Neth. J. agric. Sci. 22 (1974): 54–65

Land use planning in the Lower Mesopotamian Plain — a problem analysis

R. van Aart[1]

International Agricultural Centre, Wageningen, the Netherlands

Accepted: 21 December 1973

Summary

The history of land use on the Lower Mesopotamian Plain is described from olden times to the present. Throughout the centuries a general decline in agricultural prosperity is noted and an overall shift in land use practice from annual, mainly winter, cultivation to a system of fallow land rotation. This extensive system of land use is mainly a result of waterlogging and salinization in consequence of unreliable irrigation coupled with inadequate drainage.

A future policy for land use planning should take into consideration the available soil resources, the future utilizable water resources which, being restricted, will ultimately determine the extent of cropped land, and the system of farming aimed at. During the process of planning both the cropping intensity and the cropping pattern should be clearly identified. The size of the farm is directly related to the future system of farming and should be given due consideration.

Finally, it is stressed that social and organizational aspects play an important role in the process of land use planning.

Introduction

The Lower Mesopotamian Plain of Iraq encompasses a total gross area of 5 500 000 ha of which 4 400 000 ha is cultivable. The present area under cultivation in any one season is estimated at 2 600 000 ha (see Fig. 1).

The future acreage and intensity of cropping largely depend on the available surface water resources which, due to their limited extent, constitute a key function in the process of land use planning.

The objective of this study is to contribute to a better understanding of the planning of land use by describing its history from olden times and by giving broad lines which any future land use policy should take into consideration.

History of land use from olden times to the 20th century

It is a generally accepted fact that the earliest form of civilization evolved in the Lower Mesopotamian Plain, where the favourable environment of a suitable climate, good

[1] From 1969-1973 Land Reclamation Specialist with the Unesco Project 'Institute for Applied Research on Natural Resources', Abu-Ghraib, Iraq.

