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Land Reclamation in Iraq

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Abstract

Reclamation in Iraq was known in 1950s, where the problems salinity and water-logging are mainly apparent in the middle and south of Iraq. The early interventions in reclamation sectors was simple, not precise, or calibrated properly, hence, salinization and water-logging aggravated.

Since the reclamation activities are time and resources consuming, which may last in several years, these are highlighting the fact that most of the beneficiaries could not afford the conducting of this activity. Therefore, Iraqi government take the decision in 1970s to carry out the reclamation and improve the agricultural processes vertically. There are millions of donums were reclaimed along Iraq.

There are key steps adopted to conduct the sophisticated reclamation in order to get rid of salinity, lowering water table to acceptable depths, and prevent future salinization.

The reclamation is not just an engineering project, the full reclamation are also may include, rural development, capacities building for operators and beneficiaries, educational development, research development, and social development.

Keywords: Land reclamation, Salinity, water logging, Iraq.

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1. Introduction

Iraq had adopted the reclamation of the irrigable lands since the mid of last century, the expansion trend at the beginning was horizontal. In addition, the reclamation at this stage was not precise nor accurate in term of technical aspects, where the most important goals from reclamation at the center and southern of Iraq is to confront the salinity and water logging. Therefore, problems aggravated vertically and horizontally.

This policy has changed radically after the seventies of the last century by following scientific trends in the implementation of irrigation and reclamation projects of lands, in order to preserve water resources and organize water use up to the field level to ensure the treatment and prevention of salinity and water logging problems. On another hand, reclamation had a key role to increase agricultural density, diversification of agricultural cycles, using advanced technology and activating scientific research activities in these topics, taking into account the strategic importance of the issue of food security in Iraq.

2. The evolution of the stages of land reclamation in Iraq

It can be said that the term land reclamation was not known in its scientific content in Iraq until the end of the first half of the last century, and it was not coincided with the horizontal expansion in irrigation of lands when the first plan for irrigation projects in Iraq was drawn up by Development Board at the beginning of the fifties of the last century. It is common that the irrigation project was for a simple reason, which is that most of the projects that were planned at that time were based on one aspect of the project, which is the irrigation activity only, and even this aspect did not consider integration. It was just to improve the old networks and in all cases was low intensity or semi - intensive agriculture as a system of agricultural exploitation in line with the reality of ownership patterns that were prevailing during that era (Directorate General of Irrigation, 1954).

The concept of land reclamation has evolved in the sixties by the application of the Law of Agrarian Reform No (30) in the year 1958 , which has led to an increasing rate of salinity and rising groundwater levels. This situation argued decision makers to find and urgent solution, which is the adoption and implementation of the drains. Plans to implement drainage networks were adopted in the 1960s and the term drainage became conjugated with the concept of reclamation, and in most cases the drainage process became understood as a process called reclamation. However, the implementation of the drainage networks, which was initially limited to the main drains and then expanded to the branch drains and then the combined drains, was not actually a real reclamation process, because the main goal of its implementation was to reduce groundwater levels to the level that the density of the drainage networks allowed. The problem of salinity accumulated in productive soil layers and increasing as a result of irrigation, was still existing (Kanaan Abduljabar Abu-Gullal, 2019; Dieleman and Roumans, 1963).

In spite of some limited benefits due to conducting drainage in this way, the concept of reclamation as an integrated process in terms of study, design and implementation did not take its true status until several years later. Where installation of field drains, field irrigation, land levelling, leaching, and planting became and essential parts of the reclamation .

The concept of land reclamation in Iraq has expanded, going beyond the technical and economic aspects to the integrated development concept, with planning, study, design and implementation, and this concept was clearly adopted in the five-year plan (1981-1985), the reclamation projects that were approved and entered the implementation phase included the establishment integrated road networks in the project, during the implementation phase of the reclamation work, provided that electricity and drinking water networks, housing projects, schools, clinics and other service facilities were established, so that the project can be developed in an integrated manner and create a new, developed cultural reality in economic and social conditions (Kanaan Abduljabar Abu-Gullal, 2019; MoWR 2005; Al-Simawi, 2010).

3. Technical and economic basis for the reclamation of lands

The land reclamation projects are among the development projects that are costly in terms of the capital investment, and their implementation takes a long time , in which various complex activities overlapped .

