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Earthwork on Irrigation Works in the Land of the Indus

By

MAZHAR ALI*

This paper is an attempt to trace a brief history of development of Irrigation Works in the former Sind Province, and to assess the growing earthwork needs. Potential of professional manual labour and casual hari labour has been explored, and special features of the Sind tract have been highlighted. Role of machines and manual labour, and the shift towards mechanization has been studied. A strong case has been made for the optimum exploitation of indigenous labour force as a first preference.

Earthwork on Irrigation Works in the Land of the Indus

Historical.—The word Sind means the country of the Indus. The area of the former province of Sind which now comprises two civil divisions of Khairpur and Hyderabad was 46944 square miles. On the basis of physical characteristics, it can be divided into three parts. The western belt consists of hills forming part of the Khirtar range. The eastern belt forms part of Rajputana desert, is covered with sand dunes, and is popularly known as the Thar desert. The middle belt is the alluvial tract built up by the river Indus over the centuries. It has all the characteristics of a delta and has a gentle slope towards the sea. Irrigation from the Indus is possible only for the middle belt where the soil is loamy and rich. This tract which is nearly half of the total area is the home for bulk of the population of the former Sind. The mighty Indus forms the backbone of agricultural economy and prosperity of the population almost whole of which is directly or indirectly engaged in agriculture. Summer is long drawn out and shade temperatures cross 120°F. Rainfall is normally scanty and unreliable, and most of it falls in July and August. In the south average annual rainfall is 9 inches, while in the north it is very low and is hardly 3 inches. Land is mostly fertile, but its full exploitation needs assured life giving water supply from the Indus. Ground water reserves in the south and in areas beyond the active influence of the river are

**Superintending Engineer, Irrigation Department.*

highly brackish and unsuitable for agriculture. Sweet water zones are mostly confined to active flood plains of the Indus.

The economy of this tract has been sustained by the Indus from times immemorial. Irrigation through inundation within active flood zones was a time honoured practice. The ancient civilisation of Mohenjo Daro (about 4000 B.C.) was firmly grounded in agriculture. The development of artificial canals in the north as well as in the south fades into early history. As river banks rose steadily due to silt deposits, canals were cut from the river to irrigate the rich interior lands. Their mention in earliest recorded history is in the eighth century when the Arab conquerors arrived. For assessing land taxes, they made a clear distinction between the lands served by public canals and the lands watered from private artificial means. This system of inundation canals was rudimentary in technique, badly administered and limited in scope. By the end of nineteenth century, a complex network of large and small inundation canals had grown up to serve about 30 lac acres of land. A system of flood protection earthen dykes also grew up as a natural consequence.

The irrigation practices of the time were on the whole wasteful in labour and material. The inundation canals suffered from many ills and made heavy demands on the farmer's resources. They were irregular in slope and shape, and were pretty tortuous, sometimes following the old natural channels. Systematic improvement and remodelling of canal systems was started after 1850 and Begari canal was the first to be taken up in 1852. The Eastern Nara Canal, a natural branch of the Indus, and running along the course of the Hakro, the lost river of Sind, was improved in 1863. The construction of Mithrao canal was taken up at almost the same time in 1857. It was the first canal designed on sound principles. Its completion was delayed till 1879 due to enormous difficulties caused by non-availability of labour in a sparsely populated area and acute shortage of drinking water. By the end of nineteenth century, the mileage of channels stood at 7441, the culturable commanded area being 95 lac acres with annual cultivation nearly 30 lac acres.

Sind canals were switched over to weir control at a rather late date. Steadily growing withdrawals by the upper riparians in the Punjab and mounting needs of planned agriculture were tipping the scales in favour of weir control. The disastrously low inundation of 1918 which created severe famine conditions in Sind finally clinched the issue and silenced all controversies. The Sukkur Barrage and Canals Construction Project was framed in 1919, sanctioned in 1923 and formally opened in January, 1932. Four canals on the left and three canals on the right, with total withdrawals of more than 47000 cusecs, served a gross commanded area of eighty lac acres to form the largest single irrigation system in the world. It absorbed a large number of old inundation channels.

Total length of irrigation channels in the project was 6472 miles and of the water courses 47800 miles. Up to end of 1932, total earthwork done on all irrigation channels was 628 crore cft., and on water-courses, 124 crore cft. About half the expenditure on canals was on earthwork alone. This was the first major project in the Sind area where population was sparse and even water courses had mostly to be constructed by the Government. Out of the total earthwork done, 319.2 crore cft. *i.e.*, 45.5% had been done by 46 draglines, most of it being in the head reaches of the main canals with lifts of about 15 feet. Maximum manual labour employed at any time touched 60,000 men. Had all the earthwork been done through manual labour in the same time period, more than double the labour force would have been required. Generally speaking, there was never a shortage of labour for any considerable period. During the last two years of construction when labour was required most, it was more easily obtained than in the previous years when the demand was not so great. This was owing to world-wide depression which was quite acute in 1930 and had put a stop to much of the development projects. Most of the labour employed came from the Punjab and Afghanistan, while a certain amount came from U.P. The contribution of the local population was very small.

The Sukkur Canals Project ushered in a new era of prosperity in the Sind, and the agricultural economy started an upward swing. The progress was not rapid due to rather primitive agricultural practices and due to slow influx of trained agriculturist settlers from the more populated northern areas. The agriculturist labour force of the tract, the haris, were not enough in strength to undertake rapid opening up of large waste lands. The economy was feudalistic, with a few Zamindars owning large estates. The climate was not conducive to rapid improvements.

After the construction of Sukkur Barrage and consequent heavy withdrawals, the inundation canals in the south like the Pinyari, the Fuleli, the Kalri and the Western Nara were severely affected. Ghulam Mohammad Barrage and Canals Project with a barrage on the Indus at Kotri became the second major irrigation project in Sind area. It commanded a gross area of 34 lac acres, opened new vistas of a prosperous life and fulfilled the diverse needs of a developing economy. The project was prepared in 1946-47 and sanctioned in 1947. The barrage was completed in 1955, the irrigation channels have mostly been completed, but the project is still open. Agricultural Development Corporation has been given control of the entire area served by this irrigation system to accelerate exploitation of the land. The age of mechanisation was changing the thinking of the administrators rapidly in Sind, and though exact figures are not available, a considerable portion of earthwork on the

project has been done through machines, both draglines and dozers.