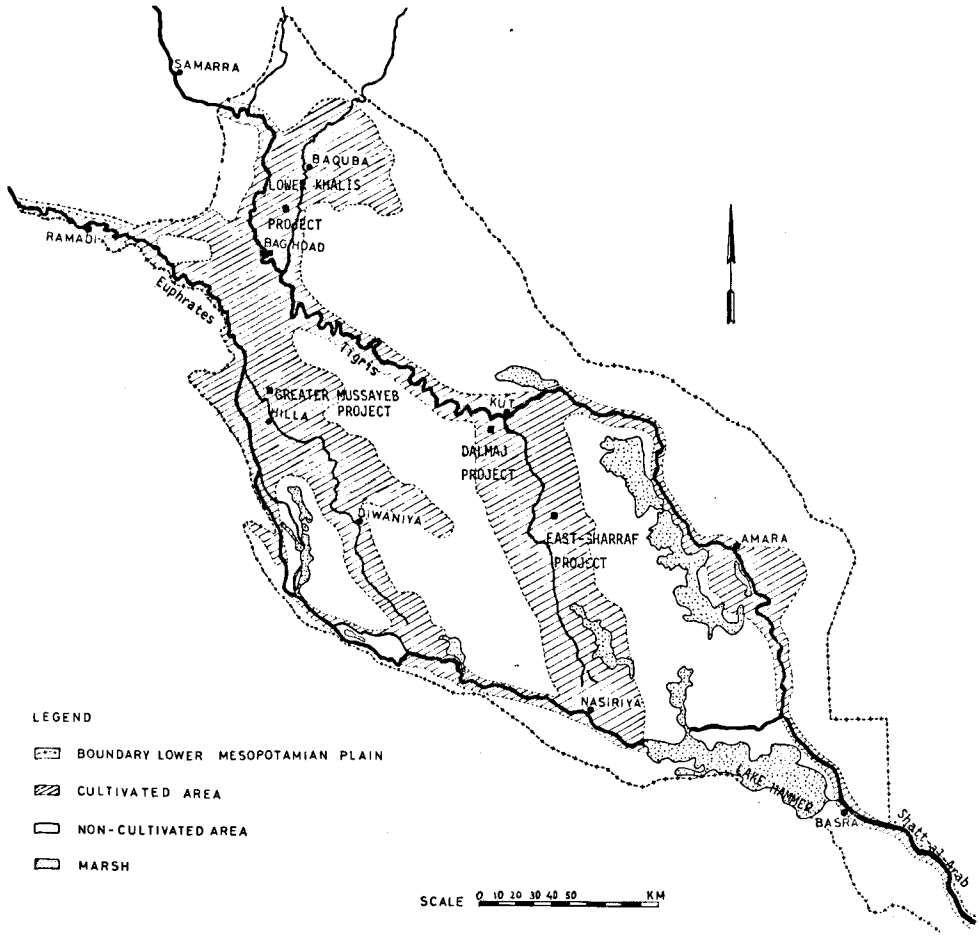

Fig. 1. Land Conditions in the Lower Mesopotamian Plain.
(Modified after: Map of Iraq illustrating Land Conditions, 1960, Ministery of Agriculture, Directorate General of Irrigation, Baghdad.)

productive soils, and abundant water resources stimulated man to cultivate the lands.

Little is known about land use in such times but archeological studies reveal that barley and wheat belong to the oldest crop species and were noted together with flax from 4200 B.C. onwards (Anon., 1958).

Mention is made of the growth of onions, peas, sesame and beans from 2300 B.C., but it is believed that in general very little summer cultivation occurred. From circa 300 B.C. rice was grown and around 1000 A.D. productive orchards and gardens are noted.

Salinity appeared in the southern part of the plain from 2300 B.C. onwards, which coincides with a change from wheat to barley cultivation, barley being more salt-

tolerant than wheat. This may be considered the first known case of a change in cultivation as a result of a changing environment.

It is believed that man followed the trial-and-error approach on his way to establishing an appropriate land use system, and with success. Highly productive orchards and gardens were established on well-drained river levee soils, and rice cultivation appeared on imperfectly drained basin soils in the southern part of the plain. Hence from olden times an appropriate form of cultivation has been found to fit environmental conditions.

From 2400 B.C. mention is made of a certain form of land use now known as the *nirin*, or fallow system of cultivation, a system by which half of the farmland is cropped in winter and the other half left fallow, the cultivated halves alternating from year to year. It is noteworthy that the first evidence of the fallow system coincides with the apperance of salts on the fields, which raises the surmise of a causal relationship between the two phenomena.

The benefits of a fallow period in the crop rotation are well known, namely:
- improvement of the natural fertility status of the soil;
- improvement of the drainability of the soil, provided that during the fallow period the water table drops below the socalled critical depth for resalinization. In that case a cover of natural vegetation with deep rooting species like a shrub as *Prosopis farcta* can establish itself, thereby lowering the water table and enhancing the leachability of the soil;
- reduction of the salinity of the topsoil as salts will be somewhat leached by winter rain and local floods.

Under such conditions it was calculated that a fallow system with a dense cover of weed growth affords farmers a time span of about 450-500 years of cultivation (Russell, 1957).

Once the conditions worsen in such a way that the water-table remains within the critical limits, this system of fallow land use collapses and the fallow period may actually accelerate salinization. When that happens, such lands are abandoned, as occurred at many places in the plain, for example in the area where the Greater Mussayeb Project was later implemented. Here it is believed that from olden times cultivation alternated with periods of abandonment. This contributed strongly to the mineralization of the groundwater, since during abandonment, rainwater and floodwater leached salts from the upper soil layers to the groundwater.

From 1200 A.D. onwards an overall decline took place, mainly as a result of political instability together with environment changes due to salinization and sedimentation in the Mesopotamian Plain. Lands gradually went out of production and low cropping intensities were observed. The land use in this period was solely a question of the selection of a system best suited to the changing environment of increasing salinity and decreasing drainability of the soil as a result of the sedimentation process.

History from 1900-1950

In the early 1900's very little land was cultivated and the population was scarce. Warriner (1962) estimated that 'perhaps as much as three-quarters of the area cultivated in 1957 has been brought under the plough since 1918, and one-third of it since 1945'. Therefore her conclusion is 'that modern Iraq is actually a new agricultural country'. But to this statement must be added 'with less favourable possibilities than in previous times due to the large quantities of salt both in the soil and the groundwater and to the enormous silt deposits all over the plain'.

