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Regional Office for the Near East (RNE)
Oriental Near East Sub-Region (SNO)

Country Study on Status of Land Tenure, Planning and Management in Oriental Near East Countries

CASE OF JORDAN

By
Awni Taimeh (National Consultant)

Edited by
Faycel Chenini (International Consultant)

Supervised by
Moujahed Achouri (DRR-RNE, HMDT-SNO-FAO)

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Foreword

Land tenure, planning and management gain increasing importance in view of accumulating problems related to natural resources degradation notably for the Oriental Near East Countries (namely the Arab Republic of Egypt, Lebanon, the Syrian Arab Republic, Jordan, Iraq and the Islamic Republic of Iran).

Natural resources degradation constitutes an important threat for the human society especially in the Near East region. Land and water degradation is affecting and will affect agriculture and all dimensions of food security, such as food availability, food accessibility, food utilization and food systems stability. Scarcity and degradation of land and water have and will have an impact on human health, livelihood assets and food production as well as growing threat to food security.

The State of the World's Land and Water Resources for Food and Agriculture (SOLAW), recently published, notes that food production has been associated with inappropriate management practices that have degraded the land and water systems.

The global assessment of the state of the planet's land resources is showing that one quarter are highly degraded. Another 8 % are moderately degraded, 36 % are stable or slightly degraded and 10 % are ranked as "improving." The remaining shares of the earth's land surface are either bare (around 18 %) or covered by inland water bodies (around 2%). Some 40 % of the world's degraded lands are located in areas with high poverty rates. Around 30 % are in areas with moderate levels of poverty while 20 % are in areas with low poverty rates.

The Oriental Near East Sub-region (SNO) is one of the most affected regions by direct and indirect causes of land degradation that is remaining one of the main challenges of the twenty-first century. The threats are still present throughout all member countries and will likely worsen with important impacts on sustainable agriculture in general and food security in particular.

Over the last few years, FAO has: i) dedicated considerable attention to land issues and taken a wide range of initiatives and activities, particularly in the Near East Region; ii) promoted sustainable land management constitutes one of the main priorities in the agenda of FAO Regional Office for the Near East; iii) reinforced capacity in land management and tenure for sustainable agriculture in the Sub-region; and iv) helped in the identification of appropriate actions and developing capacities in land tenure, planning and management.

In response to requests from its Member Countries, FAO has also dedicated considerable attention to improve agricultural productivity and food security with special consideration to sustainable land management and natural resources conservation. FAO approaches land management by developing land degradation assessment methods and sustainable land management and decision support tools for national and local levels.

Presently, FAO is more focusing on:

- Land tenure and implications of climate change scenarios;
- Land tenure and implications of policy options in relation to the rapid growth of land use for bio-energy production;
- Land tenure in emergency and post-emergency work;
- Compulsory purchase of land and compensation;
- State land management;
- Low-cost land tenure security;
- Good governance in land administration; and
- Making land information accessible for the poor..

FAO/SNO produced this country study on the "Status of Land tenure, Land Management and Land use planning in SNO Countries" – Case of Jordan to update information and data, and subsequently,

identify issues and priorities for technical and policy support, both with a sub-regional dimension and needed recommendations. It aims at providing a highlight of the current situation regarding land tenure, planning and management and making and adopting potential recommendations on what needs to change at policy and institutional and ground levels to promote interdisciplinary and inter-ministerial/institutional processes.

FAO and its partners, in collaboration with member countries, will continue to cooperate and provide technical assistance with practical and feasible recommendations for promoting sustainable land management and on what needs to change at policy and institutional and ground levels to promote interdisciplinary and inter-institutional processes on planning, tenure and management in the sub-region.

Moujahed Achouri
Deputy Regional Representative for the Near East,
Head of the Multidisciplinary Team for Oriental Near East Sub-Region, and
FAO Representative in Egypt.

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Awni Taimeh

Amman, March 2012

Executive Summary (Part I)

The Ottoman land law played an important role in determining land rights and the distribution of ownership size in Jordan. Land utilization rights in 1975 were as follows: 9.1 million donums were owned by individuals. 1.5 million donums was registered as forest land, 4 million donums as government land, 1.4milion donums was commissioned to various individuals and agencies, 0.6 million donums to government agencies, 4.4million donums under survey, 6.6 million donums oil exploration companies right, 2.0 million donums for phosphate mining right, 0.5 million donums for oil shale exploration, 1.7 million donums controlled by the military, 2.2 million donums designated as tribal land, and 0.537 million donums for potash company.

Legal land ownership indicated a substantial reduction of areas owned by households after 1997. Land owned by partners increased by 139% which suggested that investment in agriculture was reduced. While the number of holdings had increased, number of small investors in irrigated areas had increased. The number of households' ownership decreased for most land classes except for two classes; 30 - 40 donums and 500 - 1000 donums. On the contrary to the partner ownership, all land classes showed substantial increase, except for the 100 – 200 donums land class.

Land market in Jordan is an emerging one. It is among the largest and rapidly growing sector in the country. Among factors affecting land market in Jordan: location within or out of regulated areas; geographical location; level of development of the region; level of land fragmentation; economic situation within the country and the region; land legislations; and regional land use planning.

Institutional reforms were restructured in 1993. Ministry of Agriculture mandates focused on organizing and supervising development. New research and technology and extension center was also established, and the Agricultural Marketing Corporation was abolished in 2002.
The government eliminated subsidies on animal feeds and price subsides on vegetables. The price is now controlled by supply and demands, but continued to buy wheat and barley from farmers.

Many reform steps were taken to improve the performance of this sector. This included the introduction of fees restricting pumping and metering. Factors affecting sustainability of irrigated areas the Upland region are related to resource management, which is marked by continuous decline of quantity and quality of water resources available for irrigation, low productivity per land unit due to poor farm management, the use of crop poorly matched with of soil suitability, poor enforcement of environmental legislations, poor research and extension support to control pollution, increasing use of treated waste water, low water use efficiencies, reluctance of the government to enforce pumping regulations, the need to introduce modern technology, massive number of farmers lacks the required experience and the financial liability to introduce modern production, and high cost of production inputs.

Legislations with significant negative impacts on land resources included Law No. 79, 1966: Organization of Cities and Villages, and Buildings. The law did not include any article that clearly aims at protection of AL, Law No. 48, 1953, which allows division of land to minimum of 10donums outside the municipal and village boundary and encourages land fragmentation within rainfed areas, and Bylaw No.6, 1996: Land Division between Partners: This bylaw allows the division of parcels within specific governorates, to 4donums between partners, and lately, Land Use Bylaw No.6, 2007. This was rather zoning regulations, but permitted building on agricultural land.

Legislation reforms covered several relevant laws such as Agricultural Law No.20, 1973, which was replaced by Agricultural Law No.44, 2002, where Ministry of Agriculture mandates were redefined as an authority responsible for development, regulation, monitoring the agriculture sector in Jordan, and the role expected form the private sector.

In Jordan, several strategies and polices were prepared. The first policy charter was adopted in 1994. The objective of the charter was to manage different subsectors in a sustainable way. The charter was followed by more comprehensive national strategy for agricultural development for the period from 2002 to 2010. Action plan, including 130 projects covering all agriculture sub-sectors, was also prepared. A national strategy and action plan for drought management was prepared in 2007, and a national strategy and action plan to combat desertification: The strategy was adopted, 2006. Biodiversity Strategy was prepared in December 2003, and Jordan National Agenda 21 was prepared in

2001 which integrates the different disciplines of environment. In addition, the government prepared several sub-sectors water polices and the national strategy for water resources utilization, and lately, the new Water Strategy: Water for Life. The agriculture sector benefited from the ratification of many conventions such as the Conventions to Conserve Biodiversity, Combat of Desertification, and Climatic changes. As a result, action plans and measures to put the sector on the path of sustainability were prepared.

The lack of sustained national efforts to protect land resources from urbanization and degradation, improving resources productivity, deficiency of legislations or their enforcement, and government sustained efforts to develop other sector of the economy, without due attention to agricultural sector, forced farming communities to leave this sector looking for better living conditions in large cities. This resulted in the emergence of young generation with very little or no experience in farm production, who started to treat the land as a commodity, which helped in creating very active land market. Currently large areas had entered the market instead being used for food production, which explains why about thirty percent of the land is abandoned annually without cultivation every year.

Executive Summary (Part II)

Jordan has limited land resources. More than 90% of the country suffers from dry climate and various types of degradation. These land resources faces future with clear threats that jeopardize their role as a source for providing food for increasing population. Land resources in Jordan face several challenges. Among such challenges is caused by increasing pressure inflected by expansion of populated areas on these resources whose growth did not match the growing population during the last seven decades according to normal growth rate, which increased suddenly many time by waves of refuges from different surrounding countries. Such sudden increase in population contributed to establishment of new urban centers without any consideration to proper land use planning to protect the agricultural land resources from urban expansion and future encroachments of these centers on new land. The early establishment of new villages around springs within areas with higher rainfall also contributed to the establishment of more than 95% of the urban centers within areas suitable for rainfed farming. Various type of civil and heritage legislations were primary factors contributing to fragmentation of agricultural land resources concentrated around urban center.

Main arable land resources are distributed over different ecosystems including Jordan Valley (Sub-tropical climate), Upland (Mediterranean semiarid-sub-humid climate), Steppe region (Semiarid-Arid Mediterranean climate, called transitional zone), and Arid region (Mediterranean dry climate, known locally as Badiah Region). Rainfed farming system is practiced in semi-arid to sub humid climate, within 9% of the total area. Irrigated farming system is practiced in Jordan Valley and in the Upland region covering 1,258,705donums, of which, 274,300 donums, is in Jordan Valley, Range farming system is possible over 81% of the total area. Forest farming where natural and artificial forests in Jordan cover only 1% of the total area.