The third and the latest major irrigation project in this tract is the Guddu Barrage and Canals project. This project was conceived in 1940, but was sanctioned after the creation of Pakistan. Its construction was taken up in 1955 after the completion of Ghulam Mohammad Barrage and work on a number of channels is yet in progress. The barrage was formally inaugurated in March, 1963, but completion of the project in its entirety is likely to take considerable time. It has given assured supply to old inundation channels in the Upper Sind, and will open up vast new areas on both the banks in the Sind and Baluchistan tracts. Gross proposed area under its command is 33 lac acres. The Project control has changed hands from Irrigation Departmet to WAPDA and now to the Agricultural Development Corporation. Great stress is now being placed on improved agricultural practices and increased exploitation of land, and the administration is always on the look out to try new experiments.

The pressure on land has been steadily mounting. With steady fall in infant mortality and improved medicines and food, the population was increasing by strides. Agricultural reforms opened up new venues for the agriculturist abour force. There was also a steady influx of trained agriculture labour from the Punjab and the Bahawalpur areas after integration, many of whom have grown into small landholders. The price of agricultural produce has risen rapidly giving more incentive for harder work. Demand for water has grown keener every day, calling for a high proficiency of maintenance and operation of the vast irrigation network.

As one barrage was constructed after another, the floods from the Indus which were so welcome to inundate lower areas, had to be contained to protect the irrigation channels and the lands they served. A line of protective flood dykes grew steadily on both the banks even during the growth of inundation channels. One link followed another. On the right bank, a continuous flood protective line of Kashmore-Sukkur-Begari bunds had come into existence as early as 1875-96. On the left, there was no such continuous line up to 1950, and some areas were subjected to flood spills frequently. The final closing links of the left flood bunds were constructed in 1950-51, and gave complete flood protection to the left bank areas. These massive flood dykes of earth stretch hundreds and hundreds of miles and come under severe pressure when waves of the swollen Indus beat mercilessly against them. It requires all the human ingenuity to keep them in tact and to improvise in time the second lines of defence at critical points. It is the primary responsibility of the Indus River Commission to ensure that the Indus is given no handle to devastate the rich protected lands.

As the intensity of irrigation increased, ground water balance was seriously upset. The area is deltaic in nature, and has pretty flat slopes and semi-permeable sub-strata. The ground water level has steadily risen, and with the lack of proper drainage, both salinity and waterlogging have grown into a menace. The worst effects are pronounced in the southern areas served by the Ghulam Mohammad Barrage. Vast tracts of land have been laid waste or have sharply deteriorated in productive capability. There is an acute need of a drainage plan, probably of the same order as the irrigation plan in force. Apart from batteries of deep or shallow tubewells, a complex network of branch and main drains will be required as drainage *cum* disposal works. The magnitude and scope of the drainage project is immense.

The scope of this paper is confined to earthwork needs and potential. Brief description of the three irrigation projects has been given to indicate the magnitude of the problem of their satisfactory maintenance, and the need for steady improvements. It will be appreciated that vast quantities of earthwork are required annually to keep the channel banks in proper shape, to keep the beds clean and to maintain and supplement the flood dykes. The complexity of the system will be indicated by the face map. The mileage of the channels and of flood bunds is given in the following table.

S. No.	Name of Project	Total mileage of channels (except watercourses)	Total with-drawals (cusecs)	Culturable commanded Area Lac. acres	Mileage of flood bunds
1.	Sukkur Barrage Canals Project.	7180.5 (as in 1965)	47532	74.78	617.4
2.	Ghulam Mohammad Barrage Canals Project.	2556.0 (as in 1965)	41325	28.06	267.3
3.	Guddu Barrage Canals Project.	2048.8 (1954 Project).	36929	25.07 (Phase I)	
		1911.9 (as in 1965)		30.17 (After phase II)	303.7
	Total ..	11,648.4	1,25,786	133.01	1188.4

Under the present system of administration, Sukkur Barrage and canals construction project is in Sukkur Zone of the Irrigation Department. The Irrigation channels of the Ghulam Mohd Barrage area and the Guddu Barrage area are under the administrative control of Agricultural Development Cor-

poration. Statistical data was available only for the Sukkur Zone irrigation channels and flood bunds and as such detailed analysis of earthwork needs for normal operation and maintenance has been confined to this Zone. The results achieved are of a general nature and with certain qualifications stated at appropriate places, apply generally to the entire Sind tract. The earthwork potential of this tract as a whole and likely strains of the growing economy have also been reviewed.

Earthwork Needs of the Sukkur Project Canals System

Sukkur Barrage Project Canals have a total length of more than seven thousand miles, with 617 miles of protective river flood embankments. These works are under the direct operational and maintenance control of the Irrigation Department. Government is responsible to deliver a specified quantity of discharge at each outlet head for irrigation requirements and small miscellaneous uses of public. Beyond the outlet head, the care and maintenance of the local irrigation channel, commonly known as the water course, rests with the local share-holders. Efficient operation of the vast network requires unstinted vigilance, a high technical proficiency and a sound maintenance machinery. Operational earthwork needs of the channels and flood bunds here are of usual nature. The channels need periodic raising and renewal of banks to offset the effects of rain and wind. Occasionally the bed may have to be cleared of harmful silt deposits or the berms may need attention. Setting back of banks may be called for if the normal regime is seriously upset for some reasons. The channel may otherwise need regrading or remodelling to meet the special local conditions or requirements. The flood bunds get reduced in section under the action of rain, wind and river and need restoration. The river bed inside is constantly aggrading due to deposition of large volumes of silt brought from the upper catchment areas, and the flood heights steadily go on rising. This requires periodic overhaul of the dykes, raising of heights and strengthening of the sections. At times, a certain portion of the dyke may come under direct river attack and it may be necessary either to face the attack by constructing spurs or to get back and construct a loop bund. All these items of earthwork when pieced together, grow into a formidable total for a complete system. If the planning is proper, it is possible to do most of the earthwork involved through manual labour. The exceptions may be for clearance of deep drains, earthwork under water, or earthwork involving long hauls. Machines are not normally called for, unless limited labour potential has to be reinforced in a grave emergency of river attack or big breaches in dykes or irrigation channels.

