in fig. 3 b, c, d) could have been arrived at.

The sum column of the rows shows the total net-migration for those districts experiencing a net-out-migration, the sum row of the columns the total net-migration of ditricts experiencing a net-in-migration. The figures in the chart show a solution which minimizes the PM value. There may be more than one solution at the same PM value.

P = number of migrants. PM = "person-miles" i.e. migrants multiplied by distance travelled (fig. 2), M = average distance travelled.

Fig. 4. Viser den mest økonomiske måde, hvorpå slutsituationen, den totale netto-migration (som kortlagt fig. 3 b, c, d), kunne have været opnået. Sumsøjlen for rækkerne viser den totale netto-migration for distrikter med en netto-udvandring, sumrækken for søjlerne netto-migrationen for distrikter med en netto-indvandring. Tallene i matricen viser en løsning, som minimerer PM værdien. Der kan være mere end én løsning til samme PM værdi. P = antal migranter, PM = „person-km" d.v.s. migranter ganget med den rejste afstand (fig. 2), M = gennemsnitlig rejseafstand.

Female and male migration patterns

On plate 1 fig. 2 and 3 (inside back cover) the female and male migration have been charted in the same way as was done for the total population on plate 1 fig. 1. The table below shows the P values, PM values and M values for the total female and male migration:

	Females			Males		
	1921	*1931*	*1951*	*1921*	*1931*	*1951*
P	471	487	582	379	391	522
PM	540	548	737	526	531	761
M	1.15	1.13	1.27	1.39	1.36	1.46

It is seen that the female migrants are always more numerous than the male migrants, while the male migrant on the average travels further than the female. When in 1951 the PM value for men is larger than that for women, this is due to the rise in the number of men travelling more than to the rise in the average distance of a trip.

The difference between the female and male migration is refound and to some extent explained by the values for the balancing and net-migrations as shown in the table below.

	Females			Males		
	1921	*1931*	*1951*	*1921*	*1931*	*1951*
	Balancing migration			Balancing migration		
P	288	310	348	130	166	220
PM	292	314	366	132	172	246
M	1.01	1.01	1.05	1.02	1.04	1.12
	Net-migration			Net-migration		
P	183	177	234	249	225	302
PM	248	234	371	394	359	515
M	1.36	1.32	1.59	1.58	1.59	1.71

It is seen that the female migration is dominated by balancing migration, while for men the net-migration is the more important. This difference in importance of the components cannot, however, be the explanation for the difference in M values between men and women, for this difference in average distance travelled is refound

in the balancing migration as well as in the net-migration, although it is much more pronounced for the net-migration.

These basic differences between the female and the male migration, i.e. the dominance of balancing migration for the women, and the longer distances travelled by men, are quite naturally reflected in the particular patterns of migration for men and women as they can be observed on plate 1 fig. 2 and 3.

The total female migration pattern as reflected in the six most heavily travelled routes is dominated by the central districts which experience a very heavy balancing migration. The pattern of this balancing migration is very stable from one census to the next, and the stability is again reflected in the pattern for the total migration. The route from Bhagelpur to Purnea is always the most heavily travelled, and four of the six top routes persist all through the period studied, the same six even in 1921 and 1931. But in 1951 the route from Hazaribagh to Mahnbhum has increased in importance to be included among the top six and further, travel from Bhagelpur to Monghyr has become more important than from Monghyr to Bhagelpur.

On the other hand it is interesting to notice a considerable instability in the pattern of the net-migration for females. Only one route – that from Bhagelpur to Purnea – persists through all three censuses.

The total male migration pattern does not seem as stable as the female pattern. Three routes reoccur at all three censuses among the top six, and the changes from 1921 to 1931 seem almost as great as those from 1931 to 1951. The net-migration for males, however, is more stable. The patterns in 1921 and 1931 are almost alike, while in 1951 the route from Gaya to Patna has arrived among the top six, and the route from Monghyr to Mahnbum has been replaced by that from Bhagelpur to Mahnbhum.

The net-migration accounts for the larger part of the total male migration, and when the fairly stable pattern of the former does not reflect itself on the latter, the reason must lie with the instability of the pattern of the balancing migration.