The following public institutions were identified to have significant, but variable role in the development of land resources in Jordan. These institutions are: Ministry of Agriculture is mandated with development, and regulation of agriculture sector in Jordan, Agricultural Credit Corporation, which contributed significantly in the area of conservation of land resources. Ministry of Water and Irrigation is responsible for the overall monitoring of the water sector, water supply and wastewater system and the related projects, planning and management, Ministry of Municipal Affair empowered with allocation of land resources, Ministry of Environment mandated with duties to protect the environment in Jordan, conserve natural resources, adopting policies, legislations and strategies, monitor implementation of projects and ensure that environmental requirements. Land and Survey Department is responsible for the implementation of land laws and bylaws, Jordan Standards and Metallurgy Organization and Standards is mandated with issuing and implementation of standards and related to land, water and environment. Ministry of Trade and Industry implements government policy related to provision of subsidies for animal feeds, Ministry of Social Development undertakes programs related to resources use and development of rural resources, and Department of Statistics responsible for generating statistical data and undertaking periodical censuses.

Many issues are threatening land resources in Jordan. These include lack of institutional coordination with Ministry of Agriculture, poor implementation of adopted policies and strategies, weak enforcement of legislations pertinent to resource protection such as illegal pumping, poor coordination between relevant institutions, contradiction between legislative mandates , lack of adopting a national policy to protect resources, lack of sustained developmental programs focusing on protection of land from degradation, neglecting the role of Ministry of Agriculture in management of irrigated areas, lack of any national policy to protect land resources from competition by other sectors, inability of research outputs to support sustained development, and the implementation of short-term-programs that reduces the environmental hazards, and the lack of clear policy regarding expansion of urban areas on the expense on agricultural land. Among the most alarming threats is the failure to implement the prepared national strategy whether for development of AS or water sector, and the lack of proper legislations or poor or misuse of existing ones.

Land degradation is caused by many factors including socio-economic factors, framework governing the land tenure system, land use, and land use policies, national policies and market tools affecting local land users, taxation and trade barriers can be listed as factors contributing to degradation. General factors include increasing negligence, pressure on land resources, poor land allocation, expansion of irrigated land into dry regions, expansion of areas cultivated fragile land, vegetation destruction, increasing animal stocking, overgrazing, and traffic movement, and plowing of rangelands, high level

of seasonal rainfall, presence of problematic soil, poor enforcement of existing or lack of proper legislations, and lack of regional land use planning. Dominant degradation processes includes soil salinization in Jordan Valley, erosion by water in Shafa-Ghor, degradation of vegetation cover, water erosion, soil salinization, and degradation of ground water in the Upland region, salinization, degradation of vegetation, erosion by wind, erosion by water, and deterioration of soil properties Steppe Region (compaction, structural stability), and the Badiah Region.

Protecting these resources from possible degradation, while producing safe food, will be a real challenge for national research system to formulate innovative production packages which ensure balance between environmental impacts and production of safe affordable products. Land resources' utilization had experienced substantial changes during the last four decades, while rainfed production of cereals are continuously decreasing, and rainfed vegetables and legumes are on the brink of extinction, irrigated vegetables had dominated irrigated sector. With regard to fruit trees, irrigated and rainfed grown olive almost dominated fruit trees' sector.

In Jordan, successful sustainable land management practices were based on the following:

- Measures: included the preparation of many strategies and action plans to meet the commitment of international conventions on Conservation of Biodiversity, Combat of Desertification, Protection of the Environment, Climatic Changes, and Jordan Agenda 21, as well as preparation of developmental strategy and poverty alleviation. Many legislations were prepared that covered the agriculture sector, water, and environment sectors as well.
- Resource management: programs included implementation of long-term program such as the Highland Development Project, which aimed to control erosion by water on steep slope and farm development all over the country, Agricultural Resources Management Project, which focused on improvement of range resources in collaboration with International Fund for Agriculture Development (IFAD). Small scale agricultural development was carried by the Agriculture Credit Corporation. Non-governmental Organization had been active in various activities related to food production in rural areas and empowerment of rural households.
- Approaches: to improve performance of agriculture sector included improving water use efficiency, implementing many of on-farm and watershed water harvesting programs. Integrating water harvesting with resource development became one of the main pillar of resource development in dry region, which encourage private sector to invest in such technology.
- Integrated development was also employed in increasing the productivity of Arid-Semi-Arid land and suffering from desertification, and rehabilitation of range resources, which was implemented by Ministry of Agriculture to improve the productivity of the range and land resources in Jordan.

Sustainability of land resources is threatened by the continuous reduction in water quantity available for irrigation and deteriorating quality due to increasing competition of fresh water for domestic use and increasing use of treated waste water for irrigation, which enhance the rate of soil degradation,.iincreasing random urban expansion activities, poor regional planning, and inadequate legislations, lack of clear national sustained policy, absence of national integrated plan to develop and protect land resources, absence of any plans to tap land resources of the dry region with promising potential, continuous reduction of the available quantities of fresh water from surface and ground resources for irrigation and continuous depletion of ground water resources, which causes soil salinization. lack of comprehensive and stable policy, or adoption of strategic planning, which ensure long-term implementation of action plans, lack of proper legislations or and weak enforcement of existing ones, week private sector participation in planning and implementation of many activities, weak institutional coordination between governmental organizations relevant to agricultural development, lack of financial resources, and weak private sector investment, are among important threat to sustainability of agriculture sector.

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Measurements and Conversion

Area

1 Donum= 0.1 hectare

Currency

1 Jordan Dinar (JD)= 1.4US dollar

List of Abbreviations

ACC	Agricultural Credit Corporation
AD	Agricultural Development
AH	Agricultural Holding
AL	Agricultural Land
AMCO	Agricultural Marketing Corporation Organization
AP	Agricultural Production
APC	Agriculture Policy Charter
AS	Agricultural Sector
CM	Cubic Meter
d	Donum (24.1 d = 24.1 donums)
DOS	Department of Statistics
FC	Field Crops
FT	Fruit Trees
IFAD	International Fund for Agricultural Development
IA	Irrigated Area
ICARDA	International Center for Agricultural Research in the Dry Areas
JD	Jordanian Dinar
JFGA	Jordanian Farmers General Association
JOMOS	Jordan Standards and Metallurgy Organization and Standards
JV	Jordan Valley
JVA	Jordan Valley Authority
IA	Irrigated Area
IPCC	Intergovernmental Panel on Climate Change
JOHUD	Jordanian Hashemite Fund for Human Development
LF	Land Fragmentation
LH	Land Holdings
LR	Land resources
LSD	Land and Survey Department
LU	Land Use
LUP	Land Use Planning
MCM	Million Cubic Meters
MMA	Ministry of Municipality Affairs
MoA	Ministry of Agriculture
MoEn	Ministry of Environment
MoPIC	Ministry of Planning and International Cooperation
MoS	Ministry of Supply
MSD	Ministry of Social Development
MTI	Ministry of Trade and Industry
MWI	Ministry of Irrigation
NCARE	National Center for Agricultural Research and Extension
NCARTT	National Center for Agricultural Research and Transfer of Technology
NGOs	None-Governmental Organizations.
NSAD	National Strategy for Agricultural Development
PS	Private Sector.
RA	Rainfed Areas
RL	Rangeland Resources
RSCN	Royal Society for the Conservation of Nature
RSS	Royal Scientific Society of Jordan
TWW	Treated Waste Water
UL	Up Land
WAJ	Water Authority for Jordan
WR	Water Resources
WTO	World Trade Organization

PART ONE

1 Land rights

1.1 Introduction

Land use (LU) refers to a plan established for allocating land resources to different users according to specific priorities which provide balanced distribution of the national land resources to meet the demand of all users and to achieve long-term national interests and objectives. Sustainable LU must be economically feasible, environmentally friendly, and socially acceptable. Thus, land allocation to different users must achieve the following goals: (1) Meet the demand of population and protect the resources for the use of future generations, but without compromising the immediate need of the current population, (2) Enhance the protection and preservation of land resources from degradation to preserve their productivity.

Land distribution, or allocations, among citizens including all national sectors is a complicated process. Its implementation cannot be carried out without proper policy, and legislations to control and reduce competition between different users.

Unfortunately, legislations that are required to protect the limited agricultural land (AL) resources in Jordan from other non-agricultural competitions, were never adopted or properly enforced. Legislations also facilitated further land division, and big land market was created. The price of the land was several times higher than revenues attained from agricultural production (AP), which encourages young generation, who inherited land and never practiced farming to sell their land for a quick profit. Land fragmentation (LF), and size of holdings stand as the most important contributor to losses of agricultural land (AL). These issues are highly related and affected by land rights in Jordan.

1.2 Land rights in Jordan

Land rights played an important role in determining the level of ownership size in Jordan. Large part of Jordan land was allocated land rights even before Jordan was established during the Ottoman occupation which ended in 1918. Such land rights were maintained later when the new legislations were prepared when Jordan became an independent state in 1946. Table 1.1 provides information on the distribution of land among different parties with different land rights. It is worth to note that until late seventies of the last century; only probably about less than 10% of the land was privately owned, while the rest was under government control.

Land right used in the Ottoman Land Law (The law was not assigned a number) was maintained during the preparation of the new land legislations. According to the Ottoman Land rights were divided into five types:

i. Mulk: Land held in absolute ownership. Owner is free to dispose his land. According to Civil law No.43, 1953, Mulk was confined to municipal and urban land and excludes agricultural land (AL).
ii. Meeri (Ameeri): This land is legally owned by the state but is under perpetual lease to the occupier, who has inherited right of disposal. According to Land Code Article No. 68, the state has the right to claim land not cultivated for three years or more.
iii. Waqf: This land is a gift, usually for charitable or religious purposes, part of this land could be Meeri Waqf.
iv. Mawat (Mawat in Arabic means dead or useless): According to Land Code Article No.6, it is unoccupied land, which has not been left for public use; usually it is too far from urban activities.
v. Matruk: Is land set aside for public use, such as road, cemeteries and village threshing floors or transfer.