Sukkur Barrage Canal system is now more than 30 years old and may be considered as reasonably established. The initial ills and teething troubles

of any new system are far behind. Channel slopes are pretty flat, specially towards the tail ends in the south and discharge capacity of a channel has to be critically balanced against its tight command. Silt presents a variety of problems as slopes available are seriously limited. Control points may not be available on a system for many miles. Development in outlet design in the northern areas of Punjab and Bahawalpur, especially with reference to flexibility in discharge capacity and silt induction, have not been fully appreciated here though steady improvements are noticeable. Badly silted reaches of many irrigation channels, specially towards the south, are periodically cleared of deposited sand to restore the channel section to the origin design. In many cases, even main canals and big branches get the same treatment. This practice is rather a departure from the Punjab practice where raising of banks or regrading of channel is invariably preferred, and large channels are never silt cleared. The reason behind the current practice in the Sind tract is probably the limited slopes available, but there is lot of scope for research to reduce the heavy expenses of clearing the periodically depositing silt. It is, however, not the scope of this paper to discuss the morals or merits of silt clearance. It has been discussed at some length to indicate that it is a substantial item of the annual maintenance budget and it is considered as unavoidable in this part of the country.

Sukkur Zone of the Irrigation Department is headed by a Chief Engineer at Sukkur, and he holds control of the three barrages at Gudu, Sukkur and Kotri. The entire canal system of Sukkur Project also forms his charge. This canal system is controlled through four administrative units, known as circles each of which is headed by a Superintending Engineer. These circles do not control equal mileage of channels or bunds, but form units of equal responsibility. Three circles, the Khairpur, the Rohri and the Nara control the left bank canals while the Western Circle administers the right bank channels. Total mileage of channels on the left is 4943, and on the right is 2237. Pertinent data of the four circles, and the quantities of earthwork done during the last years are given in the table on the next page.

Most of this work was done by manual/donkey labour. In Rohri Canal Circle, draglines were used in 1965-66 to do the special work of silt clearing Nasir Branch to the extent of 75 lac cft., and bulldozers did about 50 lac cft. on new river bunds. In Western Sind Circle, dozers did about 85 lac cft. earthwork on new river bunds in 1963-64, and draglines did 111, 10 and 100 lac. cft. excavation on silt clearance of irrigation channels in 1963-64, 64-65 and 65-66 respectively. Only big branches or main canals required machines for clearance. Machines are not normally employed on routine silt clearance jobs, but they are at times

Item			Khairpur Irrig. Circle	Rohri Canal Circle	Nara Canal Circle	Western Sind Circle	Total of Sukkur Canals system
1. Mileage of channels		..	1023.86	2283.88	1641.38	2231.37	7180.49
2. Mileage of river bunds		..	58.15	199.55	..	359.68	617.38
3. Earthwork on	1963-64	..	106.2	NA	280.6	513.0	Average Annual
strengthening	64-65	..	130.7	NA	417.0	374.0	=980 lac cft.
banks of channels (lac. cft.)	65-66	..	43.5	50	NA	579.0	
4. Earthwork of silt	1963-64	..	34.5	NA	512.0	529.0	Average Annual
clearance of	64-65	..	41.5	NA	536.9	688.0	=1350 lac cft.
channels (lac. cft.)	65-66	..	69.8	1.75	NA	749.0	
5. Earthwork on	1963-64	..	106.0	NA	..	92.0	Average Annual
river embankments	1964-65	..	78.9	NA	..	Nil	=450 lac. cft.
(lac. cft.)	1965-66	..	160.0	275.0	..	100.0	
					Total	..	=2780 lac. cft.

Note : NA stands for Not Available.

preferred for strengthening river embankments or for constructing new loop bunds or spurs.

It will be of interest at this stage to look closely at the earthwork done in some administrative units. In Nara Canal Circle there are no river bunds. Large quantities of silt have been cleared from channel beds. This circle controls the entire irrigation from the Eastern Nara Canal beyond Jamrao weir. Slopes are very flat and of the order of 1 in 15000 to 1 in 20000, and tail reaches of channels are periodically excavated. On an average, 520 lac cft. of silt is excavated annually by manual labour. This figure excludes the enormous quantities of silt cleared from the agriculturist owned water courses by the shareholders themselves on self-help basis. Work on strengthening of channel banks was 350 lac cft. annually, it was continued all the year round and no local casual labour was employed or was available for the purpose. Donkey labour or basket labour for the bank work was all professional and at times it was migratory in nature, especially on big works. On silt clearance operations, almost half of the total quantity was done through local hari or casual labour in a period of three weeks of December closure. The rest of the quantity was also with sizeable assistance from the local tillers of the soil, but was spread over about 3-month period of low winter supplies when channels ran in rotation. The whole work was measured and paid through approved Government contractors. The casual labour worked only on the channels which fed them, and that too with the blessings of the big landholders. This labour did mostly throw or Kassi work, and occasionally used scrapers powered by a pair of bullocks (locally known as 'keins'). It would, however, never do basket earthwork. This labour would also not move out to work on other channels as mercenaries, and would also be not available for any other type of earthwork even on the same channels. They could however be summoned on a voluntary basis in case of such emergencies as breaches in feeding channels. Judged over a period of 3 weeks, 260 lac cft. silt clearance would put the working potential of the casual labour at 300 lac cft. per month of 25 working days.

In Rohri Canal Circle, about 325 lac cft. earthwork had been done on old or new embankments in one year. Earthmoving machinery was assigned about 20 percent of this quantity, mainly on a new loop dyke. For the rest, donkey and basket labour was employed. Some of this labour was of a migratory nature, but there was no casual labour whatsoever. On silt clearance of channels, this particular year a main branch was also handled. Due to great lift involved, draglines were employed to do about 75 lac cft., out of a total of 125 lac cft. On the whole, the silt quantity cleared in the whole circle by the casual hari labour within a period of 3 weeks was 100 lac cft. This gave a working potential of 120 lac cft. per month.

In Western Sind Circle, by far the heaviest quantities of earth have been required for strengthening channel banks, the average being 500 lac cft. The entire earthwork has been done by manual labour, local and migratory. On river bunds, machines were needed in 1963-64 for 85 lac cft. on a new bund. On silt clearance, machines did on an average 15 percent of the total, and they worked only on main branches. Casual agriculturist labour did bulk of the quantities as in case of Nara Circle.

Concurrently, large quantities of earthwork are being done annually at other new and old irrigation works under the administrative control of the Agricultural Development Corporation. This Corporation has a sizeable fleet of earthmoving machinery and employs it as a first preference for executing such jobs as excavating new channels or strengthening of embankments. Only for small jobs, professional migratory donkey or basket labour is engaged. WAPDA has also undertaken construction of disposal channels, and branch and main drains in the Khairpur Salinity Control Project. Except for small disposal channels from individual tubewells where ditchers miserably failed, machines are being employed to do the entire excavation, rehandling and rough dressing. WAPDA is direct administrative in charge of MPO, the Machinery Pool Organisation owning the bulk of earthmoving machinery in West Pakistan and has no difficulty in deploying a variety of the latest machines to do a job, even though manual labour be available.