The female migration, where the balancing migration dominates, has a stable balancing migration and an unstable net-migration, while the male migration, with a dominant net-migration, has a stable net-migration and an unstable balancing migration.

The degree of concentration is also different in the female and male migration.

	Females			Males		
	1921	*1931*	*1951*	*1921*	*1931*	*1951*
	Total migration			Total migration		
3 largest receivers	35 %	34 %	35 %	52 %	50 %	46 %
3 largest suppliers	41 %	40 %	38 %	43 %	41 %	40 %
	Net-migration			Net-migration		
3 largest receivers	62 %	62 %	59 %	70 %	73 %	64 %
3 largest suppliers	54 %	56 %	52 %	48 %	48 %	48 %

The male migration on the whole shows more concentration than does the female migration, except on the supplying side of the female net-migration, where the concentration is greater than for the corresponding male migration.

The total female migration shows a greater concentration on the supplying side than on the receiving side, whereas the male migration always shows more concentration on the receiving side. It would seem that there is a tendency in the female migration for rather few districts to send migrants to rather many different districts, while the tendency for the male migration is the opposite, that rather few districts attract migrants from many different sides. The female migration pattern could thus roughly be described as one of divergence, whereas the male pattern is one of convergence.

It is a fact mentioned by several authors, e.g. *Davis* (1951), *Mitra* (1953) that a large proportion of the female migration is marriage migration. Because of the custom in North India that a woman should marry within her own caste, but outside of her *gotra* (ancestry line), there is a tendency for women to marry at some quite considerable distance from home, and the chances are that many would cross a district border through their marriage and in this way become migrants.

The pattern of the female migration as it differs from the male migration may very well have part of its explanation in this marriage migration. Thus the large balancing migration becomes easy to understand, since the balancing migrants cannot replace one another as marriage partners. It is also characteristic for the female migration that migration takes place to districts which seem utterly unattractive to men.

The male migration is much more clearly directed to those districts which one would expect to be economically attractive.

The waste in migration

The separate analysis of the male and female migration patterns was meant to refine the analysis with respect to the premiss of replaceability. It has shown that the two groups behave quite differently as migrants.

If the premiss is now again assumed to be valid for the two subgroups of women and men, then the most economic migration can be computed as before. The solutions for women and for men are shown on fig. 5 and 6. In the table below the figures pertinent to illustrate the degree of waste are shown:

	Females			Males		
	1921	*1931*	*1951*	*1921*	*1931*	*1951*
PM(total)	540	548	737	526	531	761
PM(econ.)	200	178	247	343	299	374
PM(total)/PM(econ.)	2.70	3.08	2.98	1.53	1.78	2.04
Waste, i.e.						
PM(total) – PM(econ.)	340	370	490	183	232	387
PM(bal.)	292	314	366	132	172	246
(PM(bal.)/waste)100	86%	85%	75%	72%	74%	64%
Other waste, i.e.						
waste – PM(bal.)	48	56	124	51	60	141

It is seen that both female and male migration are wasteful, the male migration increasingly so, while the waste for the female migration culminates in 1931.

With respect to women, it was disclosed that the premiss of replaceability could not hold for the marriage migration. Doubtlessly, therefore, a large part of the seeming waste is not wasted at all. The table on page 14 shows that for women the balancing migration has been most dominant as compared to the net-migration in 1931, the year in which female waste in migration culminates, and it seems very likely that there is some connection between marriage migration, balancing migration, and a large apparent waste.

The female migration includes more waste than does the male migration, but for the females, a larger proportion of this waste is balancing migration than it is for men, which means that the PM wasted through the net-migration (cf. "Other waste" in table) is larger for men than for women and also grows faster for men.