The main types were divided to other right such as:

- Mudawar: Refers to land was originally held by farmers as Meeri land in Jordan Valley (JV) area but was transferred upon the farmers own request to Crown land holdings (LH) during the Ottoman rule.
- Masha'a: Refers to village land that was usually planted with field crops in common with undivided ownership represented in terms of shares.

- Meeri Muftalah: Used for agriculture.
- Meeri Kharag: Type of Mulk distributed to original minority land owners.
- Meeri Bir Maa: Water wells.
- Meeri Marwi: Irrigated land right.

2 Agricultural holdings

2.1 Changes in agricultural land holdings

Examining the development of number and size of agricultural holdings is not easy. Sometimes it is impossible to achieve due to the lack of consistent series data needed to assess possible changes. This problem is caused by the continuous changes in the administrative boundaries, and the continuous land registration which masks prior distribution of LHs in different areas. Moreover, recently, large areas within dry regions were surveyed and distributed to different owners. The government started, since 1965, conducting periodical agricultural census every ten years. These surveys also contributed to the problems, because the results of these censuses were presented using different formats, which made comparison, in many cases impossible. Very often new administrative units and new types of very important data were added to the new census. The addition of new type of data was necessary to meet, increasing demand for managing highly changeable agricultural sector (AS), and as response to the recommendations proposed by the different strategies with direct and indirect relevancy to AS. The inability to establish suitable data series was further complicated since many governorates' administrative boundaries were changed and new governorates were established between the times scheduled for new census. All these developments were also accompanied with continuous land surveys, registration, and distribution of new land.

The total land area of Jordan is 88,945,371d. According to the record of Land and Survey Department (LSD), area surveyed, in 1975, was 1,440,848 d (Table 1.1). The rest of land, 74,536,623 d was not surveyed and registered. About 50% of the registered land was in Amman and Irbid governorates.

Table 1.1: Area of surveyed and un-surveyed land, by Governerates, 1975

Governorate	Surveyed	Non Surveyed	Total
Ma'an	1363926	34776987	36140913
Mafraq	1668637	25460168	27128805
Amman	3356899	7255610	10612509
Zarqa	1812688	3388257	5200945
Karak	1700889	2308963	4009852
Irbid	2550539	--	2550539
Tafila	855051	1346638	2201689
Balqa	1100119	--	110119
Total	14408748	74536623	88945371

Sources: Awni Taimeh, Land Use in Jordan, calculated from DOS reports , 2011.

Land utilization rights in 1975 were as follows: 9.1 million donums were owned by individuals, (Table 1.2). 1.5 million donums was registered as forest land, 4 million donums as government land, 1.4milion donums was commissioned to various individuals and agencies, 0.6 million donums to government agencies, 4.4 million donums under survey, 6.6 million donums as oil exploration companies right, 2.0 million donums for phosphate mining right, 0.5 million donums for oil shale exploration, 1.7 million donums controlled by the military, 2.2 million donums designated as tribal land, and 0.537 million donums for potash company.

Table 1.2: Land ownership right in Jordan

Type of LU by Ownership & Governorate						
Governorate/Ownership	**Mulk**	**Meeri**	**Meeri Muftalah**	**Meeri Haraj**	**Meeri Bir Ma'a**	**Meeri Marwi**
Amman						
Individual	645148	1143336	345.5	126	2485.3	8842
Foreign members	2343.1	1435.4	0	0	0	0
Private companies	1907	4137	0	0	0	0
Governmental Agencies	5677.6	3538.2	0	27.4	0.8	3.5
Foreign companies	0.2	0	0	0	0	0
Government	5731.1	10580.8	55628.2	11067	15.7	2.3
Waqf (charge, mosque..)	73.1	0	0	0	0	0
Total	660880.1	1163007	55973.7	11220.4	2501.8	8947.8
Irbid						
Individual	180228	114664	76	1115	256	20182
Foreign members	201	1643	0	10	0	403
Private companies	182	1762	0	0	0	0
Governmental Agencies	851.5	3543	0	153	0	453
Foreign companies	0.3	0	0	0	0	0
Government	1981.7	16796.6	87.2	25148	14.6	95.9
Waqef (charge, mosque..)	5.4	41.2	0	0	0	0
Total	183449.9	138449.8	163.2	26426	270.6	21134.9
Zarqa						
Individual	190031	32105	1609	2	16	1384
Foreign members	166	1719	0	0	0	0
Private companies	826.5	844	0	0	0	0
Governmental Agencies	728.5	1380	0	304.2	0	0
Foreign companies	0	0	0	0	0	0
Government	13606.3	102100.2	56451.3	4292.2	281.3	0
Waqef (charge, mosque..)	0	0	0	0	0	0
Total	205358.3	138148.2	58060.3	4598.4	297.3	1384
Balqa						
Individual	354512	1203812	5	169	3	10214
Foreign members	37	1478	4	0	0	0
Private companies	121.1	1638	0	36.6	0	141
Governmental Agencies	212.4	0	101	41	0	76.2
Foreign companies	0	0	0	0	0	0
Government	290.6	17062	3236.6	13486	0	15.3
Waqef (charge, mosque..)	0	0	0	0	0	0
Total	355173.1	1223990	3346.6	13732.6	3	10446.5
Mafraq						
Individual	37224	1284430	204	270	13	0
Foreign members	98	769	0	0	0	0
Private companies	79.5	177.6	0	0	0	0
Governmental Agencies	420.1	2904.3	0	3.5	0	0
Foreign companies	0	0	0	0	0	0
Government	2846.7	29753.8	6851.7	5057.7	0	0
Waqef (charge, mosque..)	0.1	433.2	0	0	0	0
Total	40666.4	1318468	7055.7	5331.2	13	0
Karak						
Individual	396318	967408	4000	25	11	3
Foreign members	19	66	0	0	0	0
Private companies	195.7	616.1	166.2	0	0	0

Governmental Agencies	563.7	514.7	12.8	1.3	0	0
Foreign companies	0	0	0	0	0	0
Government	1159	20435.7	41931.1	20264.3	62.4	0
Waqef (charge, mosque..)	0	5.9	0	0	0	0
Total	398255.4	989046.4	46110.1	20290.6	73.4	3
Tafila						
Individual	22739	273563	318	0.6	6	0
Foreign members	6	217	0	0	0	0
Private companies	106.1	407.2	0	0	0	0
Governmental Agencies	321.5	120.8	0	0	0	0
Foreign companies	0	0	0	0	0	0
Government	326.4	12823.5	3426	8358.3	0	0
Waqef (charge, mosque..)	13.2	44.3	0	0	0	0
Total	23512.2	287175.8	3744	8356.9	6	0
Ma'an						
Individual	62076	688122	899	0	137	0
Foreign members	6	217	0	0	0	0
Private companies	10159.7	1040.6	0	0	0	0
Governmental Agencies	187	346.5	0	0	0	0
Foreign companies	0	0	0	0	0	0
Government	12261.2	34385.5	6984	2378.6	0.5	0
Waqef (charge, mosque..)	0	0	0	0	0	0
Total	**84689.9**	**724091.6**	**7883**	**2378.6**	**137.5**	**0**

All numbers are in hectare Source: Awni Taimeh, Land Use in Jordan, 2011.
Governorate of Irbid include Jarash & Ajlun Governerates
Governorate of Amman include Madaba Governerates
Governorate of Ma'an include Aqaba Governerates
Occupied land now is zero after the assignment of the peace convention

The overall average size of parcels, in 1990, decreased to 24.1d (Table 1.3 and 1.4). Balqa and Irbid governorate showed clear reduction in the average parcel size, which is due to land fragmentation (LF), while the parcel size increased in governorates such as Mafraq and Ma'an, due to distribution of land to private citizens. It should be noted that this average represented all types of land.

Table 1.3: Average changes in size of parcels for selected areas

Area	Average size/parcel	
	1975	**1990**
Amman	17.7	6.7
Balqa	60.3	16.7
Madaba	45.8	42.3
Ajlune	23.9	18.3
Zarqa	15.9	37.9 *
Karak	53.4	34.2
Tafila	29.7	35.8 *
Ma'an	21.2	48.2 *
Irbid	68.4	7.9
Ramtha	56.6	19.3
Jarash	17.1	6.6--
National average	30.8	24.1

Source: Awni Taimeh, Land Use in Jordan, Department of Land and Survey, 2011.

The average area per parcel was 24,1d in 1990. This represented a reduction of 6.7 d (21.8%) in comparison with parcel average in 1975 (Table 1.3). The total surveyed area increased from 15,234,152 d, and the number of parcels 631,555 in 1990 (Average/parcel 24.1d) , while in 1998, the surveyed area increased to 23,274,409 d (Land Survey Department report, 1998), and the number of parcels to 941,770 (Average/parcel 24.7 d). This value of average parcel size does not, by any mean, suggest that parcel size did not decrease, because the period between 1990 and 1998 was marked by registration of new large areas, especially within law rainfall areas. The reduction however, was much

higher in areas with rainfall > 200mm of annual rainfall, since most of the newly surveyed areas were within areas that receive less than 200 mm of annual rainfall. Average size of land /owners, at the national level was 8.67 d in 1998. The total number of landowners, during the same year, was 2,685,482.

The continuous changes in the administrative boundaries, new land surveys and registration, resulted in the inclusion of large size ownerships, which were concentrated in areas receiving < 200mm of annual rainfall (See distribution of ownership under different rainfall regions).
The average area/parcel for private ownership varied from 2.7- 4.5d for all areas, while average area/ parcel for governmental land, varied from 18 – 89 d. The size of private land suggested that such land is not suitable for cultivation of field crops, or other traditional cultivation.
A clear reduction in the size of parcel can be observed within Amman area, which, was not subjected to administrative chances. Area/parcel were 1.4 d and 6.4 d for North and West of Amman. These areas are highly populated and subjected to intensive urban developments. Irbid city is ranked second after Amman in size of parcels, while Tafila possessed the largest area/parcel (Land Survey Department, 1990).