Labour and Earthwork Potential in the Sind Area

Like any other area in Pakistan, earthwork and labour potential of the Sind area can be divided into:

1. Local professional labour.
2. Local casual labour.
3. Available migratory labour.
4. Earth-moving machines.

Each type will be considered at length to highlight its special features.

1. Local Professional Labour

(*a*) *Basket Labour.*—The Sind area does not claim any sizeable organised labour force, professional or casual. The local haris who are mostly Baluchis consider it highly derogatory to carry a headload, and even to work as mercenaries, except as tenants on land. Basketeers are available in small scattered groups, primarily in the lower Sind areas of Mirpurkhas, adjacent to the Thar desert. They belong mostly to Kolhi and Meghwar tribes, some of whom work also as haris. Many of them move in February-March from the generally dry Thar desert to the more populated irrigated areas to seek subsistence by doing

mostly earthwork. They get back to their homes as monsoons bring the life giving showers to grow some food and fodder for themselves and their cattle. The local migratory labour may be available for 4 to 5 months in a normal year, and for greater periods if the drought is severe. The professionals can also claim some labour from the Bhil tribe, the settlers from the Punjab and Bahawalpur areas, and the Katchi Muslims. Some locally settled Ode tribes may also be counted upon. Much of this labour may be available to work throughout the year, specially in the districts of Mirpurkhas, Sanghar and Nawabshah.

A pair of local basketeers would do about 150 to 300 cft. per day, with a lead within 100 cft. A fair guess at the available strength in the Sind area is 1000 No., and their progress may be put at 1.5 to 2.0 lac cft. per day, and 450 lac cft. per annum.

(*b*) *Local Pathan Donkey labour.*—Some pathan contractors, along with their labour force have settled permanently in the Sind area, and they generally take care of all medium size works being executed round the year in this tract. There are about 4 to 5 such contractors in Lower and Upper Sind combined, and their labour strength may be put at 200 to 300 belchas. Each belcha with 3 to 5 donkeys is capable of doing 1500 cft. earthwork per day on repair jobs and 2000 cft. per day on new job with a reasonable lead up to 400 feet. This labour is extensively employed on raising and strengthening of existing channel banks or river embankments, and is also capable of doing earthwork on new flood bunds. The optimum daily progress may be put at 3 lac cft. and it is available all the year round. This labour moves about in the Sind tract to execute the works as they arise.

(*c*) *Settled Ode labour.*—Ode tribe is generally migratory, but some of them have permanently settled and work either on land or as earthwork labour force. Their women are specially good at carriage of materials on a major construction work. They are not good at basket work, but use smaller size donkeys to carry earth. Instead of a belcha, they use kudal to dig. One kudal with 3 donkeys may yield a daily progress of 500 to 800 cft. Total available local force may be put at 300 kudal or 1000 donkeys. If the harvest is good, some of this labour force may not be available throughout the year. The optimum daily progress may be put at 2 lac cft.

The aggregate earthwork potential of local professional labour force may be put at 100 to 150 lac cft. per month, and it is generally capable of handling the routine earthwork load of the tract. This labour generally does not move towards the north, and may not be exploited at optimum capacity if the earthmoving machines catch the fancy of the administration.

2. Local Casual Labour

By casual labour is understood the huge agriculturist labour force whose primary engagement is tilling the soil and growing of crops. Agriculture, as it is practised in West Pakistan, has its slack work periods, and it is possible for this huge labour potential to perform, for some time, jobs other than those directly connected with the land. Spare hands in slack season may take jobs in the industry as unskilled labour, or they may work with the local contractors for throw earthwork or basket earthwork.

The working calendar of a hari in the Sind tract may be started from the Kharif sowings. In dry crop areas, sowing of cotton keeps him extremely busy from mid-March to early May in the Lower Sind, and from mid-April to third week of May in the Upper Sind. Nawabshah district on the left bank is the rough dividing line between Upper and Lower Sind areas. In the rice tract which is formed by the Larkana district, major part of Dadu district and a good part of Sukkur district, the hari gets busy after April. No casual labour can be free during 2½ months of the Kharif sowings. Then follows a comparatively slack period of about 2 months. After this, picking of cotton, harvesting of rice and preparing lands for Rabi keep him pretty busy and he may even be forced to borrow hands in the months of August through October. This is then succeeded by a comparatively slack period of 1½ to 2 months, coinciding almost with the period of annual canal closure in the tract. He again gets busy with sugarcane crop, and Rabi sowings. In the rice tract, mostly on the right bank, Rabi is generally Dobari as no irrigation water is to be applied. Here the labour has greater number of slack months. It should, however, be clearly understood that in busy periods, the hari force is insufficient even for the planned agricultural needs and cannot be expected to undertake any casual work. The steady influx of cultivators from the north is a good pointer towards the deficiency in the agricultural labour. But in slack period of about 3 to 4 months in a year, a substantial part of underworked labour on land offers lot of scope for exploitation to augment the national resources and to raise the low income level.

Haris in the Sind tract are mostly Baluchis, and rich or poor, they wear a 'patka' on their head as a mark of dignity and pride. No man wearing a 'patka' would ever agree to carry a head load, much less a basket full of earth. Even though the standard of living in rural areas is miserably low, much lower than in the Punjab or Bahawalpur areas, fatalistic attitude on life sustains their sense of pride of the race. They would rather starve and lie low than work part time on some job to augment their meagre incomes. Their needs are cut down to primitive levels and they continue to groan under debts and under a feudalistic system. Lack of education and lack of proper social training

continues to seriously retard their growth and their vision on life is warped. The dignity of labour as it is understood in the world today is lost on them.

This immense labour force clears and maintains on a voluntary basis thousands and thousands of miles of the water-courses feeding their lands, but is never available to the industry or the Government as an organised, dependable labour force even in the most slack periods. For the hari those are the days of relaxation and rest and he has never felt any craze for earning more to enjoy better present-day amenities. Without this realisation, which is seizing the northern parts of West Pakistan, no persuasion can be strong enough to awaken him out of his slumber under the dope of fatalism.

