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GROUP B

Chairman: L. K. ELMHIRST
Dartington Hall,
U.K.

Rapporteur: ALI ASGHAR KHAN
Lahore,
West Pakistan

Irrigation and Settlement Schemes

Y. LOWE
Institute for Farm Income Research, Israel

To deal with irrigation and settlement schemes in general seems to be a task which can hardly be achieved within the short space allowed for this paper. Therefore, I wish to concentrate on the special conditions in Israel with which I am more familiar and try to draw some general conclusions from our experience in comparison with other countries.

The State of Israel comprises only about 20,000 sq. km. (7·8 thousand sq. miles), of which less than one-third is suitable for agricultural cultivation. Accordingly, development schemes may not seem impressive in absolute terms.

To understand the development of irrigation and settlement schemes one has to see them not only in the light of natural conditions but especially under the political, sociological, and general economic circumstances prevailing in Israel.

Just a few remarks about natural conditions. A look at a map reveals that Israel is a long, narrow country bordering the Mediterranean with an axe-shaped easterly extension in the north and a large triangle at the south extending to the Red Sea (the Negev). Its land borders stretch over nearly 1,000 km. It has only one large river, the Jordan, whose sources are at the northern border, and a small one, the Yarkon, flowing into the sea north of Tel Aviv. The average annual rainfall diminishes from 1,000 mm. in the north to 500 mm. in the coastal plain, to 200 mm. in Beer-Sheva, at the northern border of the Negev, and to 30 mm. at Eilat, the southern-most tip. Jerusalem, 800 m. above sea-level, has 500 mm. rain, while at the Dead Sea—the lowest point on earth (−397 m.)—it amounts to only 90 mm.[1]

Rainfall is limited to the winter months, from November to April. The total annual precipitation that replenishes Israel's water resources is estimated at 10,000 million cu. m., of which, according to present estimates, only about 15 per cent can be brought to utilization, one-third from surface flows and two-thirds from underground flows and springs.

[1] See figures in the appended List of References.

Full utilization of all potential water resources entails carrying off surplus water from the north to the south, over distances of 200–300 km. and distributing it in the Negev. Even so, less than half of the potentially irrigable land can be brought under irrigation. Because of the large variations in water flow from winter to summer and from one year to the other, water storage becomes necessary. The only natural reservoir is the Sea of Galilee which lies 212 m. below sea level. Political reasons prevent the taking of Jordan water at the source from where it could be diverted by gravity.

The National Water Plan includes many hundreds of deep wells, huge construction works, involving lifts of 300 m. and canals and pipelines extending over 300 km. Whereas in the past every settlement usually had its own well—or in a few cases access to river water—at present all water resources are under national control and distributed according to planned utilization. Each settlement is allotted an annual and maximum monthly quota. The investigation, planning, and designing of the water utilization is entrusted to 'Tahal' (Water Planning Ltd.) (3) and construction and operation to 'Mekoroth', a Government sponsored company.

At present, 220 million cu. m. of water per year are pumped from the lake, a quantity which will increase to 300 million cu. m. within the next few years. In order to secure a regular supply and to avoid large fluctuations from year to year, especially in drought years, a system of combined utilization of all water sources and underground storage by artificial recharge has been developed. Total investment in the Master Plan will finally reach a sum of around $200 million.

To understand that costs of water are very high, it is sufficient to note that 60 per cent of the total annual water requirements of around 1,400 million cu. m. are supplied over very long distances and another 15 per cent from deep wells. For the National Water Carrier the costs are estimated at the end of the main line at 7·5–11 ag. per cu. m.[1], depending on the rate of interest assumed. To these costs the charges for bringing the water onto the land have to be added which may be 3–5 ag. per cu. m.

In effect, farmers do not in all regions pay the full price but government subsidies amount to less than 30 per cent of total costs of water (11). There also exists an equalization fund to which water-users under favourable conditions contribute, and from which some regions with extremely high costs obtain an additional reduction.

As prices of water in Israel vary greatly from one district to another—roughly between 3 and 12 ag. per cu. m.—the choice of crops has to be carefully considered. As a first guide line one may figure out the increase of costs of production at varying water prices for different types of crops.

The decisive factor is not so much water costs as such, but rather the proportion of water costs to total costs of production, so that a crop requiring little irrigation but not many other inputs is more affected by rising costs of water than another crop requiring much more irrigation, but together with it a large amount of other inputs.