The record of the Land and Survey Department (LSD), in 1998, (LSD, 2000) classified according to the size of parcels presented different dimension regarding their distribution at different locations. The number of parcels (Table 1.4) had increased to 941,770, which represented an increase of 150% since 1975. The data indicated that in 1998, parcels < one donum occupied 43.9% of the total number of parcels, while parcels with 1- 4 donums occupied 17.2%. The data also indicated that 61.2% of the total number of parcels in Amman had an area less than one donum; while for Balqa and Irbid governerates it varied between 37- 44.7%. This means that 61% of the total number of parcels of the surveyed land would not be suitable for agricultural utilization. The percentage of land with parcels with area less than 4 donums increased to 67% for Amman, and 64% for Irbid. Number of parcels with area >10 donums was 31.5%. However, this was due to higher ownership gained recently as a result of land registration within governerates occurring within low rainfall regions. The opposite was clear in governorates such as Amman and Irbid were the proportion of parcels larger than 10 d was 17% in Amman, and 25% in Irbid.

Unfortunately, the record does not distinguish between the arable and non-arable parcels, or privately from public ownership. Nevertheless, the record suggested clearly a high level of ownership fragmentation within different areas. The fragmentation seemed to reach very dangerous level within areas most suitable for rainfed agriculture. Further land ownership fragmentation is expected since areas suffering such small ownerships are located within heavily populated areas. Based on current trend of urban developmental activities on the ground, future projections pointes towards very alarming results since expansion of these populated areas will take place within and around these small ownerships, and since no measures are planned to direct the expansion of existing or future urban sites to avoid further fragmentation.

Table 1.4: Average changes in size of parcels for selected areas

Governorate	<1 d		1-4 d		4-10d		>10 d		Total
Amman Governorate	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**
Directorate									
Geza	4826	59.17	2399	29.41	570	6.99	361	4.42619	8156
Amman S.	31931	50.42	12365	19.52	4406	6.96	14629	23.0993	63331
Amman E.	24026	76.66	5874	18.74	662	2.11	781	2.49178	31343
Amman N.	39176	64.67	14829	24.48	2620	4.32	3954	6.52701	60579
Amman	72983	62.96	11008	9.50	5772	4.98	26156	22.564	115919
Amman W.	22149	68.11	5492	16.89	1708	5.25	3169	9.74537	32518
Madaba	13596	42.86	4342	13.69	2936	9.26	10847	34.195	31721
Na'or	10465	50.89	5554	27.01	1487	7.23	3059	14.8748	20565
Total	219152	60.18	61863	16.99	20161	5.54	62956	17.2893	364132
Irbid Governorate									
Directorate									

Irbid	52894	61.93	15115	17.70	5682	6.65	11712	13.7138	85403
Ramtha	6262	37.58	3672	22.04	1587	9.52	5143	30.8629	16664
Shouneh N.	2943	33.68	839	9.60	493	5.64	4463	51.0758	8738
Taibeh	2071	42.74	855	17.64	479	9.88	1441	29.7359	4846
Mazar N.	2534	31.59	1983	24.72	1487	18.54	2017	25.1465	8021
Jarash	8673	31.54	5970	21.71	4084	14.85	8768	31.8894	27495
Deir abu-sa'ad	5350	34.13	4034	25.74	2160	13.78	4130	26.3494	15674
Samar	3431	24.76	3119	22.51	2090	15.08	5219	37.6578	13859
Ajlun	8853	32.52	5409	19.87	4461	16.39	8501	31.2261	27224
Total	**93011**	**44.73**	**40996**	**19.72**	**22523**	**10.83**	**51394**	**24.7177**	**207924**
Zarqa Governorate									
Directorate.									
Rusaifah	12866	58.70	2241	10.22	2151	9.81	4661	21.2647	21919
Zaraqa	44856	65.20	7162	10.41	4010	5.83	12769	18.5604	68797
Duliel	332	22.18	280	18.70	60	4.01	825	55.1102	1497
Total	**58054**	**62.96**	**9683**	**10.50**	**6221**	**6.75**	**18255**	**19.7966**	**92213**
Balqa Governorate									
Directorate									
Salt	15525	39.35	8830	22.38	5712	14.48	9388	23.7942	39455
Shouneh S.	3313	38.38	1631	18.90	400	4.63	3287	38.0837	8631
Dier Alla	312	9.18	359	10.57	135	3.97	2592	76.2802	3398
Total	**19150**	**37.20**	**10820**	**21.02**	**6247**	**12.13**	**15267**	**29.6539**	**51484**
Mafraq Governorate									
Directorate									
Mafraq	12448	24.98	8871	17.80	4476	8.98	24039	48.2382	49834
Total	**12448**	**24.98**	**8871**	**17.80**	**4476**	**8.98**	**24039**	**48.2382**	**49834**
Karak Governorate									
Directorate									
Qaser	3561	36.84	1574	16.29	608	6.29	3922	40.5794	9665
Katraneh	561	24.20	289	12.47	220	9.49	1248	53.8395	2318
Karak	10473	32.93	6087	19.14	4054	12.75	11193	35.1904	31807
Mazar S.	5953	35.03	3188	18.76	1877	11.04	5977	35.1692	16995
Total	**20548**	**33.80**	**11138**	**18.32**	**6759**	**11.12**	**22340**	**36.7525**	**60785**
Tafila Governorate									
Directorate.									
Tafila	6063	30.86	3344	17.02	2367	12.05	7870	40.0631	19644
Bosaira	1181	18.16	940	14.45	1376	21.16	3006	46.2248	6503
Total	**7244**	**49.03**	**4284**	**16.38**	**3743**	**14.32**	**10876**	**41.5956**	**26147**
Ma'an Governorate									
Directorate.									
Shoubak	876	12.09	1308	18.06	694	9.58	4366	60.2706	7244
Aqaba	7310	66	1388	12.53	545	4.92	1832	16.5418	11075
Ma'an	4702	31.73	2142	14.45	2803	18.91	5172	34.9011	14819
Wadi Musa	3248	37.58	1708	19.76	840	9.72	2847	32.94	8643
Total	**16136**	**38.62**	**6546**	**15.67**	**4882**	**11.68**	**14217**	**34.0274**	**41781**
Grand Total									**894300**

Calculated from LSD database by the author,
Sources: Awni Taimeh, Land Use in Jordan, 2011.

2.2 Distribution within different rainfall zones

The analyses of LHs with regard to rainfall distribution revealed the potential land utilization. The available data (Table 2.1) indicated that 46.9% of the LHs occur within areas which receive < 200mm of annual rainfall. This suggested that such land under prevailing conditions would be suitable for range. Furthermore, it represented only about 9.7% of the total number of holding (MoA, 1973). This means that holdings with large size dominate this region, which is clear from the distribution of land classes, where land class > 200d occupied 44.4% of the number of holdings. The analyses also indicated that LHs which occur within rainfall zone > 500mm of annual rainfall, occupied only 5.8% of the total areas, while the number of holdings occupied 49% of the total number. More alarming to note is that land class < 10d occupied 47% of the LHs in this region, which reflects the extent of LF with an area supposed to be the most suitable for AP in Jordan. Land occurring within rainfall zone between 200 and 500mm occupied 34% of the total area, and 40% of the total number of holdings. Again holdings >200d occupied 38% of the number of holdings of area with 200-350mm, or 16.8% of its area. Land classes < 200d shared relatively similar distribution with regard to area and number of holdings within rainfall zone between 200and 500mm of annual rainfall.

Table 2.1: Distribution of agricultural holding according o rainfall zones, 2007

Class	< 200 mm		200-349 mm		350-500 mm		>500 mm		Unclassified	
	No	% Area	No	% Area	No.	%Area	No.	% Area	No.	% Area
<10	11.1	10.5	21.2	21.1	20.5	41.1	47.3	24.1	-	3.1
20-29	5.0	11.1	19.2	25.4	21.6	31.6	52.4	15.8	-	16.1
30-49	6.0	8.4	19.5	15.0	19.5	12.0	55.3	4.7	-	59.1
50-99	9.4	28.0	23.3	32.4	17.6	16.4	49.7	5.3	-	17.9
100-199	19.9	47.6	27.8	32.9	16.9	10.8	35.4	2.9	-	5.8
>200	44.3	75.7	38.0	16.8	10.0	4.0	7.7	1.3	-	2.2
Average	9.7	46.9	21.3	20.7	19.9	13.1	49.0	5.8	-	13.5

Source: Awni Taimeh, Land Use in Jordan, Source MoA, 2011.

2.2.1 Distribution of number and areas of agricultural holdings

The overall number of LH increased by 48.4% between 1975 and 1997, while the average size of holding decreased by 22%. Land holdings, < 5d, increased by 195%, while those of 5-10d and 10-20d increased by 182% and 101%, respectively (Table 2.2.). The three holding categories, which exhibited highest level of fragmentation, were those of the size of 100-200 d, which decreased by 42 %, while land class of 200-500d, and of 500-1000d decreased by 47%, and 43%, respectively.
The analyses indicated that total number of LHs was 50791 in 1975 and increased to 75968, in 1997, and 80152, in 2007. This indicates that number of LH had increased by 57.8% (Table 2.2). However, fragmentation is better expressed by the change in number of LHs, if LHs were classified into size categories.