The haris still stick to the old traditions of maintaining inundation canals on self-help basis or on the behest of the big zamindars. During the annual winter canal closure, they come out in large numbers with their spades, their bullocks and scrapers (but never a basket) to dig up any silting irrigation channel. They are generally mobilised in large groups by a local dignitary or a zamindar who may become a contractor for getting payment from government for the work done. At occasions, a local approved contractor may act as a representative of this casual labour froce. This labour prefers not to be paid in cash, but to be fed nicely while on the job and to be well looked after. It is looked upon as a pleasant change from the drudgery of agriculture where food is also scarce. Channels are cleared by them, strictly within their local beats, mostly by throw work (Kassi work) and to a limited extent by 'keins'. They do vast quantities of earthwork during the short period of two or three weeks, and it would have been impossible for the professional labour alone to handle the emergency. Professional labour force is primarily determined by the sustained work load and is not given to sporadic jumps. Import of labour from distant places cannot be undertaken for such short-lived operations.

This labour force is also available, mostly on voluntary basis, in case of such grave emergencies as breaches in channels or river attack in floods. It requires great ingenuity to get the best out of this labour as they refuse to be termed or treated as mercenaries. Whatever the urges, it is clear that a vast labour reserve is available, and has only to be tapped properly for optimum exploitation. If they can be persuaded or convinced to work in slack periods, it will not only raise their own standard of living, but also infuse a new life in the nation. The settlers from the north have brought a different social order with them, and they are having a modifying influence. Education and a changing social and political order is expected to exert its influence sooner or later.

3. Available migratory labour

Starting from the first major project of Sukkur Barrage, it has always been necessary to import migratory labour from outside. The reasons must be well understood after the discussion on local casual labour.

(*a*) Professional basket labour capable of doing earthwork up to about 100 feet generally comes from Bahawalpur, and Muzaffargarh district of the Punjab. For works involving less than 5 lac cft. of earth local labour is generally sufficient, but for bigger works, the local ranks have to be reinforced. These professionals generally work in rotation. While one group is on the job for three to four weeks, the other would stay back in the village to look after other needs of the community. The groups will change over then to keep a high tempo of work. Their progress is pretty good and varies from 300 to 500 cft. per day per pair of baskets.

(*b*) *Brohi labour.*—Brohi tribe of the Baluchis are settled in the Khirtar ranges on the west. They stay in their homes in summer but move down into Sind plains in winter to work. They have an active working period of 4 to 5 months from November to February/March. They do not do much work as basket labour or a donkey force, but essentially constitute the 'kein' labour, well suited for silt clearance of small channels or strengthening of banks within 50 to 60 feet lead. One pair of animals with a scraper or one 'kein' is capable of giving a daily progress of 300 to 400 cft. if the earth is soft. This labour is unsuitable for hard earth or wet, plastic clay. It is generally engaged by the local contractors and goes to improve the working capacity of the local professional labour in winter.

(*c*) *Professional Pathan donkey labour.*—Migratory Pathan donkey labour would get attracted if any work of a respectable size is available. Such a work may be roughly considered as involving more than 25 lac cft. earth, not below sub-soil water level, with a reasonable lead up to 400 to 500 feet. This labour comes from the north as well as from Quetta and Balùchistan in the west. Quetta labour strength may be roughly put at 200 to 400 belchas, each capable of doing 1500 to 2000 cft. per day. This labour would prefer to work in the Sind which is nearer their home, rather than move farther to the north, even if the rates may be comparatively low. It is generally attracted by the local Pathan contractors to supplement their working capacity in winter. It moves back home as the sun starts growing warmer in March/April.

Local migratory labour from the Tharparker area is generally available for four to five months in a year only in the Lower Sind tract, and it would seldom travel far. The migratory labour of Brohi Baluchis and Pathan labour from Quetta would also prefer not to cover long distances to the north. The local professional basketeers do not travel much beyond their homes. These

labour forces are not normally fully exploited and have available earthwork potential. The long distance migratory Pathan labour from the north, and basket labour of Bahawalpur and Muzaffargarh is generally busy on one project or another, and does not have much reserve capacity. Their ranks can be strengthened if more inducements and facilities are available, and it is not correct to presume that their potential is completely frozen. The casual agriculturist labour has lot of available capacity for 3 to 4 months in a year.

It has never been considered problematic to attract sufficient manual (basket and donkey) labour on any work in Sind. Lot of potential remains under-worked or undeveloped, and the optimum exploitation level is achieved only when pressure of work mounts. If the works are properly planned, and if authority is properly delegated, it is possible to meet most of the earthwork needs of this tract without any machinery.

4. Available Earth-Moving Machinery

Earth-moving machinery in West Pakistan under the control of the Irrigation Department, the Agricultural Development Corporation and the WAPDA was pooled and Machinery Pool Organisation was created with the blessings of reputed foreign consultants. The MPO was under the direct administrative control of WAPDA and administrative rivalries seriously limited the utility of the organisation. Agricultural Development Corporation quickly got out of the pool and established its independent earthmoving unit. It now imports and operates its own machines. These machines may also be available to do some work for the Irrigation Department in a contiguous area, but the scale of priorities generally tips in favour of the administering agency. These machines are doing bulk of earthwork on new channels in the Guddu Barrage Project and on a number of channels and embankments in the Ghulam Mohammad Barrage area. These machines have to be kept busy as a first priority, and only then manual labour is engaged to do the balance. There are no cost considerations to decide the issue.

The Irrigation Department is still in the Machinery Pool though it has been desperately trying to get out of it for a number of reasons. WAPDA has always had prior claim over the machinery in the pool, though the department shared the cost of imports. In a way this may be considered a blessing in disguise. The department's resources of machinery are limited, and it has been forced to explore and exploit fully the available local labour. Earthwork on river embankments, generally assigned to machines, has been done through donkey labour. It is only in under-water work or in emergencies that the department had to borrow machinery from MPO. The rapidly mounting rental and other operational charges of MPO machinery, and the administrative

difficulties in getting the machines in time have gone a long way to rehabilitate the indigenous labour force in the Sind tract.

As bulk of the machinery is in the pool and can be deployed on any project in West Pakistan and as fresh procurements are controlled by foreign aids and loans, it is out of place here to assess its potential. The rate structure of earthwork done through machines will however be examined.

Rates and Rate Structure

The available manpower for executing earthwork on existing and new irrigation works has been reviewed. The limitations have also been examined. Except for earthwork under-water or requiring long hauls, or in unanticipated emergencies, it is always possible to exploit the indigenous resources to the full for a successful completion of jobs. Earthwork through machines is considerably more expensive than through manual labour and should not normally be accepted by any commercial organisation in West Pakistan. A steady shift is noticeable towards more mechanization specially under the influence of the vast Indus Basin Replacement Plan projects. Before considering the administrative aspects of the problems, it will be appropriate to review the earthwork rates and the rate structure.