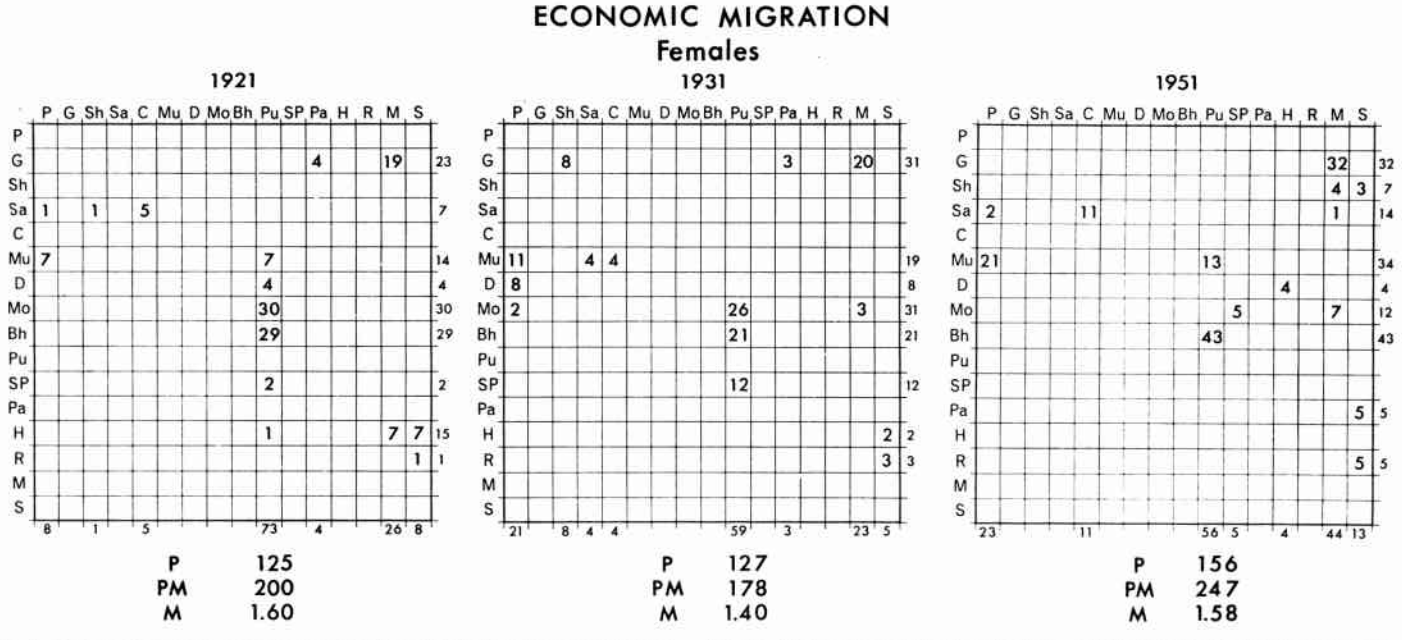

Fig. 5. Shows the most economic way by which the final situation of the female total net-migration could have been arrived at. The sum-column of the rows gives the total net-migration for districts with a net-out-migration, the sum-row of the columns gives the total net-migration for districts with a net-in-migration. The figures in the chart show a solution which minimizes the PM value. There may be more than one solution at the same PM cost.

P = number of migrants, PM = "person-miles" i.e. migrants multiplied by distance travelled, M = average distance travelled.

Fig. 5. Viser den mest økonomiske måde, hvorved slutsituationen — den totale kvinde-netto-migration — kunne have været opnået. Sumsøjlen for rækkerne viser den totale netto-migration for distrikter med en netto-udvandring, sumrækken for søjlerne den totale netto-migration for distrikter med en netto-indvandring. Tallene i matricen er en løsning, som minimerer PM værdien. Der kan være flere løsninger til samme PM værdi.

P = antal migranter, PM = „person-km" d.v.s. migranter ganget med den rejste afstand, M = gennemsnitlig rejseafstand.