Such projects can only be accomplished by the state authorities, by allocating huge sums in its developmental investments, and by mobilizing large operational resources. Therefore, projects that had the form of public benefit and have major implications for the agricultural development and the national economy, because the problem of salts spread and waterlogging in agricultural lands is one of the most important obstacles for the development of agriculture sector in Iraq and has negative economic and social consequences. (Kanaan Abduljabar Abu-Gullal, 2019; JICA, 1977). The programs of land reclamation are aiming to:

1. Maintaining soil fertility and productivity at its planned levels (preservative reclamation).
2. Restoring soil fertility to its previous levels before soil salinization and waterlogging.
3. Development of agricultural production elements, especially the irrigation network, levelling and aeration of the soil, which is meaning that land reclamation aims to develop agricultural production vertically by raising the production rates of the unit of land, and by extension to the lands involved in agricultural exploitation.

Especially those lands that went out of production due to salinity.
As the lands of most of the irrigation projects in the central and southern Iraq are affected by salinization and waterlogging, a number of economic and technical criteria have been set to determine the priority in choosing land reclamation projects. The most important of them are the following:

1. Availability of water quantities for the cultivation of the lands with an agricultural density of not less than 120%.
2. Availability of lands with high productivity according to soil studies and investigations.
3. Availability of population density to provide manpower to exploit the lands after completing its reclamation.
4. The proximity of projects to marketing and service centers and urban areas.
5. Focusing on completing direct projects that have reached the stage of investment and exploitation, with priority given to important strategic projects.
6. The project is related to the overall land and water development plan.
7. Geographical distribution of projects along Iraq in line with the principle of the development budget.
8. Adopting technical and economic analysis to give priority of implementing reclamation works in the existing projects to rehabilitate them after evaluation or to select new projects and on the basis of what these projects achieve in terms of added value to income in addition to other economic and social goals.
9. Adopting the principle of integrated reclamation for projects, where reclamation works include developing the irrigation network and implementing drainage networks, starting from field drains and ending with main drains, leveling, soil leaching and land planting.

4. Stages of reclamation process

The most important goal of the land reclamation process in the status of the central and southern Iraq (the Mesopotamian plain in particular) is to get rid the soil salinity in its productive layers that makes plant growth impossible or with diminishing and uneconomic yields, to preserve groundwater levels at non-critical depths, and prevent its negative impact on the growth of agricultural crops and this is done by finding an appropriate saline and water balance that can be obtained as a result of implementing integrated networks of irrigation and drainage and manipulating the topographic levels by modifying and leveling lands and the subsequent work of washing and cultivating the lands (Kanaan Abduljabar Abu-Gullal, 2019; Al-Simawi, 2010). The process of land reclamation takes place in several basic stages, which are in brief:

4.1 Studies and designs stage

This includes conducting a topographical survey, soil survey, land classification, hydrological investigations for the project, and the use of geological, climatic and morphological information for the area, and studying the social situation and agricultural and economic activity existing in it for the purpose of outlining the conditions and factors that affecting the reclamation process. Furthermore, to reach an assessment in the first stage of the study leads in the case of feasibility to the development of economic and social justification for the implementation of the project and then move on to the stage of the preparation of maps and detailed design of irrigation and drainage and structures.

Usually, studies focus on basic problems which are the salinity and high water levels of groundwater, so it's required at this stage study these two problems are given in the most detail as possible and the information can be used to address them in terms of design (Kanaan Abduljabar; Abu-Gullal, Al-Athari, and Abu-Gullal, 2017).

This stage ends when preparing designs, specifications, contracting documents, O&M manuals for the project, where the project is referred for implementation.

4.2 Implementation stage

Reclamation project includes the implementation of several items, of which the most important:

1. **Irrigation network:** It includes the main canal, branch canal, distributary and feeding channels, its structures, and pumping stations, if any in the design. Since the mid-seventies, the lining of the entire irrigation network from the main canal to the feeding channels has become a prevailing principle in all projects, where the concrete was mostly used as a material for lining.
2. **Drainage network:** It includes the main, branch, collector and field drains that all form the drainage network of the reclaimed project, where drainage water is discharged into the main outfall drain or into rivers in special cases or into natural depressions.
3. **Land levelling:** The aim of this process is to remove the differences in elevations topography .
4. **Leaching and planting stage:** This stage is one of the most important stages of the reclamation process in the circumstances of Iraq, as the process of soil leaching is linked to the main problem that afflicts the soils of central and southern Iraq, which is the problem of salinity accumulated at high rates in the productive soil layers. After the implementation of integrated networks for irrigation and drainage, it becomes possible to conduct this process. The leaching and planting operations are carried out according to the established technical specifications. The saline concentration is the main factor in determining the areas that need to be leached, as well as the areas that can be cultivated or to determine the types of crops that can be grown.

5. **Hand over the reclaimed lands to the beneficiaries:** Reclaimed lands are handed over to the beneficiaries in accordance with the laws, decisions and instructions arranged in this regard and through committees in which the designing implementing and beneficiaries are represented.The beneficiaries receive maps and information related to the project or part of it (Kanaan Abduljabar; Abu-Gullal, Al-Athari, and Abu-Gullal 2017; Allen et al. 1998).