(*a*) *Earthwork done manually* (*Kassi work, basket work, donkey work*).— Earthwork rates have been unified for all government and semi-government departments by the Standing Rates Committee of the Government of West Pakistan. These rates were arrived at by making rate analysis, at prevalent labour rates, for the different items involved in earthwork. The committee further laid down that administrative agencies can exceed these rates to a maximum of 20% to take care of local market fluctuations, but for any more excesses, prior approval of the Committee was made obligatory. Prior to enforcement of the unified schedule, each department had its own schedule of rates and would control its own rates based on tenders, without going to the Finance Department.

According to this unified Schedule, a thousand cubic feet of kassiwork (throw earthwork) would cost Rs. 13.00 (undressed), earthwork up to 50 feet lead is Rs. 18.00, with Rs. 0.50 for every extra 50 feet lead. Lift is converted into lead by a formula, dressing is paid at Rs. 1.50 to Rs. 2.00, compaction at Rs. 6.00, watering and rolling at Rs. 4.00. Allowing the maximum permissible leeway of 20% above, the overall rate per thousand cft. of silt clearing a channel comes roughly to Rs. 18.00, of strengthening channel banks as Rs. 22.00, and of earthwork on river bunds as Rs. 28 to 35.00. These are the best rates which can be offered to a contractor who is also expected to make a respectable profit out of it, after meeting all the incidental and accidental expenses. This mode

of execution of work involves only indigenous resources, and all expenditure is in local currency. As labour force is always considered as a national source, its exploitation and the expenses involved therein flow into a complex economic circle, each factor benefiting another. Economists consider indigenous labour as "free" and would take a different view of it in overall planning of country's development. If the labour force is not fully exploited, a welfare state has to support it otherwise by incurring expenses from other resources.

(*b*) *Earthwork done through Machines.*—Contrary to rigid controls on rates for earthwork through manual labour, there is no semblance of any check on the machine rates. Government and its agencies own most of the earth-moving machinery, and any earthwork rates are readily accepted, both by the administration as well as the audit, without any qualms. Behind this complacency is the feeling that whatever money is paid by one government agency, it becomes the income of another agency in the same government. The expenditure is considered more or less like a transfer entry, and no money is presumed to move out of government exchequer. This feeling is highly fallacious and is indirectly responsible for most of the ills. The rates of the machine work have been constantly moving up, quite out of proportion to rise in rates by manual labour, without raising any brows in the higher echelons of administration and finance.

When Sukkur Barrage project was constructed in 1923-32 rate for draglines was Rs. 7 per %o cft. In 1949-51, on the Ghulam Mohammad Barrage project, the rate per °/₀, cft. was Rs. 12/- for the draglines and Rs. 15/- for the tractors. The rates steadily moved up, and when Guddu Barrage project was started by the Irrigation Department after 1955, the rates stood at Rs. 25/- for the draglines and Rs. 30/- for the dozers/tractors for undressed earthwork. By 1959, the rates moved up to Rs. 30/- and Rs. 35/- respectively. In 1965, the ADC earthmoving machines working on the Pat Feeder have a rate of Rs. 35/- to Rs. 40/- for the draglines, and Rs. 45/- for the tractors for every 1000 cft. of undressed earthwork. Irrigation Department, with its own machinery, gets a rate of about Rs. 35/- for the draglines. Compared to this, manual labour at the same sites is offered Rs. 25/- to Rs. 30/- for dressed earthwork.

The Machinery Pool Organisation has, however, a different tale. It was established in 1959-60, and took over control of bulk of the earthmoving machinery. It had a vast administrative machinery, armoured with vast powers and initially its broad organisational lines were determined by Morrison and Knudsen a firm of foreign consultants. It developed its own system of working out machinery rentals and machinery operation charges. The new rate structure was said to be in line with certain international practices, but it created quite a scare in the borrowing agencies. The agencies preferred to

give the job to MPO rather than rent the machines and do it themselves. Agricultural Development Corporation quickly moved out of the pool, leaving the Irrigation Department and WAPDA. Earthwork rates for draglines varied from Rs. 35/- to Rs. 40/-, and tractors had Rs. 40/- to Rs. 45/-. On the Pat feeder the rates sometimes touched Rs. 60/-. In 1965, MPO gave a rate of Rs. 72/- for draglines and Rs. 116/- for tractors on the river training works at Guddu while manual labour was paid at Rs. 32/-. On the Desert Feeder, while the manual labour was paid at Rs. 31/-, the MPO draglines claimed Rs. 61/-. In 1964 at Sukkur, MPO machines did some work on a canal diversion at the rate of Rs. 37/- for draglines and Rs. 53/- for the tractors, while manual labour was paid at Rs. 24/-. In 1965-66, on Indus Road Bridge at Thatta, MPO machines have a rate for undressed earthwork of Rs. 35/- for draglines and Rs. 50/- for the tractors. In another fresh project, the Khairpur Salinity Control Project, where MPO is a contractor for WAPDA, earthwork rate for small and big drains with rough dressing comes to Rs. 50/- to Rs. 80/-. A tendered rate of Rs. 44/- by a local contractor for the completed section was not accepted. MPO is still finding it difficult to stick to this rate as machinery rentals are very high. It is now importing 10 small $\frac{1}{2}$ to $\frac{3}{4}$ cubic yard draglines with 8 D-4 dozers to do the work in the old conventional way, when rentals were not charged and over heads were low. On Taunsa-Panjnad link, another big project close to the Sind tract, MPO has quoted a rate of Rs. 74 to Rs. 100/-, while some of the foreign contractors quoted Rs. 45/- to Rs. 50/-. Contractor's ultimate paid rates rise due to certain built-in clauses and reservations.

It is not the intention to criticise here the administration in MPO or any other Machine operating organisation. It is a review of the current rates as they affect the projects. There is something seriously wrong with our operation of machinery, and with our concept of the rate structure. For getting the merits or limitation of a certain mode of operation, it must be acknowledged that the money which is paid by one agency to another Machine Operating agency in the government, ultimately moves out of the government exchequer. The machine rates are generally based on no-profit, no-loss basis, and instead of the field civil agency, the machine operating agency becomes the ultimate spender of the total money paid. The irrigation projects are invariably prepared and operated as commercial enterprises, and their productivity aspect and cost benefit ratios are elaborately and meticulously worked out. No commercial organisation can divorce itself of the ultimate expenditure on initial construction and subsequent operation and maintenance budget. Yet surprisingly the earthmoving machines always get a soft corner, and while higher rates for earthwork through manual labour come under rigorous check and

control, the machines get away with twice or three times the accepted levels.