ECONOMIC MIGRATION
Males

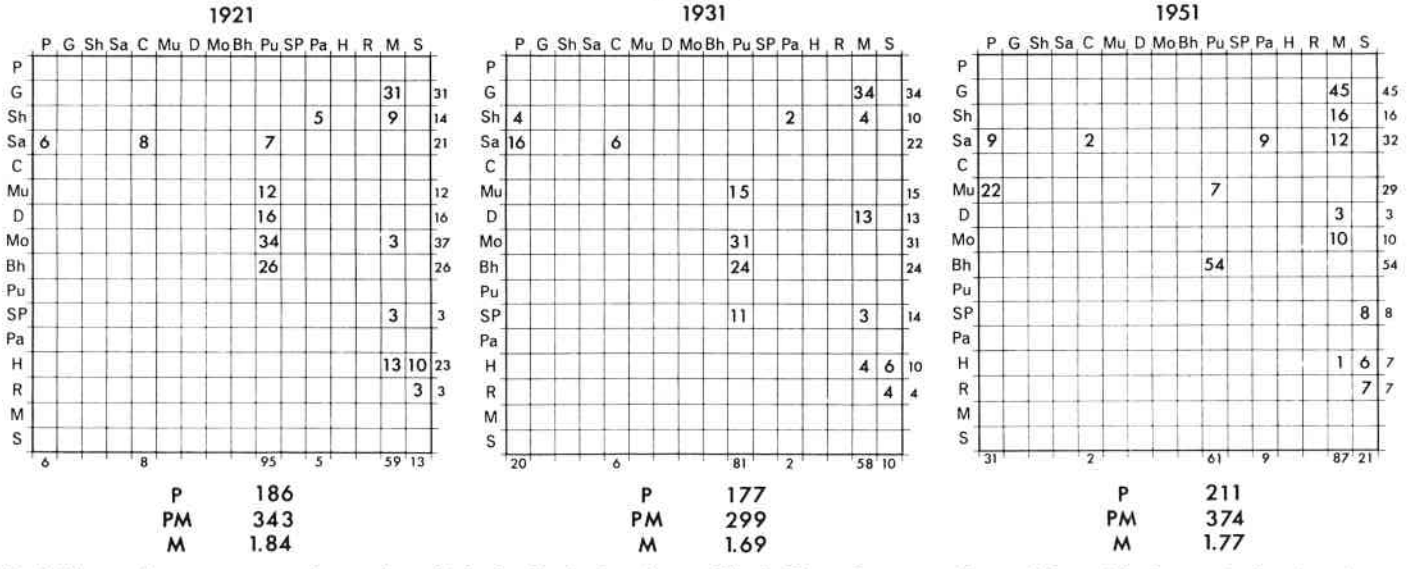

Fig. 6. Shows the most economic way by which the final situation of the male total net-migration could have been arrived at. The sum-column of the rows gives the total net-migration for districts with a net-out-migration, the sum-row of the columns gives the total net-migration for districts with a net-in-migration. The figures in the chart show a solution which minimizes the PM value. There may be more than one solution at the same PM cost.

P = number of migrants, PM = "person-miles" i.e. migrants multiplied by distance travelled, M = average distance travelled.

Fig. 6. Viser den mest økonomiske måde, hvorved slutsituationen — den totale mands-netto-migration — kunne have været opnået. Sumsøjlen for rækkerne viser den totale netto-migration for distrikter med en netto-udvandring, sumrækken for søjlerne den totale netto-migration for distrikter med en netto-indvandring. Tallene i matricen er en løsning, som minimerer PM værdien. Der kan være flere løsninger til samme PM værdi.

P = antal migranter, PM = „person-km" d.v.s. migranter ganget med den rejste afstand, M = gennemsnitlig rejseafstand.

Any attempt to explain the waste in migration, and particularly the increase in wastefulness, must by necessity keep close to the premiss of replaceability.

It is natural that actual migration should contain some waste as compared to a theoretical, most economic migration, simply because any one migrant behaves less rational, seen at a high level, than does "economic man". The real question is therefore why the waste has increased; why man, as it seems, has become more irrational.

One explanation could be that to an increasing degree people cannot substitute for one another, i.e. there has been an increasing specialization, and the intricacy of the migration pattern is necessary to arrive at the optimal allocation of skills, or whatever attribute the specialization is based upon.

Waste may also appear because there has been a separation in time between in-migration to and out-migration from one district. Since the migration as recorded at any of the censuses simply depicts the situation at that moment, and does not refer to migration in any specific span of time, it could be that the changing patterns of migration have accumulated as seeming waste. This theory, however, does not correspond very well with the observed relative stability and instability of the total female and male migration patterns, and also the rather stable male net-migration pattern shows a higher waste, and a larger increase in waste, than does the instable female net-migration pattern.

Lastly, the development observed, may simply be taken as a literal fact: more people do travel and travel longer average distances, probably for their own very important reasons.

Further research into the questions and answers outlined above awaits the publication of the 1961 migration figures, and plans for the application of the concepts of "the most economic migration" and "waste in migration" to migration in other regions and at other levels of observation.