Table 2.2: Number and areas of agricultural holding for 1975-2007, by land size

Land class	75		83		1997		2007	
	Num.	Area	Num.	Area	Num.	Area.	Num.	Area
<5	8522	16100	9050	23720	20210	47535	34189	55525
5 – 10	3825	25700	5451	36701	11012	72502	11250	75193
10 – 20	6922	92200	9655	128687	14317	185471	11905	154620
20 – 30	5337	121900	6609	151281	7416	168258	5617	131042
30 – 40	4666	150800	5743	185945	4208	136833	5582	182344

40 – 50	2963	125900	3547	150276	2787	118007	2160	92254
50 – 100	8634	570800	8981	592126	6532	418917	3969	259945
100 – 200	5476	701800	4947	631963	3291	410323	1779	228773
200 – 500	3359	933800	2610	727050	1778	487871	1147	328714
500 – 1000	719	452100	569	355634	409	257340	517	246507
1000 – 2000	253	299700	191	238911	151	188707	199	253581
> 2000	103	516500	85	420331	54	294126	109	520878
Total	**50791**	**3904000**	**57438**	**3642632**	**75968**	**3060007**	**80152**	**2615107**

Source: Awni Taimeh, Land Use in Jordan, 2011.

2.2.2 Changes in size and number of (AL) holding since 1975

Analyses indicated a clear trend when the analyses were carried for longer period (Table 2.3).

Land classes < 30 d showed substantial increase in number and areas occupied during the period between 1975 and 1997, while after 1983, land classes 20-30 d started to show reduction in number and size. The variation in the extent of changes, whether in number or areas occupied by some holdings with large land size, suggested dynamic changes in the size of the AL holdings. It is true that land registration had increased the number and areas of large holdings, but the same LHs class category indicated a reduction trend during subsequent period. One of the probable reasons is that such land started to suffer from LF driven by investment, or even market demands. One clear trend indicated that the number of holdings for different land size categories could vary quickly with time, which deserves careful investigations, and attention. Finally, two patterns could be deducted from such analyses: 1) Continuous fragmentation of large holdings to smaller ones; 2) Variable level of fragmentation exhibited by the different land classes, which suggest that some incipient factors might have contributed to this trend. It could be attributed to the economic conditions in the country, emerging land market, legislations, or increasing urban activities. All these factors together deserve further investigations.

Table 2.3: Changes in number and area of holdings by years and size

Land class	1975-1997		1983-2007	
	Number	Area	Number	Area
<5	137	195	277.8	134.1
5 – 10	188	182	106.4	104.9
10 – 20	107	101	23.3	20.2
20 – 30	39	38	-15.0	-13.4
30 – 40	-10	-9	-2.8	-1.9
40 – 50	-6	-6	-39.1	-38.6
50 – 100	-24	-27	-55.8	-56.1
100 – 200	-40	-42	-64.0	-63.7
200 – 500	-47	-48	-56.1	-54.8
500 – 1000	-43	-43	-9.1	-30.7
1000 – 2000	-40	-37	4.2	6.1
> 2000	-49.	-43	28.2	23.9
Total	**48.4**	**-22**	**39.5**	**-28.2**

Source: Awni Taimeh, Land Use in Jordan, 2011.

2.2.3 Relative distribution of area occupied by classes of land holdings since 1975

Total area of LH was reduced by 21.6% from 1975 to 1997, and 33.0% from 75 to 2007. This suggested that most of the reduction had occurred before 1997 (Table 2.4). Examination of land size classes suggests that most of the increases occurred in the small size land classes in following order: < 5 d, 5 - 10 d, 10 - 20 d, and 20 - 30 d, and 30 - 40d respectively. These land classes accounted for 10.5% of the total areas in 1975, 19.0% in 1997, and 22.9% in 2007, which substantiate the results that most of the conversion in these land classes occurred before 1997. Similar trend was observed for land

classes (40 - 1000 d land classes), except for the 30 - 40 d land class, which were reduced between 1975 and 1997 only, while it increased afterwards.

Table 2.4: Relative distribution of area of agricultural land, by size

Land Class	1975	1997	2007
		% of total area	
<5	0.4	1.5	2.1
5-10	0.7	2.4	2.9
10-20	2.4	6.1	5.9
20-30	3.1	5.5	5.0
30-40	3.9	4.5	7.0
40-50	32.3	3.6	3.5
50-100	14.6	13.6	9.9
100-200	18.0	13.4	8.8
200-500	23.9	15.9	12.6
500-1000	11.6	8.4	12.7
1000-2000	7.7	6.2	9.7
>2000	13.2	9.6	19.9
Total*	100.0	100.0	100.0

Sources: Awni Taimeh, Land Use in Jordan 2011 and Census: 1975, 1997, 2007

2.3 Changes in holdings of rainfed and irrigated holdings

Total number of rainfed and irrigated areas was reduced by 24.3%. Amman and Mafraq, Madaba, and Tafila seemed to suffer the highest reduction level, but in terms of cultivated areas, Irbid, which possessed 33.8% of the total cultivated area, was reduced by 17.6%, although it still posses 36.8% of the total number of cultivated area in Jordan. Balqa seemed to enjoy a modest increase in cultivated area. This was attributed to the increase in irrigated areas in JV (Table 2.5).

Table 2.5: Change in number of Rainfed and Irrigated Holding, 1997-2007

Governorate	1997		2007		97-2007
	Number	%/total	Number	%/total	
Amman	10972	9.68	4331	5.05	-60.5
Balqa	6986	6.16	8166	9.51	16.99
Zarqa	2854	2.52	2177	2.54	-0.2
Madaba	6412	5.66	3215	3.75	-49.9
Irbid	38300	33.80	31568	36.79	-17.6
Mafraq	12009	10.60	5984	6.97	-50.2
Jarash	7792	6.69	8459	9.99	8.6
Ajlun	6335	5.59	8675	10.11	36.9
Karak	12074	10.65	8029	9.36	-33.5
Tafila	4705	4.15	1552	1.80	-67.0
Ma'an	4512	3.98	3289	3.83	-27.1
Aqaba	371	0.33	356	0.41	-4.0
Total*	**113322**	**100.0**	**85801**	**100.0**	**-24.3**

Sources: Awni Taimeh, Land Use in Jordan, 2011.

2.3.1 Changes in number and areas of rainfed holding

The analyses on LU changes indicated that rainfed agriculture had been subjected to significant reduction in areas within all governorates (Table 2.6). Rainfed area was reduced by 652,284 d, during the period from 1983 to 1997, or 22.6%. The data also showed that rainfed area occupied 88.9% of the cultivated land in 1983, but it decreased to 72.9% in 1997, which was due to the reduction of total cultivated area by 11.4% from 1983 to 1997.

Average rainfed holding decreased from 49.4 d in 1983 to 23.4 d in 1997. This represented a reduction of 573,607d in cultivated rainfed land or 19.89% of the total area.
The relative land size occupied by holding < 30d occupied 7.9% of the total cultivated areas in 1983, but it increased to 26.3% of the total cultivated area in 1997.
Land classes which indicated substantial reduction was those classes of less than 20 d, which increased in number from 145.6% to 322%, and in area from 205 to 732.6%, from 1983 to 1997, respectively. Other classes with area > 50 d suffered from very significant reduction in number, except for land class 200 - 500 d which increased in area, but with clear reduction in the number of holdings. Land classes representing 30 - 50 d indicated a slight increase in their area, but it suffered from reduction in the number. Area occupied by land classes < 20 d, which exhibited the highest change occupied about 24% of the total areas. Land class of 200 - 500 d occupied about 13.8% of the total area, while 20 - 40 d land class occupied 16.3%.
Number of LH for the land size < 30 d was 27,661 holdings, in 1983, or 38.8% of the total holdings, while in 1997, the number of holdings for the same land class was 80,607 or 71.1% of the total cultivated land in 1997. This represented an increase of 32.3%. The analysis clearly indicated the conversion of rainfed agriculture to smaller holding, after 1983, which could be attributed to weak investment in this type of farming system.

Table 2.6: Changes in number and areas of rainfed holdings 1983-1997

Size	1983		%Area/ Total	1997		%Area/ Total	1983-1997	
	Number	Area		Number	Area	5.1	Number	Area
<5	7255	17589	0.5	30599	146442	4.3	321.8	732.6
5-10	4762	27029	0.8	18912	122593	9.5	297.1	353.6
10-20	8772	88850	2.7	21540	271368	7.4	145.6	205.4
20-30	6872	112217	3.5	9556	211577	5.3	39.1	88.5
30-40	5628	122093	3.8	4788	152281	4.2	-14.9	24.7
40-50	4005	114388	3.5	2907	120648	13.4	-27.4	5.5
50-100	10871	472974	14.6	6238	383966	11.5	-42.6	-18.8
100-200	6070	514551	15.9	2781	329723	10.2	-54.2	-35.9
200-500	3127	58264	1.8	1121	294049	4.6	-64.2	404.7
500-1000	672	287326	8.9	216	130960	2.7	-67.9	-54.4
1000-2000	217	186081	5.7	70	78388	2.3	-67.7	-57.9
>2000	103	357465	11.0	20	66602	**80.4**	-80.6	-81.4
Total	58354	2883204	88.9	95895	2230920	72.9	94.3	-22.6

Sources: DOS Censuses of 1975 and 1997, JV is included; Awni Taimeh, Land Use in Jordan, 2011.

Rainfed areas on the contrary of IA, suffered from a significant reduction in both total parcel areas (-0.8%) and number of parcels (-31.9%), between 1997 and 2007 (Table 2.7). Almost all governorates suffered from losses of RA. More important average size of rainfed parcels was also significantly reduced, except for Ma'an and Mafraq, where land prices are marginal. Most significant losses was in Irbid, which occupied 21% of the total areas in 2007, while it occupied relatively the same area in 1997, despite the fact the total areas was reduced by 40.8% . Amman followed by Irbid, and Mafraq suffered the highest losses. Other governorates suffered similar level of losses, but the area was very much smaller. It was interesting to notice that, while the total area of rainfed parcels, were reduced for Ajlune and Jarash, the number of parcels had increased, which suggested clear sign of LF. This was also reflected by the significant reduction in the average parcel size. Average parcel size had significantly decreased for many governorates, except for Amman, although the total areas was substantially reduced, followed by Mafraq and Ma'an. One possible explanation for increasing average size of rainfed parcels in some governorates, while the area was significantly reduced, could be attributed to increasing number of land parcels with small size were withdrawn from agriculture, and replaced by smaller number of parcels but with larger area. The most common pattern that could be generalized form such information is that areas occupied by RA and number of parcels was reduced, with some exception in governorates such as Ajlune and Jarash.