Taking a broader outlook, money paid to a manual labour indigenous contractor is all in rupees. About seventy to ninety percent goes directly to the labour, and helps them get a better living and an opportunity for healthy employment. The contractor's savings vary from five to thirty percent and like any other industry, it helps raising the nation's prosperity and income levels. In any welfare state, it is otherwise the primary responsibility of the government to offer and create healthy employment for its citizens, and there can be no better way of doing so than engaging maximum amount of available labour on nation-building projects. Money remains in circulation within the country, and we may look upon it as the cost of exploitation of indigenous national resources. In the nation's overall budget, labour is considered as free and without cost, the same way as we look upon reserves of natural gases and other ores.

The money spent through an earthmoving machine operating agency needs a closer look. The agency is a government-controlled administrative unit, and if it works on no-profit, no-loss basis, as is usually the case with manufacture accounts, it only means that the government is spending all the money. If the agency works as a contractor, and declares to have made some 'profit' out of a government assignment, it only means that part of the money returns directly to the government as 'savings' and the net money cost to the government is less than that billed in the project. Out of total money billed to a machine work, part of it goes to meet the overheads. The overheads are in rupees and take care of the administrative costs and other indirect charges. In a way, they go towards providing employment to the local population. In case advisory services of some foreign consultants are also acquired, part of the overheads may be in foreign exchange, and would flow out of the country. Balance of the charges cover the abatement of capital cost or depreciation charges, interest on the capital, cost of spare parts, cost of oils and lubricants, and labour charges of maintenance, operation, storage and direct field control. Labour charges are almost entirely in rupees and provide employment to a limited local population of skilled, semi-skilled and some unskilled workers. A part of the total cost on spares and oils is also in rupees to cover the local freight, the local duties and taxes, and the local profits. Interest on capital will be in foreign exchange if the purchase had been financed through a foreign loan, as is mostly the case these days. All other charges of initial capital cost of machinery (or depreciation charges), and of spares and lubricants are in foreign exchange, and they all flow out of the country. Pakistan is at present not manufacturing any earthmoving machines or their spares or fuels, and has to spend its valuable gold reserves to procure them. It is a fair guess to presume

that sixty percent of the total expenses on earthmoving machinery bill ultimately gets converted into foreign exchange, leaving forty percent in our local currency. In case earthwork is assigned to foreign contractors who bring their own machines, the bulk of payment for work done is in dollars or pound sterling. If the huge Indus Basin Works may be taken as a reference, the average earthwork rates for undressed work range from Rs. 40/- to Rs. 65/- per %o cft. Bulk of this work is with foreign contractors, and foreign exchange component may be taken at 65 to 70 percent.

It is not correct to compare the earthwork rates of machinery and manual labour at their face rupee values in view of the analysis made in the foregoing paragraphs. The foreign exchange component should be accepted at its current market value, indicated by the bonus voucher index. This represents the correct commercial value of dollars and pound sterling and would represent the correct cost. Average representative machine rate per %o cft. earthwork undressed may be taken at Rs. 50/- and with 60 percent foreign exchange component and 150 percent bonus voucher rate, its real value rises to Rs. 95/-. This is the rate which for a similar work should be compared with the average manual labour rates of Rs. 25/- to Rs. 30/-. In a country like Pakistan which has large exploitable reserves of labour resources and which has to import all earthmoving machinery with required spares and oils, the administration and finance has to reorient its attitude towards mechanized earthwork. Not only does the machinery tax the national gold reserves, it also throws idle a substantial part of unskilled professional and casual labour. The damage is two fold.

Reasons for shift towards Mechanisation

It will be appropriate at this stage to investigate some of the causes which have been increasing our leanings towards earthmoving machinery over the past few years, specially the last then years. The main causes may be listed as follows.

1. Increased Pace of Development

Pakistan has entered its third five-year development plan and the tempo of work has vastly quickened. Large quantities of professional labour have been absorbed, and it has been considered necessary to supplement the national resources through imported machinery. For many reasons, the local and migratory professional labour has not increased its strength to such an extent as to handle all the works.

2. Difficult Working Conditions

Many of the projects had to be executed under difficult field conditions. Earthwork under sub-soil water level, in very hard reaches, and where water supply and fodder was scarce could be more reasonably handled through machines.

3. Impact of Indus Basin Treaty Works

Indus Basin Treaty Works have to be executed at a high pitch. The time schedule is specified and the magnitude of works is unprecedented. The progress required to finish them in time made extensive use of machines necessary and had a great impact on all works in West Pakistan. It is not the intention here to defend the present mode of executing these works as considerable economy could be effected even if we had to import all the needed machinery. It has only to be stressed that the indigenous labour resources needed considerable reinforcement. The progress achieved on the treaty works considerably influenced the thinking of the administration on the role of machinery. At many occasions, the unusual nature of this immense project was lost sight of, and attempts were made to transplant the ideas all round.

4. Impact of foreign training

Many of our top talent has had advanced training courses in America, Canada or the continent of Europe where working conditions are vastly different. These countries are industrially advanced, labour is expensive and well occupied and earthmoving machines are manufactured locally in the countries. The foreign trainees carry deep impressions of 'gigantic machines moving rapidly vast masses of earth' and have considerably modified our outlook on earthwork through local labour. Akbar Allahabadi has quite satirically summed up in his famous couplet the deep influence of education and training on the human mind.

5. Growth of Professional Administrators

Not many years back, the engineers in Pakistan administered their own affairs even at the highest policy-making levels and had controlling influence on development planning as well as execution. Quite recently there has grown up a class of professional administrators and policy-makers in the Government. Many of these officers are young and enthusiastic, have foreign degrees or foreign training, but lack the insight of an experienced engineer. They lack first-hand knowledge of indigenous labour resources and the technique of their optimum exploitation, but since they sit on the policy-making panels, their decisions carry all the weight. They derive lot of support from such acade-

micians as doctors economists and financial wizards. A technical secretary of today, who previously controlled the department's overall planning and policies and was well grounded in his lifelong first-hand experience, finds himself helplessly pitched against such super administrative bodies as the Development Working Parties, the Planning Commission, the development councils, and the finance boards, where professional administrators have almost complete control. The influence of foreign training is much more pronounced in their case as they possibly cannot have reorienting local experience.