5. The future prospects for land reclamation in Iraq

Future prospects of reclamation in Iraq might base on the following indicators:

1. Considering the reclamation project as the basis for developing the project area, and focusing the rest of the sectors on it in order to secure all the requirements for the success of the project's objectives economic and social goals.
2. Developing and implementing a plan to educate farmers in cooperation with agricultural and youth unions, organizations, and relevant authorities in the agricultural sector to make them aware of the methods of project operation and maintenance .
3. Focusing in particular on the operation and maintenance of the reclaimed projects as it is the most important project in terms of integration of implementation.
4. Reactivate **MEAL** activities annually and periodically, as well as to the overall activities for the purpose of benefiting them in the face of potential problems or avoid them, especially with regard to the salinity of the soil and the problem of re-salinization as the land reclaimed threatened to re-salinization as a result of mismanagement and cultivation and not to give serious importance to the proper O&M.

6. Recent status of reclamation projects in Iraq

According to the last updates by Ministry of Water Resources (MoWR), there are 142 irrigation projects (reclaimed, partially reclaimed, and non-reclaimed), there are as well 275 pumping stations. Figure 1 below shows irrigation projects map in Iraq.

According to the report published by (JICA agency), there are about 16% or 7 million ha of area are arable land, of which about 5.985million ha is under irrigation or rain-fed. From this area, about 64% of cultivated land is irrigated, of which 3.384 million ha is irrigated by surface, while the rain-fed area is about 2.175 million ha. Regarding cropping ratio, and according to the information of the year 2011, the ratio was 70%. In 2011, due to the drought, cropping ratio decreased by about 20%. While the average cropping ratio was estimated about 85%, this estimation made according to SWLRI study, which is Strategy of Water and Land Resources in Iraq (JICA, 2016).

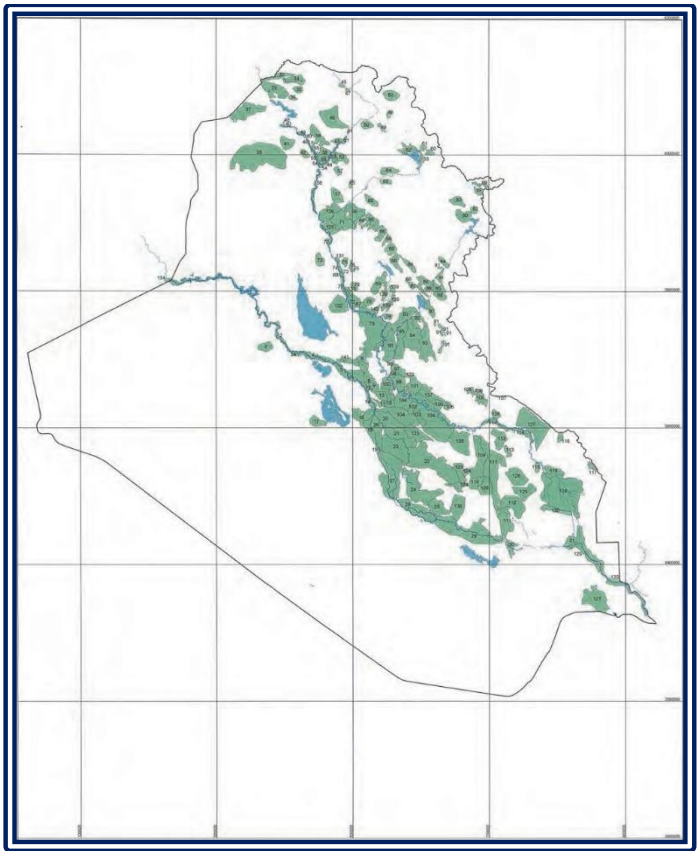

Figure 1: Irrigation projects in Iraq. (JICA 2016). Through SWLRI study, an evaluation was made to the recent status of canals. As shown in Table 1, there are approximately 20-24% of these canals with concrete lining.

Table 1: Length and Lining Ratio of Main, Branch and Secondary Canals (JICA 2016).

	Main canals			Branch canals			Secondary canals		
	Lining	**Earth canal**	**Other**	**Lining**	**Earth canal**	**Other**	**Lining**	**Earth canal**	**Other**
Length(km)	1,972	7,729	26	2,332	9,330	254	2,353	6,018	1,493
Ratio (%)	20	79	1	20	78	2	24	61	15

As seen in the above table, the low ratio of lining is one of drawbacks in the irrigation projects.