In this period we note that the response of the farmer to increased supplies of water was the extension of the area of cropped land, rather than an increase in the cropping intensity of the area he was already cultivating. The old system of fallow land rotation was still practised even after the increase of the amount of available water.

History from 1950 to the present

In 1952 a private American firm (Knappen et al., 1952), completed a development plan for the Tigris and Euphrates rivers, incorporating the Lower Mesopotamian Plain. The plan mentioned 'that the total supply of water available to Iraq is more than enough to irrigate all arable lands, vast as they are; however this supply does not come when needed'. Consequently a civil engineering development plan incorporating the Lower Mesopotamian Plain was proposed to the Government, and is in broad lines still being implemented.

The report gives the following figures for the river plain:
- total cultivable area: 4 400 000 ha (80 % of gross area, 5 500 000 ha)
- land cultivated in 1952: 2 600 000 ha (will be supplied with 53 cm water per year)
- potential extension area: 1 800 000 ha (will be supplied with 95 cm water per year)

It was assessed that with the new storage and regulatory facilities available, 60-75 % of the land already cultivated would be cropped annually and for the new lands the figure would be 85 %.

It is evident that this development plan aimed at bringing the greater part of the cultivable land in the river plain under crop in any one season. Therefore the former system of fallow land rotation would cease to exist; however the limited future water resources would result in low cropping intensities, especially on already cultivated lands.

Thus land use planning followed the same approach as that applied by farmers of the period 1900-1950, envisaging land development mainly as the extent of the acreage. The immediate effect of this study was that all over the plain project plans ware drafted and locally initiated, one example being the Greater Mussayeb Project. For this Project, encompassing 83 700 ha as gross area, the Development Board decided in 1952 that the land already cultivated (16 800 ha) would get 55 % winter and 12 % summer intensity, gardens included. The new land (50 000 ha) would get 75 % winter and 60 or 85 % summer intensity, depending on the available water supply. However it is seen that the actual farm pattern in 1968 was 41 % winter intensity and 14 % summer intensity.

This phenomenon was not restricted to the Greater Mussayeb Project alone but was

Table 1. Winter and summer cultivation in thousands of hectares in the Lower Mesopotamian Plain.

Year	Total cultivated area	Winter crops	Summer crops	Cropping intensity (%)	
				winter	summer
1953	2 600	1 180	–	–	–
1958	2 600[1]	1 190	157	46[1]	6[1]
1963	2 600[1]	1 420	–	–	–
1968	2 600[1]	950	157	37[1]	6[1]

[1] Estimated figures.

Table 2. Acreages and yields of wheat, barley and rice grown in Northern Iraq and in the Lower Mesopotamian Plain, in 1958 and 1968.

	Total area (ha) 1958	Total area (ha) 1968	North 1958		North 1968		Lower Mes. Plain 1958		Lower Mes. Plain 1958		Yield (kg/ha)			
			area (ha)	%	area (ha)	%	area (ha)	%	area (ha)	%	North		Lower Mes. Plain	
											1958	1968	1958	1968
Wheat	1 533 250	1 662 680	1 082 000	70	1 190 105	72	451 250	30	472 575	28	380	660	760	710
Barley	1 156 500	875 600	436 000	38	425 575	49	720 500	62	450 025	51	550	770	990	760
Rice	88 811	107 290	9 800	11	470	0.5	79 011	89	106 823	99.5	2 214	1 830	1 460	2 260

Source: Annual Abstract of Statistics, Central Statistical Organization, Ministery of Planning. Baghdad.
The data for 1968 were taken from an Agricultural Sample Survey.

valid for the whole Lower Mesopotamian Plain. It is even seen that the actual cropped area has been reduced since 1950 as is demonstrated in Table 1, which gives the cultivated area under farm crops, gardens and vegetables excluded.