Table 2.7: Changes in rainfed areas, by governorates, 1997- 2007

Govern.	1997			2007			1997-2007	
	Number	Area	Average	Number	Area	Average	Number	Area
Amman	8168	414816	50.8	3251	154903	47.7	-60.2	-62.7
Balqa	5909	79179	13.4	3457	50923	14.7	-41.5	-35.7
Zarqa	1420	57602	40.56	1046	39852	13.9	-26.3	-30.8
Madaba	5315	130534	24.6	2866	62678	21.9	-46.1	-52.0
Mafraq	7402	383969	51.9	3760	254172	67.6	-49.2	-33.8
Irbid	37170	462081	12.4	26896	277425	10.3	-27.6	-40.0
Jarash	7107	116648	16.4	7857	88493	11.6	10.6	-24.1
Ajlun	5800	75693	13.1	8216	72752	8.9	40.7	-3.9
Karak	10092	283130	28.1	4960	168461	4.0	-50.9	-40.5
Tafelah	3916	80413	20.5	1220	38199	31.3	-68.8	-52.5
Ma'an	3509	139482	39.8	1643	108728	66.2	-53.3	-22.0
Aqaba	87	7370	84.7	94	4297	45.7	8.0	-41.7
G. Total	95895	2230920	23.3	65266	1320881	20.2	-31.9	-40.8

Sources: Awni Taimeh, Land Use in Jordan, 2011(% of the total area).

2.3.2 Changes in irrigated land holdings

Changes in irrigated land parcels indicated a substantial increase in area and average size of parcels (Table 2.8). This is not strange since land size in JV was fixed and irrigation in the UL is generally investment farming activities. Moreover, recent irrigated farms were established in Eastern and Northeastern parts of Jordan. This is very clear from the land size within governorates located within rainfed land such as Irbid, Jarash, Ajlune, Karak ,and Tafila, while for Zarqa, Mafraq and Ma'an, the average size of parcel increased after 1997. It was very interesting to note that although the number of irrigated parcels, in Amman, decreased by 61%, irrigated area had increased by over 107%. This was also matched by significant increase in the average size of irrigated parcels. This means that many small farms are replaced by large farms, which explains why the number decreased, while the area had significantly increased. The increase in Irbid and Balqa is due the location of part of JV IA within the boundary of these two governorates.

The overall average of irrigated parcel size increased by almost 60%, while the total irrigated area increased by 126.8%, which was not matched by significant increase in the number of parcels (17.85%). This clearly suggested that this type of land did not suffer from LF. This could partially be due to the early implementation of legislation in JV, which prohibited any LF, while large parcels farmed under irrigation within dry region are farmed for investment purposes.

Table 2.8: Changes in in irrigated area, 1997- 2007

Govern	1997			2007			1997-2007 %	
	Number	Area	Average	Number	Area	Average	Number	Area
Amman	2804	66892	23.9	1080	138456	128.2	-61.4	107.0
Balqa	1077	25022	23.2	4709	191349	40.6	337.2	664.7
Zarqa	1434	70935	49.5	1131	233511	206.5	-21.1	229.2
Madaba	1097	16712	15.2	349	7946	22.8	-68.2	-52.5
Mafraq	4607	123686	26.8	2224	204564	92.0	-51.7	65.4
Irbid	1130	15548	13.8	4672	147755	31.6	313.5	850.3
Jarash	685	14970	21.9	602	19237	32.0	-12.1	28.5
Ajlun	535	8119	15.2	459	4824	10.5	-14.2	-40.6
Karak	1982	27508	13.8	3069	65614	21.4	54.8	138.5
Tafelah	789	9445	11.9	332	8908	26.8	-57.9	-5.7
Ma'an	1003	115023	114.7	1646	154136	93.6	64.1	-34.0
Aqaba	284	61106	215.2	262	82402	314.5	-7.7	34.9
G. Total	17427	554970	32.0	20535	1258705	60.3	17.8	126.8

Sources: Awni Taimeh, Land Use in Jordan, 2011 (* % of the total area)

1 - Irrigated area in 1997 for Jordan was 554,970 d (17427 holdings), while irrigated area in JV was 274,116 d (3806 holdings).
2 - Distribution of irrigated land classes for 1983 and 1997 were not provided by land size. Distribution of rainfed and irrigated areas by land classes were not provided by the 2007 census.
3 - This table was prepared because previous analyses suggest that most of the significant changes had occurred between 1975 and 1997. Changes in irrigated land would not be sensitive to land classes because size of irrigated farms is rather larger than those of rainfed, and is not subjected to fragmentation within short period of time due to higher investment Other type of analyses indicated that rainfed land was most sensitive to changes.

3 Legal land ownership in Jordan

3.1 Distribution of ownership

The data indicated a substantial reduction of areas owned by households after 1997, while land owned by partners increased by >139% (Table 3.1). Moreover, number of ownership decreased in total area, while the number of holdings had increased > 120%, which suggested that investment in agriculture was reduced, but the number of holding had increased. This means increasing number of small investors using small areas, which is characteristic of irrigated areas in Jordan. The data also showed a substantial increase in the number of holdings with more than one family or mixed partnership. The increase in area was more than 134%, while the number of holdings with such ownership was increased by > 234%, over the same period. This will complicate land farming where agreement had to be reached on the LU. This ownership is about 14.4% of the total household ownership, which could be counted among land left uncultivated every year, in addition to holdings suffering form high land fragmentation.

Table 3.1: Number and area of land holding by legal status of holder 1997

	1997		2007		1997-2007	
Type of holding	**Number**	**Area**	**Number**	**Area**	**Number**	**Area**
House hold	90829	2576183	50425	1496830	-44.8	-41.9
Partners	1369	90012	4579	215774**	234.5	139.7
Company	39	114159	86	86723	120.5	-24.3
Government			100	3687		
Others	26	1740	961	88978*		
Total	**92259**	**2782694**	**56151**	**1924291**	**-39.1**	**-30.8**

Source: Awni Taimeh, Land Use in Jordan, 2011

* JV not included

* Includes legal status not know of mixed.

** Includes more than one family and partners

3.2 Changes in number of legal ownerships by land size

The data indicated that total number of legal ownership was reduced by 16% between 1997 and 2007. The data also suggested that the number of households' ownership decreased for most land classes except for two classes 30 - 40 d and 500 - 1000 d (Table 3.2). On the contrary to the partners' ownership, all land classes showed substantial increase, except for the 100 - 200 d land class. Such pattern strongly suggested increasing partnership, which could be due to inheritance law. Number of the companies increased from 8 companies, in 1997 to 112, in 2007. However, the increase was in the areas owned by these companies, rather than number of companies.

Table 3.2: Change in number and area of holding for legal holder for 1997-2007

	Area				Number		
	House hold	**Partners**	**Company**	**Total**	**House hold**	**Partners**	**Total**
<2	37.9	120.0		0.2	-3.7	102.0	-2.8
2-5	-4.9	17.3		6.0	1.1	247.3	3.2
5-10	-2.8	204.1		3.5	-3.3	208.9	0.1
10-20	-22.2	147.6		-17.1	-22.2	154.2	-19.5
20-30	-13.9	114.4		-22.4	-29.8	112.5	-27.1

30-40	24.0	238.0		33.1	23.5	236.5	28.3
40-50	-28.7	92.7		-21.9	-29.3	92.2	-26.4
50-100-	45.3	37.2		-38.1	-45.6	36.8	-43.5
100-200	-50.4	-16.0		-44.3	-52.2	-16.7	-50.4
200-500	-44.2	67.3	574.6	-32.8	-46.0	50.8	-42.0
500-1000-	10.9	80.2	1468.0	30.0	7.8	80.0	17.4
1000-2000	22.0	92.7	23.3	34.4	-2.1	112.5	7.3
>2000	60.9	234.7	98.8	37.6	-61.7	300.0	-74.1
Total*	**-19.8**	**82.3**	**21.5**	**-7.1**	**-15.3**	**125.9**	**-16.4**

Source: Awni Taimeh, Land Use in Jordan , 2011

4 Land market in Jordan

4.1 Introduction

Land market in Jordan is an emerging market. It is among the largest and rapidly growing sectors in the country. Land sales had always been practiced between land owners, but land was never considered as a commodity. One might argue that land market is a logical response to meet the demand of increasing population. This is true, but land price is not increasing proportional to the increase in population. Many factors contributed to the increase in land prices and sometime explosion of sales and price increase. Some of the factors are due to increase in natural increase in population. However, the increase in population in Jordan during the last six decades had never been normal, because of sudden increase in 1948, 1976, 1994, and 2004. These waves of migration to Jordan from different places had moved the price of land to an extremely high level. The need to accommodate forced immigrants, on short notice, increased the land price rapidly. Unfortunately, the distribution of the immigrants was not carried according to any plan. Therefore, demands around many cities had suddenly increased, and created an area with dense population, and increasing land demands. The following section discusses some of the factors that affect land market in Jordan.

4.2 Factors affecting land market in Jordan

4.2.1 Location within or out of regulated areas

Usually a plan allocating land for different uses such as residential, housing, commercial industrial, etc, is prepared for village or city regulated area. Price of the land will depend on designated land class. Residential areas are classified as A, B, C, or D. Building on each class has different specification. Land price for each class is also different, because the area and building specification for class A should be 1,000 m^2, and different from other classes, while area for class D is 250 m^2, and area of building is smaller. The price is not due to the area, but to the quality of the housing permitted on each class. Fore example, only capable person can build house on class A. Furthermore, land could be classified as commercial land. This means business can be established on such land. Usually such land is located along streets. The price of the land would be much higher than residential lands. If the urban center has industrial zone, this would substantially increase the land price. Such classification encourages sales of the land; personal financial liability is an important factor, which controls land with specific classification would be used first. This depends on the area, how close is it to major city or developmental zones. The level of land prices and extent of price increase depends on the rate of population increase, and availability of jobs.