Table 2 shows the details of all 142 irrigation projects in Iraq These projects are covering an area of about 13.7 million donum. Data source for these details are from SWLRI study, which were listed in the reports of JICA agency. The tables also show the targeted development until the year 2035 according to SWLRI. Also, at the last rows, details can be found about each project water demands (JICA 2016; Al-Simawi, 2008).

Table 2: Details of Irrigation Projects in Iraq (JICA 2016)

ID	PROJECT NAME	GOVERNORATE	SOURCE	RANKING	Total Area MoWR	Develed till 2013	To Be Developed in the Plan	Final Development	Net area	% DEV	TOTAL DEMAND	Total dem/kdon	Max Monthly demand	Max discharge (l/s)
1	Small farms to hadeetha dam	Anbar	Euphrates	71	59	4	47.3	51.3	45.0	87%	130.3	2895.556	21.5	8.29
2	Small farms from the hadeetha dam	Anbar	Euphrates	81	47	1	46	47	41.2	100%	132.5	3213.83	21	8.10
3	Up to the boundary of the Ramadi project Small farms at springs in the Anbar	Anbar	GW-springs	GW	1		1	1	0.9	100%	2.9	3306	0.5	0.19
4	Ramadi-habaniyah	Anbar	Euphrates	73	135	111	20.4	131.4	115.3	97%	326.8	2835.251	52.1	20.10
5	Faluja-amreah	AnbarBaghdad	Euphrates	75	56		50.4	50.4	44.2	90%	134	3030.952	21.6	8.33
6	Saqlawiya	Anbar-Baghdad	Euphrates	D	140	140	0	140	122.8	100%	367.7	2994.129	60	23.15
7	Abu ghraib	Anbar-Baghdad	Euphrates	D	206	206	0	206	180.7	100%	576.8	3192	93	35.88
8	Radhwaniyah	Baghdad	Euphrates	D	28	28	0	28	24.6	100%	81	3297.857	13	5.02
9	Yousifia	Baghdad-Wasit	Euphrates	45	125	57	68	125	109.6	100%	360	3283.2	57.8	22.30
10	Latifia	Baghdad-Babil	Euphrates	37	108	88	20	108	94.7	100%	304.8	3217.333	48.8	18.83
11	Iskandariyah	Baghdad-Babil	Euphrates	42	51	44	0	44	38.6	86%	122.3	3168.682	19.5	7.52
12	Faluja al-muahada	Anbar-Baghdad Babil	Euphrates	62	54		54	54	47.4	100%	152.2	3213.111	24.4	9.41
13	Small farms from the boundary of the anbar muhafadha	Babil	Euphrates	72	25		15	15	13.2	60%	42.4	3222.4	6.8	2.62
14	Jarf al sakhr & ruwaiyah	Anbar-Baghdad Babil-Karbala	Euphrates	69	38		38	38	33.3	100%	107.8	3234	17.2	6.64

15	Greater musaiyab	Babil	Euphrates	D	310	310	0	310	271.9	100%	836.1	3074.69	132.5	51.12
16	Husainaia	Babil-Karbala	Euphrates	41	101	80	21	101	88.6	100%	251.9	2843.228	36.9	14.24
17	Small farms; at spring irrigated in karbala	Anbar-Karbala	GW springs	GW	10	10	0	10	8.8	100%	29.7	3385.8	4.9	1.89
18	Bani-hasan	Babil-Karbala Najaf	Euphrates	52	145	43	81.6	124.6	109.3	86%	304.7	2787.785	44.3	17.09
19	Small farms from the Hindiyah barrage	Babil-Karbala Najaf	Euphrates	64	4		3.6	3.6	3.2	90%	8.7	2755	1.3	0.50
20	Iskandariyah -mehaweel & gadwel al-nasiriya	Babil	Euphrates	74	182	11	153.3	164.3	144.1	90%	432.7	3002.301	68.7	26.50
21	Hilla-hashimiyah	Babil	Euphrates	70	240		204	204	178.9	85%	531.2	2968.471	84.2	32.48
22	Huriyah-daghara	Babil-Diwaniyah	Euphrates	12	635	207	428	635	557.0	100%	1,702.50	3056.457	243.1	93.79
23	Hilla-diwaniyah	Babil-Diwaniyah Najaf	Euphrates	55	282		273.8	273.8	240.2	97%	643.6	2679.708	100	38.58
24	Diwaniyah-shaifiyah	Diwaniyah Muthanna	Euphrates	19	380		380	380	333.3	100%	1,031.90	3095.7	157.7	60.84
25	Rumaitha	Muthanna	Euphrates	40	144	30	114	144	126.3	100%	426.6	3377.25	58.4	22.53
26	Hilla-kifil	Babil-Karbala Najaf	Euphrates	D	173	173	0	173	151.8	100%	411.5	2711.618	59.7	23.03
27	Kifil-shnafiyah	Babil-Diwaniyah Najaf	Euphrates	58	494	50	444	494	433.3	100%	1,338.00	3087.692	192.4	74.23
28	Muthanna	Muthanna	Euphrates	27	41	32	9	41	36.0	100%	123	3420	18.7	7.21