Table 2 compares acreages and yields of wheat, barley, and rice in northern Iraq and in the Lower Mesopotamian Plain in 1958 and in 1968. It can be seen that in the plain the area under wheat remained almost the same, that the area under barley was reduced, and that the area under rice was increased.

Details on the acreage under wheat, barley and rice in different parts of the plain are given in Table 3. From this it can be seen that a decrease in barley cultivation took place all over the plain between 1958 and 1968. It is believed that this coincided with the increase in soil salinity which was noted during the same period and which, even for barley, became too high. For both the Euphrates and Tigris regimes it is noted that the ratio barley to wheat cultivation increases going downstream, which agrees with the change in environmental conditions as a result of an increase in soil and water salinity, both in the rivers and in the groundwater.

Table 4 gives details on the crops actually grown. Besides wheat and barley as main winter crops, linseed and broad beans are grown. As summer crops rice, green gram, sesame, cotton, giant millet, cow peas, maize and millet are grown to a limited extent. In 1958 the summer cropping amounted to 13 % of the winter cropping, of which 7 % was rice cultivation, and in 1968 the summer cropping was 17 % of the winter cropping of which 11 % was under rice.

The main reasons for failing to reach the assessed land use pattern in projects like the Greater Mussayeb Project are:

- scourge of salinization due to insufficient drainage – actual field drainage was absent in all projects – counteracting any extension in cultivation. All the constructed drainage

Table 3. Acreages under wheat, barley, and rice in different areas of the Lower Mesopotamian Plain in 1958 and in 1968.

		Area under wheat (ha)		Area under barley (ha)		Barley/wheat ratio		Area under rice (ha)	
		1958	1968	1958	1968	1958	1968	1958	1968
Euphrates regime	Ramadi	24 750	19 850	14 000	9 150	0.56	0.46	20	448
	Kerbela	2 250	3 750	3 000	4 900	1.33	1.31	200	12 295
	Hilla/ Diwaniya	52 250	105 000	129 000	110 675	2.47	1.05	31 898	51 530
	Nassiriya	35 250	39 825	127 250	49 050	3.61	1.23	12 688	2 498
Tigris regime	Baghdad	99 500	96 675	83 000	40 150	0.83	0.41	1 838	6 523
	Kut	103 250	96 300	173 750	108 300	1.68	1.12	9 700	4 500
	Amara	23 000	23 225	56 250	26 450	2.48	1.14	18 138	16 323
Diyala regime	Diyala	106 250	84 200	133 750	101 350	1.26	1.20	4 036	12 528
Shatt-al-Arab	Basrah	4 750	3 750	500	1 000	–	–	493	178
Lower Mesopotamian Plain		451 250	472 575	720 500	450 025			79 011	106 823

Source: Annual Abstract of Statistics, Central Statistical Organization, Ministry of Planning, Baghdad. The data for 1968 were taken from an Agricultural Sample Survey.

Table 4. Area and crops grown in the Lower Mesopotamian Plain in 1958 and in 1968.

Winter crop	Area (ha) in 1958	Area (ha) in 1968	Summer crop	Area (ha) in 1958	Area (ha) in 1968
Wheat	451 250	472 575**	Rice	79 010	106 825**
Barley	720 500	450 025	Cotton	32 000*	8 400**
Linseed	9 050	15 450	Sesame	12 000*	10 000*
Vetch	1 600	945	Maize	6 350	3 875
Broad beans	6 000*	9 000*	Green gram	11 150	15 600
Chick peas	–	2 500*	Millet	6 450	3 000*
			Giant millet	8 330	5 675
			Cow peas	2 000*	4 000*
Total cultivated in winter	1 188 400	950 495	Total cultivated in summer	157 290	157 375

Source: Annual Abstract of Statistics, Central Statistical Organization, Ministry of Planning, Baghdad.
* Estimated.
** Based on Agricultural Sample Survey.

systems were underdesigned because too optimistic an assessment of the drainage criteria had been made;
– lack of maintenance of the irrigation and drainage systems, coupled with the absence of proper soil and water management practices;
– unreliable and often inadequate availability of irrigation water, particularly during the summer season;
– siltation of the canal systems, resulting in too low a supply, particularly during summer;
– unsound land tenure systems. No real ownership of the lands existed. Moreover too much share-cropping took place for persons who lived in towns outside the project areas;
– non-availability of properly functioning cooperatives and market facilities;
– unsound balance of payment for many farmers and consequently difficulties in establishing a sound land use pattern.