RESUMÉ

En analyse af den interne migration i den indiske stat Bihar.

I artiklen gives en kvantitativ beskrivelse af den interne migration i Bihar, idet man særligt har interesseret sig for detaljen i mønstret af befolkningsbevægelser. Ved analysen anvendes lineær programmering.

Undersøgelsen er baseret på fødestedsstatistikken fra Census of India 1921, 1931, 1951, idet tallene fra 1941 aldrig er blevet publiceret, og de fra 1961 endnu ikke er udkommet.

Som migrant betragtes enhver person, der ved en folketælling er talt i et andet distrikt end fødedistriktet. Den externe migration, der er rettet væk fra Bihar, især imod Bengalen og Assam, har man helt set bort fra i undersøgelsen, og de analyserede tal repræsenterer simpelthen antallet af indvandrere til biharske distrikter, specificeret fra alle andre biharske distrikter, og antallet af udvandrere fra ethvert biharsk distrikt til alle andre biharske distrikter.

De interne migranter er indført i en matrice som vist på fig. 1. Distrikternes beliggenhed ses på kortet (fig. 3a). I matricens vandrette rækker er indført udvandringen fra ethvert distrikt til ethvert andet, angivet i tusinder. I de lodrette søjler ses indvandringen til ethvert distrikt fra ethvert andet. Det er et lukket system, totalsummen af rækkerne er lig med totalsummen af søjlerne og svarer til det totale antal interne migranter.

For at få et udtryk for den totale bevægelighed ved de tre folketællinger, har man vurderet afstanden fra ethvert distrikt til ethvert andet ved hjælp af et tal mellem 1 og 6; værdierne findes angivet i fig. 2. Ved at gange antallet af migranter med den afstand de har rejst og summere op for alle distrikter, får man et udtryk for den totale mobilitet, udtrykt i „person-km", PM værdien. Divideres denne værdi med antallet af migranter (P) fås den gennemsnitligt rejste afstand (M).

Migrationen er derefter blevet opdelt i ligevægtsstrøm og netto-migration. Ved ligevægtsstrøm forstås den migration til et distrikt fra et andet, som direkte opvejes af migrationen fra det andet til det første. Denne migration medfører ikke nogen ændring i befolkningstallet i de involverede distrikter. Det, som er tilovers, når ligevægtsstrømmen mellem to distrikter er trukket fra, kaldes netto-migrationen. Denne vil medføre en ændring i befolkningstallet i de involverede distrikter. Planche 1 fig. 1 (indsat bagest) viser opdelingen af den totale migration på ligevægtsstrøm og netto-migration. P, PM og M værdierne er angivet. Man ser, at ligevægtsstrømmen omfatter flere mennesker, end netto-migrationen gør, men PM værdierne for netto-migrationen er altid højere end for ligevægtsstrømmen, idet netto-migranterne gennemsnitligt rejser længere end ligevægtsmigranterne. M værdierne bliver i øvrigt større for hver folketælling.

Migrationsmønstret kan opfattes som netto-resultatet af alle befolkningsbevægelserne, d.v.s. som den regionale fordeling af den totale netto-migration. Denne er kortlagt fig. 3 b, c, d. Ligheden mellem de tre kort er slående. I Purnea og Champaran har kolonisationsmulighederne tiltrukket migranter, i Mahnbhum kullejerne og den dertil knyttede industri, i Singhbum jernlejerne og i Jamshedpur Tata-værkerne. Patna tiltrækker folk takket være byen Patna, som er hovedstaden i staten og den største by. De migrantafgivende distrikter er de meget tætbefolkede landbrugsdistrikter i Ganges-flodsletten.

En sammenligning mellem kortene og diagrammerne planche 1 viser imidlertid, i hvor høj grad kortene generaliserer de faktiske befolkningsbevægelser. Det er muligt direkte ud fra diagrammerne at danne sig et indtryk af migrationsmønstret. På planche 1 fig. 1 er de mest berejste ruter indrammet. Ved vurderingen af ændringer i migrationsmønstret benyttes også den såkaldte koncentrationsgrad, d.v.s. antallet af migranter fra de

tre største leverandører og modtagere hver for sig som procent af alle migranter. Tallene i tabellen side 10 viser, at de store leverandører af migranter samtidig også er betydelige modtagere af migranter, medens det modsatte i ringere grad er tilfældet for de store modtagerdistrikter.