29	Shnafiyah-nasiriya	Diwaniyah/Dhi-Qar/Muthanna	Euphrates	43	260		260	260	228.1	100%	790.8	3467.354	118.9	45.87
30	Suq al shoyokh	Dhi-Qar	Euphrates	65	75		22.5	22.5	19.7	30%	72	3648	10.4	4.01
31	Small farms in the Euphrates river mouth	Basrah	Tigris	53	35		35	35	30.7	100%	93.1	3032.4	16.2	6.25
32	Zakho	Dohuk	GW-wells	60	15		15	15	13.2	100%	17.3	1314.8	4	1.54
33	Small farms from the boundary up to Mosul dam	Dohuk/Nineveh	Tigris	63	11		11	11	9.6	100%	14.6	1513.091	3.2	1.23
34	Small farms at springs in the dohuk	Dohuk	GW-springs	GW	4		4	4	3.5	100%	5.7	1624.5	1.4	0.54
35	Small farms at wells in the	Dohuk	GW-wells	GW	1		1	1	0.9	100%	1.4	1596	0.4	0.15
36	Dohuk	Dohuk	Tigris	D	2	2	0	2	1.8	100%	2.6	1482	0.6	0.23
37	North jazeera	Nineveh	Tigris	D	264	264	0	264	231.6	100%	477.6	2062.364	98.8	38.12
38	East jazeera	Nineveh	Tigris	26	215	12	203	215	188.6	100%	403	2136.837	90.3	34.84
39	South jazeera	Nineveh	Tigris	8	344		344	344	301.8	100%	670.3	2221.343	118.6	45.76
40	Small farms up to greater zab river	Nineveh	Tigris	33	46		46	46	40.4	100%	86.1	2133.783	19.3	7.45
41	Small farms at springs in the Ninawa	Nineveh	GW-springs	GW	2		2	2	1.8	100%	3.6	2052	0.8	0.31
42	Small farms at wells in the Ninawa	Nineveh	GW-wells	GW	1		1	1	0.9	100%	2	2280	0.4	0.15

43	Small farms at springs in the Ninawa	Nineveh	GW-springs	GW	3		3	3	2.6	100%	5.3	2014	1	0.39
44	Small farms at wells in the Ninawa	Nineveh	GW-wells	GW	4		4	4	3.5	100%	7.4	2109	1.4	0.54
45	Balandah	Dohuk	Greater Zab *	83	1		rainfed		0.0					0.00
46	Khazir-gomel	Nineveh	Khazir *	61	148		rainfed		0.0					0.00
47	Bela-rizan	Dohuk/Nineveh	Greater Zab *	80	1		rainfed		0.0					0.00
48	Diyana-balikiyan	Erbil	Greater Zab	87	6		0.9	0.9	0.8	15%	1.5	**1900**	0.4	0.15
49	Harir	Erbil	Greater Zab *	78	25		rainfed		0.0					0.00
50	Small farms at springs in the erbil	Nineveh/Erbil	GW-springs	GW	1		1	1	0.9	100%	1.7	1938	0.4	0.15
51	Markaz	Nineveh/Erbil	Greater Zab	39	14		5.6	5.6	4.9	40%	10.2	**2076.4**	1.9	0.73
52	Shemamuk	Erbil	Greater Zab	30	60		54	54	47.4	90%	101.4	2140.667	18.8	7.25
53	Eski-kalak	Nineveh/Erbil	Greater Zab	D	42	42	0	42	36.8	100%	81.4	2209.429	14.5	5.59
54	Kashaf	Nineveh/Erbil	Greater Zab	14	12		12	12	10.5	100%	25.3	2403.5	4.6	1.77
55	Sallamiyah	Nineveh	Tigris	D	9	9	0	9	7.9	100%	17.2	2178.667	3.2	1.23
56	Small farms at wells in the ninawa	Nineveh	GW-wells	GW	1		1	1	0.9	100%	1.9	2166	0.4	0.15
57	Makhmur	Erbil/Kirkuk	Greater Zab *	54	140		rainfed		0.0					0.00
58	Small farms at well in the ninawa	Nineveh/Salah-ad-din	GW-wells	GW	42		42	42	36.8	100%	107.6	2920.571	19.2	7.41