Future policy for land use planning

Soil and water resources

The available soil resources in the river plain are well defined and amount to 4 400 000 ha of cultivable land.

The water resources are less well defined as only few data on the future river supplies, particularly for the Euphrates, are available. Treaties with Syria, Turkey, and Iran on the distribution of the waters have still to be concluded. However, it is evident that in the future the water resources are the limiting factor which will ultimately determine the area of cropped land in the plain. As only a minor part of the discharge – estimated at 21 % (Khashab, 1960) – originates in Iraq, it is of the utmost importance that an inventory be made of the future utilizable water resources in order to establish a well-defined development plan for the Lower Mesopotamian Plain which stipulates the future cropping pattern and their extent. This will provide the basis for a sound water

policy and will enable the engineers to design the irrigation and drainage schemes in a proper way.

System of farming

A considerable difference exists between planning a farming system for a new area and planning one for land already under cultivation. In the first case the degree of freedom is much higher and direct planning towards well-defined objectives will take place. In the cultivated lands the planning process is much more intricate and any future farming system should always take into consideration the present situation of farm size, cropping system etc. Consequently the existing project areas will have to be remodelled and the cropping patterns modified and related to the present economical needs.

During this process of planning, two objectives should be clearly identified, namely the cropping intensity which should finally be aimed at and the cropping pattern.

Cropping intensity

With the limited water resources available a choice should be made between intensive farming on selected project areas and extensive farming on a wider area.

Although currently a very low cropping intensity is practised (e.g. 43 % in 1968) the tendency in the development areas in towards higher intensities.

The Greater Mussayeb Project now aims at an annual intensity of 100 % in winter, and an as yet undefined high percentage in summer with which farm management can cope. The Dalmaj Project aims at an annual intensity of 115 %, the East-Gharraf Project at an annual intensity of 140 % and the Lower Khalis Project at an annual intensity of approximately 150 %.

However the following reasons should be mentioned as unpropitious for high cropping intensities (Lieftinck, 1969):

– physical difficulty exists of growing certain crops like cotton and wheat in succession as they will cause overlap in growing season;

– limitation in labour and/or mechanization may make it impossible to have a variety of summer and winter crops grown in succession;

– subsistence farming will have to be incorporated in the agricultural pattern and therefore a part of the land should be reserved for private cultivation and for livestock;

- peak water demands will occur in April-May with a heavy duty on the irrigation system;

- high summer intensities will make heavy demands on the drainage system for reasons of salinity control in summer.

– an intensity of 120 % will be easily attainable but higher intensities would mean a confrontation with farm management constraints.

When these points are taken into consideration it is believed that an average intensity of 150 % – which for example has been decided on as an ultimate objective for the development of the Indus Plain in Pakistan (Lieftinck et al., 1969) – may not immediately be applicable for the Lower Mesopotamian Plain.

The present continuous sedimentation, resulting in the soil having generally low water intake characteristics, and the large salt deposits both in soil and groundwater, constituting an ever-present hazard of resalinization, will make proper irrigation and drainage and consequently proper soil and water management practices a delicate task, particularly when high cropping intensities are aimed at.

It is, therefore, wiser to aim at somewhat lower intensities, 120-130 %, and to practise

intensities, of 150 % on the better lands only, for example on the river and irrigation levee soils situated in the central and northern part of the plain, which lands even nowadays have much higher intensities than the rest of the plain.

Cropping pattern

The present cropping pattern, even in the project areas, is inadequate to meet local demands. The increase of irrigation throughout the plain will provide the opportunity to change the cropping pattern both by changing the acreage of existing crops and by introducing new crops.