If the land is located outside the regulated area, generally the minimum size of the holding is 10 d. The new Bylaw No.6, 1996, allowed the division of the 10 d unit to minimum 4 d between partners. This special bylaw applies to areas west of the railways and for some governorates mentioned by the bylaws. Land with 10 d size can be used for some kind of farming. The bylaw was prepared under heavy pressure form people, and the land market witnessed heavy trade after the approval of the bylaw during the period which coincided with the period when the annual economic growth in Jordan was 9 - 10% during the nineties of the last century until the latest global financial problem. The growth of the economy and booming of oil price helped increasing availability of financial resources which contributed to the capability of many to enter the market because of the need to provide houses within regulated areas.

4.2.2 Population density and growth

The population density within an area depends on the level of economic development, and job opportunities, which attract more residents. During the last three decade, Jordan had witnessed substantial migration form rural to few cities. This was inflected by incredible increase in the price of land around and within these cites. Small towns or villages also witnessed increase in land price, but was much less than prices within and around cities.

Table 4.1: Distribution of area of different types of buildings, and cost

Governorate	Year		
	2000	**2003**	**2007**
Amman	2000	3079	4246
Balqa	120	142	276
Zarqa	227	215	407
Mafraq	63	62	63
Madaba	70	50	62
Irbid	358	526	577
Jarash	37	43	24
Ajlun	22	24	11
Karak	94	88	70
Tafila	35	30	27
Ma'an	34	36	89
Aqaba	36	165	457
Total	**3096**	**4462**	**6309**
Cost/JD	240,458	471,272	710,341

Cost in (1000JD), area (1000) meters. DOS annual statistical report
Source: Awni Taimeh, Land Use in Jordan, 2011

Table 4.1 shows built in different governorates for the years of 2000, 2003 and 2007. The data clearly show the level of building where highest in governorates like Amman and Irbid, followed by Balqa. Aqaba showed significant increase, not because of increase in population, but because of commercial activities in Aqaba Special Zone. The cost of the building also was doubled between 2003 and 2007. During 2007, it was almost equal 20% of the annual budget (DOS, 2000, 2003, 2007).

4.2.3 Level of development of the Region

Certain regions in Jordan enjoyed economic development for many reasons, such as availability of natural resources, which was accompanied with poor regional planning. Therefore, the concentration of jobs and other income generating activities were concentrated around or within major urban areas in Jordan. As results, rural areas were not attractive to investors, which encouraged migration of rural people to urban cities seeking better job opportunities. This had contributed to development of a new generation who do not have experience in AP, or because AP were not enough to support their living. Therefore, they started to look for jobs outside AS, and a new generation with no interest or experience in AP started to treat the land as commodity rather than heritage of their ancestors, and became willing to sell their land to improve their living conditions. The negligence of agricultural activities and the increasing availability of small land units contributed substantially to the rapid growth of land market in Jordan. Before four decades, agricultural activities were the main mean of livelihood for many Jordanians. As a result of increasing commercial and industrial activities, and accompanying unbalanced governmental developmental policies, substantial portion of Jordanian had deserted the AS. Their land ownership became a major source for land market, since revenue from land sale is many folds higher than return from agriculture activities.

4.2.4 Level of land fragmentation

Level of land fragmentation is the main source for land market, especially within regulated areas. For example, regulated areas within Amman Municipality increased from 18 km^2 in 1958, to 300 km^2 during early the nineties of the last century again to 610 km^2 by the year of 2000. According to latest plan for Greater Amman Municipality, the city will cover 1200 km^2, by the year 2025. The increase in

regulated areas and inclusion of new areas with extremely low land price, will provide the market with abundant number small parcels, which are not suitable for AP. The increase of number of parcels from 1,000,000, in 2000 to 1.3,000,000 in 2006 and 1,451,990 in 2010 demonstrates the rate by which small parcels were available, which eventually enter the land market and mark the level of land transfer.

4.2.5 Economic situation within the country and the Region

The level of economical activities usually affects many sectors. In Jordan land market reacts quickly with improving economic activities. Experience lead many to strongly believe that land is the best area for investment in Jordan. The land price never decreases. It could be stable for certain period of time, but always witnessed a cycle of price increase, which coincided with economic growth. Another important factor is related to the regional growth especially within the Gulf countries, where Jordan enjoys good relation with the Gulf countries, and hundreds of thousands working there have sustained jobs for long time in these countries. Many of those workers buy land in Jordan, whether for future investment, investment in housing projects, or for securing homes for their families. Jordan economy experienced cycles of regional growth almost every ten year, during which land market witnessed substantial increase in land price.

4.2.6 Land legislations

Land legislation in Jordan had always been conducive to land fragmentation. Law No. 78, 1966, Amman Municipality special laws, and by law No.6, 1996, facilitated the rapid growth of number of small villages and cities. These laws also facilitated conversion of land for industrial, commercial, and residential zones, in addition to the bylaws which encouraged the division of small land units. Thus, land fragmentation was carried within and outside regulated areas. Unfortunately, most of these activities occurred within rainfed areas, which are the home of rainfed AP. Heritage laws also enhanced, to a great extent, land fragmentation, by allowing land division between brothers upon the death of their father. The way the land is divided between them is carried according to special law.
The land laws in Jordan also allow non-Jordanian citizens to own land in Jordan. Sales of land for non-Jordanian are either for investment outside regulated areas or for investment in housing projects.

4.2.7 Regional land use planning

LU planning is a good tool for providing balanced development which takes into consideration the spatial distribution of resources, future demographic growth, and population activities. It takes into consideration the protection of resources for future need, and thus controls all activities toward avoiding the depletion of these resources.
The lack of adopting LU planning at regional and distinct level in Jordan, contributed to the development of major cities within some regions, and increasing economic growth around these cites. This explains why most of the developmental activities were carried in few areas, due to improper demographic distribution dominating the land and water resources allocation in Jordan. Water resources are transported form the four corners of the country towards one area, and most job opportunities were generated within these cities. Such distribution is responsible for creating big land market and determines the level of land price in these areas.

4.3 Magnitude of land market in Jordan

Statistic related to sales of land is available in terms of annual areas used for building for different purposes. Very few statistics are available regarding the price of agricultural land. This is not to say sales and price of agricultural land is low, but land sales did not distinguish between agricultural and non agricultural land. As a matter of fact AS lost about 884,000 d between 1965 and 2000, and another 300,000 d from 2000 to 2007 (2007 Census) It is believed that this land entered into land market. According to 1988 statistics, the regulated areas occupied about 1.7 million d of land, where 95% of these areas are located within RA (Taimeh, 2011).
According to LSD, in 2006, which focused on land market, total land sales was 111,629 d within the whole country, of which 4868 d were agricultural land and 131 industrial lands, while number of land sales applications was 47,223. Previous reports provided information on number of sales applications for land sales only. For example a total land sale was 66,639 d, in 2000, 55,260 d, in 2009, and 65,714 d in 2010, without distinction between land types.

Land sold to non- Jordanian was 4,19 d in 2000, 11981d for the period of 2001 - 2005, and 26,635d in 2010.
Areas licensed for non-residential purposes during first third of 2011 was 844,000 m^2, in comparison with 908,000 m^2 for the same period of 2010, while for residential and other purpose, it was 12,700 d in 2010, of which 9,600 d was for apartments, and 3,100 d for other uses. Sales application was 22,414 in 2009, which increased to 23,838 in 2010. Such trends were attributed to political situation in surrounding countries, and the stable security conditions conducive to investment in Jordan, and favorable investment laws.
Reports generally focus on the sales and value of real sates (Land and apartments) regarding land sales only number of applications is generally reported. For example, areas of apartments sold during the first half of 2009 was 1,151,942 m^2, and increased to 1,353,452 m^2, and to 2,031,202 m^2 for the same period in 2010, and 2011, respectively. The number of land sale applications was 35,240; 41,878, and 25328 for the same years. The total values for real state, including land and apartments was, 1974, 2,337, and 3,480 million JD for the years 2009, 2010 and 2011, respectively.

5 Land management

5.1 Introduction

Agriculture sector, in Jordan plays an, important social, economical, and environmental role. Economically speaking, AS has been an important source for supporting livelihood of many Jordanians for long time. It is considered the main source of living for more than 15% of the total population, and the main sources of food for most Jordanians. The AS provides job opportunities for many Jordanian. During the early 1960s, the AS absorbed around 33% of the total labor force; but due to the development of the other sectors, and the problems that AS had to face, its contribution has progressively dropped.

Socially, AD is strongly regarded as a reliable mean to fight poverty in rural areas and unemployment. This role is increasingly becoming significant due to its expected role in halting of migration from rural to urban centers.

The environmental role of AS is increasingly recognized as the burden to absorb the increasing amount of TWW, which it is expected to reach 246 MCM by 2020 (Nasser, 2002), depends on AS. The economical role of AS, however, is not expected to remain the most important sector in the national economy, as it has been until the seventies of the last century, due to the growth of other economic sectors, and the fact that AS did not receive attention equivalents to other sectors. The productivity of this sector is still not high in spite of the relative improvement in production, and product quality. The danger of the decline in the contribution of the AS is not only measured by the economic scale; but in terms of it social value. However, this sector is gaining higher recognition due environmental pressure generated by water sector.