Man kan opfatte den totale netto-migration, vist på kortet fig. 3, b, c, d som et resultat af alle de komplicerede befolkningsbevægelser, der er foregået. Hvis man teoretisk forudsætter, at enhver migrant kan erstatte enhver anden, så skulle det være muligt at udregne den billigste måde, udtrykt i „person-km", hvorved det totale migrationsresultat kunne have være nået. Distrikterne sættes igen op i en matrice, som på fig. 4. Man lader sum-søjlen for rækkerne vise den totale netto-migration for de distrikter, som har oplevet en netto-udvandring, og sum-rækken for søjlerne vise den totale netto-migration for distrikterne med netto-indvandring. Problemet er så at udfylde matricen på en sådan måde, at PM værdierne minimeres. Opgaven svarer til det, som kaldes „transportation problem" i lineær programmering. Problemet kan løses på computer eller i hånden efter en metode opfundet af *Danzig* (*Gass*, 1964). Her har håndmetoden været anvendt, og den fundne løsning er indført på fig. 4. Det må understreges, at det ikke her er den specifikke løsning, som er af interesse, men løsningens PM værdi.

En sammenligning mellem PM værdien for migrationen, som den har fundet sted, og for denne teoretiske, mest økonomiske migration viser, at der har været et spild, og at dette spild vokser forholdsvis mere end den totale migration. En del af spildet udgøres af ligevægtsstrømmen, men også spildet i netto-migrationen har været stigende.

Det vil altså sige, at selv om de iagttagne migrationsmønstre synes ret ensartede fra folketælling til folketælling, så er de ensartede resultater opstået gennem i stigende grad indviklede befolkningsbevægelser.

Det blev sat som forudsætning, at enhver migrant kunne erstatte enhver anden. Dette holder naturligvis ikke stik, men det er ikke muligt at inddele migranterne efter alder, uddannelse, erhverv eller lignende. Derimod kan de opdeles efter køn.

Den analyse, som ovenfor er gennemført for alle migranter, gennemføres derefter for kvinder og mænd hver for sig, ref. planche 1 fig. 2 og 3 (indsat bagest). Det viser sig, at der er en væsentlig forskel mellem kvinde- og mandsmigrationen. Der er flere kvinder end mænd, som migrerer, hvorimod mændene gennemsnitligt rejser længere. I kvindemigrationen er ligevægtsstrømmen større end netto-migrationen, medens netto-migrationen dominerer for mændene. Migrationsmønstrene er også forskellige. Kvindemønstret er diffust med en divergerende tendens, medens mandsmigrationen viser konvergens, nemlig imod de økonomisk attraktive distrikter.

Det kvindelige migrationsmønster kan til dels skyldes, at en del af migrationen er giftermålsmigration. I den nordlige del af India er det skik, at kvinder bliver gift inden for deres egen kaste, men uden for deres *gotra* (forfædrelinie). Dette medfører, at mange kvinder bliver gift langt fra hjemmet, ofte kommer til at krydse en distriktsgrænse gennem giftermålet og derved bliver migranter. Den store ligevægtsstrøm for kvinder bliver herved lettere at forstå, idet disse kvinder, som talmæssigt opvejer hinanden, ikke kunne have erstattet hinanden som ægteskabspartnere.

Udregningen af den mest økonomiske migration for kvinder og mænd (fig. 5 og 6) viser et større spild for kvinder end for mænd, men for mændene ligger mere af spildet på netto-migrationen. Spildet vokser fra tælling til tælling.

Forøgelsen i spild kan skyldes, at folk i stigende grad er blevet specialiserede og ikke kan erstatte hinanden, hvorved det mere indviklede mønster er nødvendigt for opnåelsen af den optimale fordeling af de egenskaber, hvorpå specialiseringen er baseret.

Det kan også skyldes en adskillelse i tid mellem indvandringen til og udvandringen fra et distrikt. Det kan således være, at spildet repræsenterer en opsummering af de gennem tiderne skiftende migrationsmønstre. Endelig kan det være, at folk rejser mere og længere af deres egne, vigtige grunde.

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