Formulation of justifiable cropping patterns for both cultivated and new lands is a complicated process and may vary from one area to another. However, considering the present cultivation as delineated in Table 4, the following priorities should be endorsed after the construction of irrigation and drainage schemes:

1. Summer cropping should be increased and more cash crops introduced. It is recommended for instance, that more maize, green gram, millet, and cow peas be cultivated. These crops have a relatively short growing season and fit easily with wintercrops in a rotation.

The experience with cotton has not yet been very successful, which is reflected in the reduction in acreage from 32 000 ha in 1958 to 8 400 ha in 1968. Cotton is a crop particularly sensitive to pests and diseases, and moreover is difficult to incorporate with a winter crop in an intensive rotation. Although at present less attractive to the farmers, it should not be excluded from the cropping pattern.

Rice should be grown exclusively on the heavier soils in the southern part of the plain, and is not suitable for growing in rotation with other crops. Its cultivation should be increased as annual imports are still being made.

2. Intensive winter cropping is strongly to be recommended due to the suitable climatological conditions. Wheat should be given priority over barley as it has a higher net return and is still being imported. Other crops like broad beans and chick peas are suitable winter crops and are useful in a rotation.

3. The incorporation of oilseeds in a rotation is strongly recommended. Crops like linseed (15 450 ha) and sesame (10 000 ha) are already grown in the plain. Other crops like ground-nuts, which were recently introduced in the Greater Mussayeb Project, sunflower, safflower etc. should be tried.

4. Fodder crops like lucerne and berseem in a rotation with barley or wheat have a high priority and should be strongly promoted in order to increase the number of livestock in the system of farming. The incorporation of a fodder crop in a rotation with wheat or barley enables the system of fallow land rotation to be replaced. Apart from their nutritive value fodder crops can be ploughed under and act as green manure crops.

5. The cultivation of vegetables on the lighter soils, mainly in the neighbourhood of population centres, should be encouraged by introducing more permanent vegetable sites.

6. The plantation of orchards on the better, well-drained soils situated mainly along rivers and irrigation canals should be stimulated as a growing demand exists. In the Greater Mussayeb Project a start has been made by reserving 700 ha of irrigation levee soils for this purpose.

7. Dates grown in the plain form the most important agricultural export product of the country. Although date palms are known to be among the most resistant of all crops to high salinity and drought, a serious salinity problem is arising, particularly in

the south. This is reflected in gradually decreasing yields, the figures for 1958 and 1968 being 450 000 and 328 000 tonnes. Many date gardens are in need of artificial drainage, especially those around Basrah which are irrigated with more or less saline water of the Shatt-al-Arab. A gradual expansion of date clutivation is recommended provided that the need for drainage is catered for.

Size of the farm area

The parcelling of land is directly related to the intended system of farming. Subsistence farming and the reservation of land for livestock, for example, will result in a low cropping intensity and consequently in a large parcel. In Iraq there is a clear tendency towards a smaller cultivation unit per individual. Under the Dujailah scheme (1946) parcels of 25 ha were distributed to the farmers; in the Greater Mussayeb Project (1956) parcels of 16.6 ha were allocated, and the present approach in the Lower Khalis Project is to create farm units of 4-8 ha. It is evident that the reduced parcel size will mean higher cropping intensity in the newly irrigated and drained areas.

Social and organizational aspects

It can never be too often emphasized that social and organizational aspects have a key function in the process of sound land use planning. For a successful land reclamation scheme it is of vital importance that the farmers live and work under satisfactory conditions.

In olden times the lands were mainly owned by landlords who cultivated the fields after the traditional institution of tenant-sharecropper. The lands were extensively cultivated according to the fallow land use system which minimized the salinization of the soils.

In 1857 a law was introduced, though never implemented, defining the right of use and transfer of the state lands. It was not until 1932, when Iraq became independent, that with some effect a law entitled Settlement of Land Rights was passed. 'This law settled many disputes but at the same time made it possible for influential people to obtain control over vast areas' (Hassan, 1955).

The next step was made in 1945 when, under the Dujailah Land Development Law, governmental land was distributed in farm units of 25 ha amoung small farmers who had no land in the Dujailah Project (35 500 ha).