[1] Ag. 1 = I£ 0·01 I£ 1 = $0·33.

Corn, green-fodder, and peanuts are very susceptible to rising prices of water and cannot be economically grown in regions of high water prices. Bananas, sugar-beet, cotton, and citrus are less susceptible; cucumbers, cabbages, and potatoes, and especially tomatoes and apples, still less, so that their costs of production are very little affected by rising prices of water within the limits quoted.

In the light of such considerations it should be noted that out of the total water consumption for irrigation in Israel, 40 per cent serves at present for fruit plantations, mainly citrus, which is the country's most important agricultural export commodity. Another 30 per cent is used for field crops among which cotton and sugar-beet make up the greater part. Green-fodder crops, which formerly comprised 80 per cent of the irrigated field crop area, are today reduced to only 20 per cent. Fifteen per cent of the water-supply still serves for growing carp in artificial fish-ponds, a fact which may seem surprising considering the scarcity of water but is explained by the fact that they are mostly fed by brackish water. Another 10 per cent of the water is used for the production of vegetables and potatoes, and the last 5 per cent for flowers, nurseries, etc.

Before going into details about the economy of irrigation, it is necessary to give a brief outline of the main objectives of the agricultural and general policy of the State.

The State of Israel has the declared aim of serving as the old–new home country for Jews from all over the world. It increased its population from around 900,000 inhabitants (of whom 650,000 Jews) in 1948 to around 2·5 million people, of whom 2·25 million are Jews, in 1965; no less than 1 million people were new immigrants. The occupational structure, consisting as it did abroad mainly of people living on trade or belonging to the free professions, had to be reformed into one, with a reasonably broad basis of agriculture, handicraft, and industry. There was in the beginning a tendency to increase the number of earners in agriculture by settling a rather large proportion of new immigrants on the land. During recent years, however, their percentage decreased from 16·4 per cent in 1955 to 11·7 per cent in 1965, whereas manufacture and construction increased during the same period from 36·6 to 42·4 per cent. The density of the population reaches today, on the average, 128 per sq. km. but is far higher if related to the cultivable area.

The present national income *per capita* is I£3,600 approximately. These few data may show that Israel cannot any more be classified as an under-developed country. It is a high-priced economy with a tendency to substitute capital for rather expensive labour.

Regarding settlement schemes, it has to be pointed out that most of the land is in national ownership and is leased in hereditary leasehold to settlers at a nominal rent. The size of area given to a settler is determined by the Planning Centre so as to ensure an adequate income. There is almost no free trade of land or water rights, both being distributed by the Planning Authority according to the opportunities existing in each region, especially rainfall on the one hand, and the price of water on the other.

None the less, over time there develop large differences in income between farms not only from one region to the other but also within each region and even within each village, because of the differing use actually made of available opportunities.

As irrigated crops, combined with livestock of very high productivity, demand a relatively high labour input per acre, 7–10 acres of irrigated land with an annual water-supply of 15–20,000 cu. m. per family are regarded as sufficient to give an adequate income. In large-scale, mostly collective, farms industrial crops, especially cotton, take up a large part of land and water with a very small investment of labour per acre.

With the introduction of regional water-supply from distant sources the Water Carrier became the life-line of whole new regions for settlement. Special attention was paid to proper planning of all stages of development, starting from the erection of the waterworks and the preparation of the land and ending with the utilization of land and water by new settlers often brought straight from the ship to the land. The services for farming communities are lastly being planned in such a way that 4–5 villages are located around village centres where service facilities of all kinds are set up for 300–400 families. Only the most essential services for daily use remain in each individual settlement, consisting of 60–80 families, whereas all larger facilities, such as schools, cultural centre, dispensary, general store, as well as tractor station, packing house, etc., are located at the village centre. Within the region of some 60–70 settlements a central town is developed where all the major industrial enterprises, as well as commerce, banking, high school, hospital, and the cultural centre are located. In this way a self-contained rather large region is created based on the best possible use of all available resources.

As a brief account of the economic results of agricultural development, the following data may suffice.

The value added (net product) in the agricultural economy (2) rose at constant (1966) prices from I£277 million in 1952 to I£722 million in 1966—a total increase of 161 per cent or an average annual increase of 11·5 per cent. During this period the total cultivated area increased from 3·45 to 4·17 million dunams[1]) or by only 21 per cent. The irrigated area, however, was enlarged from 0·56 to 1·55 million dunams, or by 177 per cent, whereas the unirrigated area even diminished from 2·89 to 2·62 million dunams (by 9 per cent).