59	Penjween	Sulaymaniyah	Lesser Zab	85	10		10	10	8.8	100%	16.3	1858.2	4.2	1.62
60	Small farms at siprins in the sulaymaniyah	Sulaymaniyah	GW-springs	GW	2		2	2	1.8	100%	3.6	2052	0.9	0.35
61	Sangasar	Sulaymaniyah	Lesser Zab	25	2		2	2	1.8	100%	3.8	2166	0.9	0.35
62	Raniya-sarujawa	Erbil/Sulaymaniyah	Lesser Zab	82	48	10	0	10	8.8	21%	15.7	**1789.8**	3.4	1.31
63	Sarsiyan	Sulaymaniyah	Lesser Zab *	79	1		rainfed		0.0					0.00
64	Small farms at springs in the erbil	Erbil	GW-springs	GW	1		1	1	0.9	100%	1.8	2052	0.4	0.15
65	Small farms at wells in the kirkuk muhafadha	Erbil/Kirkuk	GW-wells	GW	1		1	1	0.9	100%	1.9	2166	0.4	0.15
66	Kirkuk	Kirkuk Salah-ad-din Diyala	Lesser Zab	D	662	662	0	662	580.7	100%	1,298.40	2235.915	224.7	86.69
67	Resasy-tereshiyah	Salah-ad-din	Tigris	76	60		60	60	52.6	100%	135.9	2582.1	23.5	9.07
68	Al boajeel	Salah-ad-din	Tigris	D	6	6	0	6	5.3	100%	16.2	3078	2.8	1.08
69	Small farms at springs in the salahad din	Salah-ad-din	GW-springs	GW	20		20	20	17.5	100%	47.2	2690.4	8.3	3.20
70	Small farms at wells in the salah addin	Salah-ad-din	GW-wells	GW	16		16	16	14.0	100%	37.6	2679	6.5	2.51
71	Haweeja	Kirkuk	Lesser Zab	23	192	100	92	192	168.4	100%	398.7	2367.281	68.4	26.39

72	Small farms from lesser zab river up to udhaim	Salah-ad-din	Tigris	56	102	0	102	102	89.5	100%	240.9	2692.412	41.6	16.05
73	Small farms at wells in the salah ad din	Salah-ad-din	GW-wells	GW	7		7	7	6.1	100%	15.2	2475.429	2.5	0.96
74	Al-khalij, al aali	Salah-ad-din	Tigris	D	18	18	0	18	15.8	100%	47	2976.667	8.1	3.13
75	Upper naifah	Salah-ad-din	Tigris	48	59		59	59	51.8	100%	150.3	2904.102	25.8	9.95
76	Dour	Salah-ad-din	Tigris	D	8	8	0	8	7.0	100%	20.4	2907	3.5	1.35
77	Al-aoja & dujail	Salah-ad-din	Tigris	D	24	24	0	24	21.1	100%	63.4	3011.5	10.9	4.21
78	Al-nai	Salah-ad-din Diyala	Tigris	D	33	33	0	33	28.9	100%	69.5	2400.909	11.2	4.32
79	Ishaqi	Salah-addin Baghdad	Tigris	D	317	317	0	317	278.1	100%	753.7	2710.467	127.6	49.23
80	Shahrazoor	Sulaymaniyah	Diyala *	84	74		rainfed		0.0					0.00
81	Kalar	Sulaymaniyah	Diyala	57	12	4	0	4	3.5	33%	8.6	**2451**	1.9	0.73
82	Kaolas	Sulaymaniyah	Diyala *	86	17		rainfed		0.0			#DIV/0!		0.00
83	Small farms at springs in the sulaymaniyah	Sulaymaniyah	GW-springs	GW	1		1	1	0.9	100%	1.6	1824	0.4	0.15

84	Shekh-langar	Sulaymaniyah	Diyala	67	1		1	1	0.9	100%	2.1	2394	0.5	0.19
85	Balajo-khanaqeen-wind	Sulaymaniyah Diyala	Diyala	68	89		89	89	78.1	100%	167.1	2140.382	29.9	11.54
86	Qara teppe	Diyala	Diyala	17	62		62	62	54.4	100%	117.2	2154.968	20	7.72
87	Jalawlaa & al-sa'diyah	Diyala	Diyala	18	24		24	24	21.1	100%	47.7	2265.75	8	3.09
88	Small farms at wells in the diyala	Diyala	GW-wells	GW	4		4	4	3.5	100%	7.6	2166	1.3	0.50
89	Upper khalis	Salah-ad-din Diyala	Diyala	D	216	216	0	216	189.5	100%	467.1	2465.25	74.9	28.90
90	Lower khalis	Diyala Baghdad	Tigris	D	230	230	0	230	201.8	100%	587.7	2912.948	98.8	38.12
91	Mandeli	Diyala	Diyala	13	29	3	26	29	25.4	100%	64.9	2551.241	10.1	3.90