6. Lack of proper work planning

Many of our routine works can be so planned that a uniform lower progress over a longer working period may meet all the requirements of the job. Such a progress could be possible through local indigenous professional labour, suitably strengthened with imported labour if necessary. Bulk of the work on excavation of irrigation channels and drains, maintenance of existing irrigation channels and flood dykes, and usual construction of new flood bunds or river training work falls under this category. It is however experienced that at many an occasion the works, though long foreseen, are generally rushed and whatever the reasons may be, it creates a sense of panic in the field officers. Since labour procurement has its own headaches, the easiest recourse is to fall back upon earthmoving machinery, specially when the highest rates would be accepted by the audit. The assignment of a part or whole of the earthwork to machines also divides the responsibility of the civil engineer and offers him a welcome relief. At other occasions, earthwork on a project may not be critically planned, and an unnecessary sense of emergency may exist. Such examples will not be few. A better phasing may considerably modify the required daily progress.

7. Financial and Administrative Controls

Planning of works is no longer possible by engineers in isolation. There is a growing lack of trust in the field agencies and the administration has imposed a number of checks and super controls, though they are nicely coated with fancy titles. A variety of monitoring agencies have been created. Fund distribution is done, beyond the Secretary's level, by individual major works, with no powers of reappropriations. The grants may be varied at any time of the year, and the administrative departments have to do a fine bargaining job with the super administrators. Decisions on many schemes take long, and sometimes come towards the later part of a financial year. The field agencies are not free to accept the best advertised tendered rates if they infringe the controls imposed by the Rates Committee. Reference of cases to the Finance

Department naturally takes lot of time, and seriously affects the decision-making power of the administrative department. This inevitably leads to sketchy planning and control over field works, and greatly restricted freedom of action. Whatever good may be flowing out of these checks, the damping effect on the local labour exploitation is quite pronounced. Though slightly higher rates may attract enough manual labour, the sanctions take long in coming and the field agencies face rather a difficult position. Machines provide the ready answer, though their very high rates may even lead to over all increase in project costs.

8. Rivalries between parallel agencies

In the water sector, irrigation department, the WAPDA, the ADC and recently the Land and Water Development Board have many similar responsibilities, which are at occasions overlapping. This may create either a sense of healthy competition or of professional rivalry. At many an occasion, the over all planning gets confused and the sense of priorities is lost. This also hampers field planning and control of works, optimum exploitation of available machinery and proper phasing of projects. Since machinery is best given to show spurts of progress, and can also be kept going even in the absence of formal administrative and technical clearances, the organisations tend to depend the most on it, mostly at the cost of proper exploitation of labour.

9. Existing Social Structure

Agriculturist labour in West Pakistan is not fully employed on land throughout the year, and it has its slack periods. In the Sind tract, in dry farming areas this period ranges from 3 to 4 months, and in rice-growing tract from 5 to 6 months. This vast labour force has generally a low per capita income and stands desperately in need of a supplement to their earning power. In Sind it has been seen that they are capable of doing vast quantities of earthwork on silt clearance of channels during winter canal closures. Yet this labour is extremely resistant to work as organised labour force at any other time. Their sense of racial pride, fatalistic attitude on life, lack of education and feudalistic land system stand in the way of their earning a better living. The absence of casual labour naturally makes the dependence on machines greater.

Scope of Manual Labour for Earthwork on Irrigation Project in Sind Area

The case of manual labour in preference to machinery has been discussed at some length. The machines are vastly more expensive than manual labour and should never be employed unless absolutely essential. In the overall analysis, it may be possible even to add loss of revenue if completion of a

project is delayed without machines. In case of breaches or other emergencies where indirect losses due to any delay may be high, it may be expedient to supplement the labour force with machinery. For works below ground water level, it may be more economical to use machines. For long hauls, the position has to be critically examined. But even in difficult cases, it may be judicious to have a balance between men and machines, as men are vastly more economical. Machines should be accepted as a last resort, and not as a matter of course, as a supplement and not as a substitute. Behind the decision should be the active realisation that machines need solid gold wheels for running.

In the Sind tract, the local professional labour has an optimum potential of 150 to 200 lac cft. per month. Annual normal needs of the Sukkur Irrigation system for channel banks and river embankments may be taken at 1000 to 1500 lac. cft. Based on pro rata basis, the total such needs of Guddu, Sukkur and Ghulam Mohammad Barrage Projects Irrigation works may be taken at 2000 to 2500 lac cft. If these works are suitably planned and well phased, the local labour, with a little reinforcement from Quetta labour can cope with the needs. If the needs of other departments like roads and railways are taken into account, reinforcement of professional labour from local casual labour may go a long way towards reducing the dependence on machinery. The machines may be confined only to the most tricky jobs not otherwise feasible through normal labour.

Regarding silt clearance of channels, the casual labour in the Sukkur Irrigation tract has shown a tremendous potential of 500 to 700 lac cft. per month for throw earthwork. Making liberal allowance for change over to basket work and allowing only 3 active months a year, we get an annual potential of about 1000 lac cft. The figure may be increased to 1500 lac cft. for the whole irrigated Sind tract. This potential is at present lying dormant and is a standing challenge to the administrative and social forces.

In such isolated pockets as the Nagar Parkar Valley of the Tharparker area, full exploitation of available surface and ground water resources offer a challenge to the engineers. A system of small dams, spill weirs, storage tanks and irrigation channels will be necessary. Such works can be best done through local Kohli and Meghwar labour as there are no alternative means of their employment. Use of earthmoving machinery at such a site should be viewed with extreme caution. Carriage, operation and maintenance of the machines in such isolated pockets would be highly difficult and uneconomical. The projects can be given considered priorites and so laid out that there is no sense of panic. The valley population will be twice benefited—firstly when the works are executed by improvement in their earning power, and secondly after the works have been completed by the increase in their productive capacity.

CONCLUSION

Large quantities of earthwork are required in Sind tract to keep a complex system of irrigation channels and flood embankments operating at a high degree of efficiency. Occasionally new works also become necessary. This tract has no organised casual labour force and a limited professional labour strength. If the works are properly planned and phased and if proper authority, both financial and administrative, is delegated at all levels, it is possible to do away with machines almost completely in this region. The rate structure of machine works needs a critical appraisal. The dormant casual agriculturist labour offers a great challenge to the nation. The role of manual labour, professional and casual, can be vastly improved by a more realistic look at the rate structure, delegation of proper authority, intensive planning, effective co-ordination between various field agencies and social reforms.

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