Relating the value added to the unit of area, it may be seen that it rose from I£80 per dunam ($107 per acre) in 1952 to I£173 ($230 per acre) in 1966, or by 116 per cent, equalling an average annual increase of 8·3 per cent. This quantitative increase has to be ascribed mainly to the expansion of irrigation.

Calculations by Dan Yaron (5) show that the marginal value of output per cubic metre of water at 1960–1 price relations (which were not much different from present ones) amounted to 10–16 ag. in most regions. This shows that at present price relationships farmers can utilize the water

[1] 1 dunam = 0·1 ha. = 0·25 acre.

profitably if they make the right choice of crops and with proper management. But as water reserves are nearing exhaustion, the question of utilizing new methods, such as desalination, arises time and again. At present costs these seem to exceed by far the marginal value of output.

In trying to draw conclusions from Israel's experience it has to be repeated that the development of irrigation schemes had to take place under most adverse natural and political conditions. As a well-known American farm economist put it—'In other countries water is used for creating power, in Israel it is the opposite'.

Comparing for instance the conditions in Italy or Greece (9), most of their irrigable lands can be irrigated at comparatively low costs. In Italy nearly 90 per cent of the water is supplied by gravity. Distribution is by earth-banked channels, the heavy seepage losses being regarded as unimportant in view of the quantity of water available and the ease of upkeep.

Before deciding on irrigation as a means for increasing agricultural production, the question must be raised whether there is a demand for the additional supply. One should consider not only the possibilities of marketing additional agricultural products in the towns or on the world market, but rather whether it may lead to the improvement of the standard of nutrition of the farmers and their families themselves. This seems to be the case in quite a few developing countries and the considerations are widely different from the ones applying to increasing production of export crops for the world market, of which there may already be a surplus. Under such conditions, costs of irrigation have necessarily to be kept at a minimum. They depend first of all on the selection of proper sites. Where there is a constant flow of water, flat land adjacent to the water source, and little difference in level between land and water, there may be easy and cheap opportunities for introducing irrigation even though in a primitive form. Methods relatively wasteful in labour may be preferable to high-cost installations enabling a saving of labour which may be in abundant supply at least at certain seasons, i.e. where there is hidden unemployment. In many developing countries there exists a vicious circle: insufficient draft-power makes the preparation and cultivation of land such a labour-consuming business that only insufficient areas are being cultivated, thereby hampering the production of a sufficient supply of food, let alone feed for draft animals. With proper financial assistance as a start, one could break this vicious circle by growing a second crop, providing feed for animals and thereby enabling the keeping of draft animals, which in turn would make possible the cultivation of more land, offsetting by far the amount of feed needed for them. I have seen examples, for instance in Madagascar, where fields used for rice growing lie waste for many months after the harvest, water-supply is ample but farmers are idling because of a lack of proper use of land.

In Israel's experience, irrigation affects the potential of agricultural production in the following ways. First, it makes it possible to introduce crops which cannot be grown at all without irrigation, e.g. citrus, bananas, alfalfa, etc. Secondly, it permits change and/or lengthening of crop seasons.

In this way summer vegetables and potatoes can be introduced, and clover gives three times more cuttings than without irrigation. Other fodder crops, such as maize and fodder-beets can serve as a basis for intensive dairying. Thirdly, yields per acre are increased many fold and secured against the rather frequent drought risk; cotton under irrigation in Israel yields around 0·5 tons per acre as against 0·16 tons unirrigated and sugar-beet 23 tons as against 8 tons per acre. Finally, irrigation makes possible double cropping on part of the land, up to eight crops in a five-year rotation. All these possibilities together bring about an enormous increase in agricultural production but—at least under Israel conditions—no reduction in costs of production per product unit but rather the opposite. It is therefore of the utmost importance to determine in advance, by long-range planning and cost/benefit calculations, what to grow and to what extent to use irrigation as a means for developing agricultural production.

One of the frequent set-backs to huge irrigation projects is the time-lag causing insufficient utilization of the potential which may extend over years, as described for instance for northern India (10): 'While more and more headworks and main canals were constructed, the completion of branches and field channels was allowed to lag, with the result that the large investments already made were allowed to yield small returns for want of some additional investment. What is actually necessary is . . . that the scheme itself forms a balanced component of a more comprehensive programme of agricultural development in any region where irrigation is introduced.'