92	Haruniyay+combined head reach (sudour)+ muqdadiyah	Diyala	Diyala	D	93	85	8	93	81.6	100%	188.1	2305.742	28.7	11.07
93	Ruz	Diyala	Diyala	D	230	230	0	230	201.8	100%	541.7	2684.948	82.6	31.87
94	Mahrut	Diyala	Diyala	38	190	10	100	110	96.5	58%	283.1	2933.945	48.1	18.56
95	Khoraisan (sareah) + tel asmar	Diyala/Baghdad	Diyala	31	93.4		93.4	93.4	81.9	100%	238.8	2914.69	40.3	15.55
96	Small farms in the low course of diyala river	Baghdad	Diyala	47	3		3	3	2.6	100%	7.4	2812	1.2	0.46
97	9th april project (nehrawan) "previously 7th of april project"	Baghdad	Diyala	D	78	78	0	78	68.4	100%	227.1	3319.154	37.4	14.43
98	Small farms on left bank of the diyala	Baghdad	Tigris	51	17	0	12.8	12.8	11.2	75%	37.1	3304.219	6	2.31
99	Wihda (nehrawan)	Baghdad/Wasit	Tigris	D	85	85	0	85	74.6	100%	251.5	3373.059	40.8	15.74
100	Hour-rijab	Baghdad/Wasit	Tigris	D	95	95	0	95	83.3	100%	275.9	3310.8	44.4	17.13
101	Suwairah (hafria)	Diyala/Baghdad Wasit	Tigris	D	148	148	0	148	129.8	100%	398.9	3072.608	59.3	22.88
102	Qusaiba	Wasit/Babil	Tigris	D	55	55	0	55	48.2	100%	141.1	2924.618	20.5	7.91
103	Shihaimiyah	Wasit/Babil	Tigris	D	72	72	0	72	63.2	100%	185.7	2940.25	25.9	9.99

104	Middle tigris	Baghdad/Wasit Babil/Diwaniyah	Tigris	35	528.2		528.2	528.2	463.3	100%	1,442.50	3113.309	196.6	75.85
105	Daboni (al-jutfarms)	Wasit	Tigris	D	68	68	0	68	59.6	100%	196.5	3294.265	27	10.42
106	Badra-jassan	Wasit	Tigris	21	75	47	28	75	65.8	100%	198.3	3014.16	30.3	11.69
107	Karmashiyah	Wasit	Eastern Tributaries	77	1		1	1	0.9	100%	2.6	2964	0.4	0.15
108	Dalmaj	Wasit	Tigris	D	296	296	0	296	259.6	100%	848.9	3269.412	114.5	44.17
109	West gharaf	Wasit/Dhi-Qar	Tigris	15	337	60	277	337	295.6	100%	999.3	3380.421	138.6	53.47
110	Al-mghashe "previously 17th july"	Dhi-Qar	Tigris	D	56	56	0	56	49.1	100%	167.2	3403.714	23.2	8.95
111	East gharaf	Wasit/Dhi-Qar	Tigris	24	475	55	400.7	455.7	399.7	96%	1,367.50	3421.001	193	74.46
112	Dawaiyah "previously 30th july"	Misan/Dhi-Qar	Tigris	11	183	123	60	183	160.5	100%	567.9	3537.738	79.9	30.83
113	Dujailah	Wasit	Tigris	D	186	186	0	186	163.2	100%	556.4	3410.194	81.7	31.52
114	Kut-butaira	Wasit/Misan	Tigris	20	133	16	117	133	116.7	100%	393.3	3371.143	60.1	23.19
115	Abu-bshoot	Misan	Tigris	D	29	29	0	29	25.4	100%	88.7	3486.828	12.9	4.98