In 1951 the Miri-Sirf Land Development Law was passed giving the government the right to transfer to small farmers the ownership of farm units irrigated by flow and not exceeding 25 ha. Under this law some tens of thousand hectares were distributed among settlers in various project areas. This individual farming was not very successful as the farmers had to cope with serious problems of salinization, sedimentation of material suspended in the irrigation water, and unreliable water supply, which resulted in mainly subsistence farming and a consequent unsound balance of payment.

In 1958 an Agrarian Reform Law was issued by which large ownership was limited to a maximum of 250 ha for irrigated lands. Under this law some 22 000 ha were distributed in farm units of 16.5 ha in the Greater Mussayeb Project. In this period state co-operatives were established but were not very effective due to the insolvency of the farmers, who were thus unable to maintain the farm drainage and irrigation systems properly, to use high quality seed and fertilizer, and to make use of machinery services. The lesson learned from this period is that the institution of individual farming was unable to cope with this enmity of the environment and that a stronger social organization was required to bring general welfare to an entire project community.

The Agrarian Reform Law of 1970 further diminished the size of the maximum personal holding, which was now reduced to 75 ha for good-quality land supplied with gravity irrigation, with the extra proviso that the area be reduced by half if it was situated not far away from market centres. The Law provided means for the establishment of cooperative societies and for collective farming. Several projects applying the principes of collective farming were initiated during this period. The principle is that a group of farmers establishes a co-operative farm unit in which the area allocated to any one crop is consolidated to one unit according to a predetermined rotation scheme. The farmers take care of proper irrigation, and the farming operations are handled by a state co-operative society. This system simplifies the farming operations and facilitates the layout of irrigation and drainage systems whose designs could directly be related to the predetermined cropping patterns. If so desired, the farmers could be made more responsible in alotting them by ballot their share in each crop unit seasonally, and committing them to participate in certain farm practices. In this case the farmer will feel himself socially more associated with the farming process and will probably be able to cope with the environmental problems.

Conclusions and recommendations

The unsound system of land use in the Lower Mesopotamian Plain with low summer and winter cropping intensities, a fallow land use rotation, low yields, predominance of salt tolerant crops, and absence of a variety of cash crops is attributable to the serious problems of water-logging and salinization which are mainly a consequence of unreliable irrigation coupled with inadequate drainage.

The future available water resources will be scarce and will form the limiting factor which will ultimately determine the extent of cropped land in the Plain.

Alternative land use priority plans taking into consideration varying amounts of future utilizable water resources will have to be established for the country as a whole and for the Lower Mesopotamian Plain in particular.

The land use plans should be based on an optimal use of the lands for agricultural purposes while paying due attention to the existing and changing natural and human environment.

The lesson learned from the past is that engineering works like irrigation and drainage schemes form just a starting point for the real and difficult task towards a sound land use system which is the aim of any land development activity.

Apart from the technical aspects due attention should be given to the socio-economic and organizational aspects of the planning process to guarantee a durable sound land use policy.

Acknowledgments

The author is indebted to Prof. Ir G. A. W. van de Goor and Dr Ir M. Knibbe for critical comments and, to Mrs M. F. L. Wiersma-Roche for correction of the English text.

References

Anonymous, 1958. Salinity and irrigated agriculture in antiquity. Diyala Basin Archeological Project. Baghdad.

Hassan, M. A., 1955. Land reclamation and settlement in Iraq. Baghdad.

Khashab, W. H., 1960. Facts and speculations about the water supply of Iraq. University of Baghdad, Baghdad.
Knappen, Tippets, Abbett & mcCarthy, 1952. Report on the development of the Tigris and Euphrates River Systems. Government of Iraq, Development Board, Baghdad.
Lieftinck, P., A. R. Sadove & T. C. Creyke, 1969. Water and power resources of West-Pakistan, a study in sector planning, Volume II. John Hopkins Press, Baltimore, USA.
Russell, J. C., 1957. Iraq lives with soil salinity. Lecture, Baghdad.
Warriner, D., 1962. Land reform and development in the Middle East. Oxford University Press, London.