Another important point is that irrigation and drainage have to go hand in hand. Investigations in West Pakistan (10) indicate, however, that irrigation and drainage could hardly become paying propositions as long as the present reliance on peasant hand-labour prevails. The only long-term solution to agricultural improvement lies in a change towards a more capital intensive high-yielding type of farming.

If irrigation and settlement schemes are well planned and co-ordinated, they may lead to a general economic growth resulting in a large increase of demand for consumer goods in general, and of agricultural products in particular. This rising demand enables in turn a more intensive method of farming, justifying higher inputs per unit of area and making fuller use of water even at higher costs possible. In this way a self-perpetuating economic growth is set in motion.

There can be little doubt that there are still vast opportunities in many countries to increase agricultural production in a rational manner by a wider and wiser use of water for irrigation. In many cases the high costs of capital investments impede the initiation of such projects. Yet, in judging the economic feasibility, one should not forget that it may be better to invest money for these purposes than for a programme of armament, which certainly does not fall under the category of economically justified projects.

In the debate about the advisability of development schemes the

economist has not the last say. He can only advise which of any alternatives might be the most advantageous from an economic point of view, or he may warn about the consequences of an uneconomic approach. In the end, the politicians will decide and the economist often has to console himself with the fact that bad results came about because his advice was not heeded. Occasionally a change of conditions may give better than anticipated results, a feature much enjoyed by non-economists.

LIST OF REFERENCES

1. *Statistical Abstract of Israel*, 1966, Central Bureau of Statistics, Jerusalem.
2. *National Income Originating in Israel's Agriculture, 1952–1963*, Jerusalem, 1964 (1964/5 and 1965/6 published in Hebrew).
3. Tahal (Water Planning) Ltd. *Reports*.
4. *Israel Today—Water Development*, Israel Digest, Jerusalem, 1964.
5. Yaron, Dan, 'Demand for Water in the Israeli Agriculture'. *The Economic Quarterly*, vol. xii, nos. 45–6, May 1965 (Hebrew).
6. Weitz, Raanan, *Prospects of Agriculture and Settlement in Israel*. National and University Institute of Agriculture, Rehovoth, 1962 (Hebrew).
7. Lowe, Yehuda—*The Agricultural Economy*, Textbook. Am Oved 1963 (Hebrew).
8. *The Profitability of Various Farm Branches in Israel, 1964/65*, Institute of Farm Income Research, Tel Aviv, 1967.
9. *The Economics of Water Supply and Control*, International Journal of Agrarian Affairs, 1963 vol. iii, no. 4, Greece, Italy.
10. *The Economics of Water Supply and Control*, International Journal of Agrarian Affairs, 1963. vol. iv, no. 1, Pakistan, India.
11. Bank of Israel, *Annual Report*, 1965.

GROUP B. REPORT

DISCUSSION began in the context of Dr. Lowe's reference to investigations in West Pakistan indicating that irrigation and drainage could hardly become paying propositions as long as reliance on peasant hand-labour prevailed. It was pointed out that the word 'irrigation' needed to be defined in relation to source. If the author meant irrigation from surface sources, like canals, the conclusion was not correct as Pakistan had been successfully carrying out canal irrigation programmes for the last eight or nine decades. If development of underground water resources were intended then it was relevant that studies and experience in Pakistan had proved, beyond doubt, that as a result of tube-well irrigation to supplement canal irrigation, four main distinct advantages accrued. Firstly, the cropping intensity went up by 80 to 150 per cent and even 200 per cent; secondly, changes in cropping pattern took place which secured higher incomes for the farmers; thirdly, acre yields were increased by 50–100 per cent; and, fourthly, the production was more stable.