116	Taib	Misan	Eastern Tributaries	2	1		1	1	0.9	100%	2.8	3192	0.4	0.15
117	Duwairij	Misan	Eastern Tributaries	1	3		3	3	2.6	100%	7.2	2736	1.1	0.42
118	Nahar-saad	Misan	Tigris	D	75	75	0	75	65.8	100%	215.7	327.64	31.1	12.00
119	Amara	Misan	Tigris	7	400		400	400	350.9	100%	1,118.40	3187.44	159.3	61.46
120	Shatt al-arab & swaib	Basrah	Tigris	66	290	20	130	150	131.6	52%	404.8	3076.48	70.3	27.12
121	Zubair (irrigated from wells)	Basrah	GW-wells	GW	35		35	35	30.7	100%	99.5	32400.857	18.4	7.10
122	Modern village 1 and 2	Baghdad	Tigris	50	60		60	60	52.6	100%	156.1	2965.9	23.3	8.99
123	Basroukiya	Diwaniyah Muthanna	Tigris	10	94		94	94	82.2	100%	273.9	3321.766	38.4	14.81
124	Mdalel, mrezeja and fao	Diwaniyah Muthanna Wasit Diwaniyah Dhi- Qar	Tigris	9	12		12	12	10.5	100%	35.5	3353.5	4.9	1.89
125	Abbasi	Kirkuk Salah-addin	Tigris *	34	60		rainfed		0.0					0.0
126	Sader	Erbil/Kirkuk Salah-ad-din	Tigris	28	150		20	20	17.5	13%	44	**2508**	7.6	2.93
127	Ali gharbi and ali sharqi	Misan	Tigris	3	137		137	137	120.2	100%	403.4	3356.759	6207	24.19
128	Boghaylat	Misan Dhi-Qar	Tigris	6	30		30	30	26.3	100%	93.4	3549.2	13.2	5.09
129	Jazeera (island) sayed ahmad	Misan Dhi-Qar	Tigris	5	40		40	40	35.1	100%	123.3	3514.05	17.4	6.41
130	Southern ez river	Misan	Tigris	4	17		17	17	14.9	100%	45	3017.647	7.7	2.97
131	Khozaimiya	Salah-ad-din	Tigris	29	5		2	2	1.8	40%	4.9	2793	0.8	0.31

132	Jazeera western samarra	Salah-ad-din	Tigris	49	89		89	89	78.1	100%	220.9	2829.506	37.5	14.47
133	Upper resasy	Salah-ad-din	Tigris	44	18		18	18	15.8	100%	45.8	2900.667	7.8	3.01
134	Southern haseeba al baghouz	Anbar	Euphrates *	59	4		rainfed		0.0					0.0
135	Expanding hilla hashimiyah	Babil Diwaniyah	Euphrates	46	150		150	150	131.6	100%	361.8	2749.68	50.5	19.48
136	Extension sewaer	Muthanna	Euphrates	16	43		43	43	37.7	100%	129.3	3427.953	18.8	7.25
137	Extension Middle Tigris-	Wasit	Tigris	36	137		137	137	120.2	100%	374.1	3112.949	51	19.68
138	Al Gharbia	Wasit	Tigris *	32	40		rainfed		0.0					0.0
139	Kirkuk Phase 3	Salah-ad-din/Diyala	Udhaim	22	160		160	160	170.4	100%	313.8	2235.825	54.3	
140	Dhalouia	Salah-ad-din Diyala	Tigris	22	32		32	32	28.1	100%	62.8	2237.25	10.9	
141	Farms in the north of Saqlawiya	Anbar	Euphrates	26			26	26	22.8	100%	68.3	2994.692	11.2	
142	Is'haqi farms from Balad up to the confluence with Tigris arm	Salah-ad-din Baghdad	Tigris		62		62	62	54.4	100%	147.4	2710.258	25	

7. Recommendations for implementing land reclamation projects

As the reclamation projects are costly projects and require large sums, and for the purpose of accelerating the reclamation of large areas, especially in central and southern Iraq, during an appropriate period, the following methods can be proposed for this purpose:

1. The governments' reclamation of lands belonging to the owners of agricultural properties by referring them to contracting and allocating the necessary amounts for them and after the completion of the reclamation work, the amounts spent on these works are recovered from the owners of agricultural properties after an appropriate period of investment, and the recovery is either in cash or in a certain percentage of the productive agricultural crops, and the government may obtain loans from international financial institutions to finance some projects
2. Carrying out reclamation projects under investment by local and foreign investors and companies, so that the investor undertakes the implementation of the integrated reclamation work of the project and then invests it for certain years and under certain conditions specified in investment contracts, and this applies to state- owned lands. The investment contract should stipulates the employment of the farmers and contractors in the project as part of the agricultural reclamation and investment works until the project is handed over to the government, which in turn returns these lands to the agricultural contracting farmers in the project, and here the farmer has gained experience and the method of work from the agricultural investor.
3. Involving agricultural engineers and graduates of agricultural institutes to invest in lands that are reclaimed by investors for the purpose of cultivating it and forming agricultural societies from them to assume this task, provided that these societies undertake work with investors during the implementation of the reclamation work and during the period of cultivation and productive agriculture and prepare a form of law and instructions for this purpose.
4. Stages of reclamation works must be integrated (study, design, implementation, washing, farming).
5. Focusing on applied scientific research in the fields of irrigation, soil and land reclamation, the results are reflected in the development of reclamation methods, shortening the implementation period, reducing the cost and improving the capabilities of reclaimed lands, as well as training engineering and intermediate personnel in operating and maintaining irrigation and drainage networks.

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