Discussion then developed on the need for close co-ordination between different departments for the balanced development of Settlement Schemes. In an irrigation-cum-settlement project, not only the construction of a barrage or land dam and the digging of canals was involved, but also land development (generally by means of machinery), the selection of suitable

settlers, the provision of agricultural inputs, extension, drinking-water, medical, educational, health, marketing and transport facilities, etc. Consequently, autonomous or semi-autonomous bodies have been set up to ensure balanced development. Experience had shown that in Pakistan in the initial years of settlement, in one of that country's biggest projects, water was available, but settlers were not brought to the land at the right time, and other vital facilities were not provided, and so the water, a very scarce resource, went to waste. In order to avoid such wastage in the future Agricultural Development Corporations were set up so that all the departments concerned were co-ordinated and brought under a single control. This system had worked with success and programmes of development proceeded according to an agreed schedule. The experience of Pakistan might be made use of by other countries which are contemplating irrigation projects, big or small, which involve settlement under similar conditions.

Turning to a different setting, the arguments for and against irrigation and closer settlement schemes in Australia were outlined. These have been complicated by political and other considerations, such as: (i) the national policy of decentralization, (ii) inherent deficiencies in cost/benefit-type project analysis arising from difficulties in defining and evaluating factors, particularly when dealing with multi-purposes water projects, where the aims of power-generation and water conservation do not always coincide, (iii) the scarcity and unreliability of available statistics.

The critics of irrigation in Australia maintain that irrigation development has just evolved without any regard to social costs or profitability. In other words, irrigation projects have not been looked at in the light of alternative investment opportunities. Better irrigation farming techniques were found by trial and error—some of the errors proving costly. Initially, farm sizes were arranged in concentric rings of two-, ten-, and fifty-acre farms. The two-acre and many ten-acre farms were then found to be too small to support a subsistence-level income. Further problems were encountered in the choice of settlers. Though 441 irrigation farm allotments were made in 1912 in the Murrumbidgee Irrigation Area (M.I.A.) alone, little check was made to ascertain from successful applicants whether they had sufficient initial capital (and reserves) and sufficient knowledge of farming to ensure that the potential of the irrigation area was fully utilized. After the First World War, notwithstanding the earlier mistake of expecting inexperienced settlers to succeed in irrigation blocks, the Government decided that many unemployed retired soldiers could be settled as farmers in the M.I.A. History repeated itself and only one-third of the soldier settlers succeeded as farmers. In time, Italian migrants were attracted to the M.I.A. as they were better suited to intensive agriculture than their inexperienced Australian counterparts. Today, 40 per cent of the population in this region is Italian in origin. Though there is no antipathy between Australian and Italian settlers now, some sociologists regard the high proportion of migrant population there as undesirable.

Those in favour of the extension of irrigation projects were of the

opinion that it was largely a waste of time to criticize existing irrigation schemes in the light of present-day knowledge. They concede that mistakes were made, as a result of insufficient knowledge of soil types, of drainage problems, of crops suitable for irrigation as well as of inexperience in irrigation farm management. However, given time the majority of farmers have succeeded.

Owing to the changing pattern of events and the discontinuous growth of technical progress, assessments of future profitability are subject to wide variations over a period. A benefit/cost analysis can give no more valid results than the data and assumptions it incorporates, and for many projects the principal problem will be the scantiness of the data and the scope and lack of realism of the assumptions. The onus is upon the evaluator to be sound and impartial. Benefit/cost analysis presents a further problem in evaluating secondary benefits, non-market goods, and intangibles.

Another problem is that large dams and irrigation waterways in Australia are more often than not, considered to be public utilities. The price of irrigation water to farmers should therefore include only a fair proportion of the dam-maintenance cost and most of the canal costs. The remainder of the dam-maintenance costs should be met by the other joint users, namely, electricity consumers and those enjoying recreational benefits from the dams and waterways.

About 6 million acres are under irrigation in Italy; there are two different situations. In northern Italy the land is in irrigated hay, alfalfa, and rice. In this part of Italy the cultivation standard for rice is one of the highest in the world and yields are large. In southern Italy irrigation is applied to fruits and vegetables. Feeding-stuffs are not considered to be an economical proposition under irrigation.

In concluding, the chairman remarked that he wished some discussion could have taken place on the following broad subjects relating to irrigation problems—(*a*) co-ordination between irrigation engineers and agricultural departments, (*b*) problems of cost, especially the need to measure the wastage of irrigation water whether through evaporation or unskilled operation, or porosity of channels.

Among contributors to the discussion in addition to the opening speaker were: M. Shafi Niaz *Pakistan*, T. V. Edwards *Australia*, Giuseppe Medici *Italy*, C. H. Bonte Friedheim *Kenya*, A. B. Lewis *U.S.A.*, Q. B. O. Anthonio *Nigeria*.