The AS witnessed very high growth rate during the seventies and eighties due to the expansion of IA in JV and in the UL, the introduction of advanced production system and favorable investment environment, especially in the area of fruit trees FT production in both rainfed and irrigated area. The AS faces increasing constraints to sustain the productivity of IA due to diminishing availability of fresh water resources, and increasing use of TWW with marginal quality. Social pressure is expected also to be exacerbated by the need to either improve the production efficiency or reduce IA, which was developed with substantial investments. IA in the UL is expected to face increasing pressure due to increasing allocation of fresh water for domestic consumption, leaving irrigated area under high risk.

With respect to Forestland, it covers about 76,000 ha out of which 130,000 ha registered as forestland. The area of forest is relatively constant despite the continuous afforestation efforts due to destruction of forest, and conversion of private forests to FT orchards.

5.2 General land allocation

The AS lost large productive areas because of improper LU allocation for different purposes were carried out without ensuring their future sustainability. Lack of adopting regional planning resulted in the concentration of major cities such as Amman whose area increased from 18 km^2 s in 1958 to about 360 km^2 in 1990 and 630 km^2 in 2000 when several municipalities were merged with Greater Amman

municipality. Other major rapidly developing cities started on best AL include Irbid city and surrounding towns. In 1997, total area included within the regulated borders of villages and cites was 1.7 million d, of which 95% occurring within rainfed land. Any future expansion of these urban centers will be on the expense of arable land within the UL. It is estimated that 40% of the AL was lost since 1965.

Poor resource and demographic planning resulted in the concentration of population in the heart of best agricultural productive land. This resulted in the concentration of population in almost in a narrow strip. Water had to be carried from different corners of the country to these dense centers. For, example, the fresh Yarmouk River water is currently pumped to Amman, subjecting the LR in JV under the risk of soil salinization and pollution, since TWW will be carried from UL to the JV to compensate this quantity. Water will be transported about 380 km from Disi to Amman, which will result in phasing out AP in that area, and form Azraq, Northeast of the Badiah depriving any local AD in these areas. Future plans, even call for reduction of water available for agriculture in these areas by almost two third of current amount. The most important consequences to be born by LR is the increased use of TWW produced in great quantities expected to reach about 225 MCM by 2025, while projection indicates that about 500 MCM will be produced in Amman - Zarqa area alone by 2050. The environmental pressures on LR to absorb such quantity need no emphases.

5.3 Agricultural land allocation

- Total AL decreased from around 3.904 to 3.06 million d over the period from 1975 - 1997 and to 2,615 million d, in 2007. It is estimated that the area permanently lost since the year 1975 was about 884,000 d and additional 444,924 d until 2007.
- According to 2007 census, total cultivated area in Jordan was 1,871,886 d, of which 1,260,606 d is in the UL region and 317,672 d in JV. Total irrigated land was 810,896 d, of which 498,387d is in the UL, and 312,611d, in JV, while cultivated rainfed land was 1,060,987 d of which 1,055,826 d was in the UL region, and 5,060 d in JV
- Farmers responded to the loss in LR by cultivating less productive land in marginal areas, which will increase the rate of land degradation in this fragile region.
- The RA seemed to suffer the highest losses, and highest rate of LF. This had resulted in leaving about 33% of cultivated land without cultivation annually. Furthermore, the composition of crops also witnessed important changes including quick reduction in areas cultivated with rainfed vegetable crops, which is about to face extinction, and increasing area cultivated with FT.
- There was a noticeable increase in irrigated FT and vegetables in the UL during the last three decades. However, sustainability of such area is questionable in the light of decreasing availability of water resources in the UL region.
- IA in JV faces new challenges caused by the total withdrawal of fresh water from Yarmouk River to Amman, leaving IA in JV to rely entirely on runoff water mixed with TWW for irrigation.
- Lands available for cultivation in RA decreased remarkably due to intensive urbanization.
- Wheat and barely are the dominant FC in RA .Areas planted with wheat and barley fluctuated annually, but with clear reduction trend in areas planted with wheat and increasing areas planted with barley in unsuitable marginal areas.
- Increasing areas were planted with olive orchards, especially in the Upland regions.
- Area cultivated with legumes is very small and is decreasing continuously.
- Large area is annually left without cultivation due to LF, or low return.
- Despite the fact the afforestation activities were carried since 1924, area of forest suffer from continuous reduction due conversion of forest to other uses, trespassing, and forest clearing for various reason.

5.4 Organizational changes

5.4.1 Institutional reforms

AS was restructured in 1993 and area of reforms focused on:

- Restructuring of MoA with new mandates and role in AD.
- Establishment of the National Center for Agricultural Research and Technology Transfer (NCARTT) in 1994. Lately extension service was added to the duties of NCARTT. The center now is called NCARE.
- The Agricultural Marketing Corporation was abolished in 2002.

5.4.2 Policy reforms

The main policy reforms are:

- The government eliminated subsidies on barley and other animal feeds in 1998/1999.
- The Jordanian Farmers General Association (JFGA) was established in 1999, and the Jordan Valley Farmers Association was abolished.
- In 1998/1999, the government suspended buying cereals from farmers, but under public pressure continued to buy wheat and barley and paid 3-5 JD above world price for quality cereal.
- The government eliminated price subsidies for tomatoes delivered to Jordan Company in 1995. The price is now controlled by supply and demand.
- In 1998, the government canceled individual payments, and reduced the price of bread, but continued supporting price of bread.

5.4.3 Legislations

The main related legislations are:

- The government prepared a special law in 1996 converting Agriculture Credits Corporation to a commercial bank.
- Approved Bylaw No.6, 1996, which allows division of 10 d land unit (outside municipal and village council limits, and in areas west of the railway line), into units of 4 d.
- Approved environmental law No.12, 1995, which included several articles that regulate activities relevant to the AS, such as the protection of the environment, desertification, erosion control, and other issues. This law was replaced by a new law: under the name "Environment Protection Law No.52, 2007.
- Agriculture Law No.20, 1973 was replaced by a new law in 2002 (Agriculture Law No. 44, 2002) to meet the requirements of the Agricultural Reform Program. The role of MoA was redefined to reflect its new duties, which include control, supervision, and follow up. The new law is still a temporary one waiting to pass through required legislative steps.

5.4.4 Strategic planning

The main strategic plannings are:

- **Agricultural Policy Charter (APC)**: The policy charter was adopted in 1994. The objective of the charter was to mange and utilizes available agricultural resources in an economically efficient manner while ensuring their sustainability (MoA, 1996). The strategy proposed measures to conserve and sustainably utilize low rainfall areas, forests, and IA.
- **National Environmental Strategy (NES):** The National Environmental Strategy was prepared in 1991, and a National Environmental Action Program in 1996. NES aims to maintain long-term environmental balance and enhancing the preparation of developmental plan, while ensuring its continuity through economic planning. The action plan prioritized areas to be addressed to ensure sustaining productivity of AL, while protecting the environment (MoEn, 1996)**.**
- **Environmental Action Plan:** The final draft was prepared in 1993. The plan covered wide projects, legislation, and various implementation plans to promote the protection of environment.
- **National Strategy for Agricultural Development (NSAD)**: The strategy was prepared in 2002. Action plan proposed all required measures (NASD, 2002) to be taken by all relevant public, and PS's organization. Around 130 projects covering all AS sub-sectors were also prepared. The action plan for the strategy was updated in 2009, with a new document called "The 2009 Agricultural Document".
- **National Strategy and Action Plan for Drought Mitigation (2007):** A national strategy and action plan for drought management was prepared by MoA in cooperation with FAO in 2007(MoA, 2007). Final recommendations and conclusions were discussed in a national workshop held for this purpose.
- **National Strategy and Action Plan to Combat Desertification:** The strategy was adopted, 2006 (MoEn, 2006). An integrated financing strategy was also prepared in 2009. Although the focus for implementing the strategy is MoEn, most of the proposed projects were related to AS. The plan provided recommendations regarding the different mode of actions to be implemented at the national level to combat desertification (MoEn, 2006).
- **Biodiversity Strategy:** The strategy was prepared in December 2003. A national biodiversity action plan was prepared in 2003. MoEn is mandated with its implementation.

- **Jordan National Agenda, 21**: Agenda 21(MMA, 2001) is a document which integrates the different disciplines of environmental**.** The Agenda was prepared to ensure that environmental resources (water, soil and plant) are used in a sustainable manner. The Agenda was prepared in 2005 and launched in 2006 comprising a comprehensive political and socio-economic reform plan for the country until 2017. The Agenda focused on several key areas directly related to natural resources, dry land issues and energy, and called for promoting the participatory approach at all levels to ensure success and sustainability. The Agenda also stressed the need for implementing integrated approach to environment and development, and with objectives about poverty alleviation and sustainable human development. A multi-disciplinary national plan of action for an environmentally sound and sustainable economic development was also prepared. The Agenda also introduced the concept of "integrated resource management" by linking the sectors of water and, land resource management, energy, and mineral resources.

5.4.5 External drivers

External drivers triggered local changes after the ratification of many conventions such as the conventions to Conserve Biodiversity, Combat of Desertification, and Climatic Changes. The concerned authorities, realizing the positive impacts of these global conventions on the preservation and sustainability of national LR, had ratified all these conventions. Moreover, the government response to these conventions triggered the preparation of several national strategies such as: protection of the environment, which was adopted and was followed by an appropriate action plan, a case study on the biodiversity, national biodiversity strategy, and national strategy to combat desertification, and a national strategy for agricultural development. In addition, the government prepared several sub-sectors water polices and the national strategy for water resources utilization, and lately, new water strategy: Water for Life, 2007-2022, in 2007.

As clear commitment of Jordan towards important issues relevant to sustainability of resources, Ministry of Environment (MoEn) was established in 2004. An Environmental Law No.12 was prepared in 1995. The MoEn is designated as a focal point for the implementation of the three conventions. These developments had a profound impact on the activities related to resource sustainability during the past 10 years, and are expected to dictate most of future research and developmental activities. Accordingly, several projects were carried by the different institutions. Among these projects were; preservation of wildlife conservation, preservation of wet land, climatic changes, the conservation of agro-biodiversity through the enhancement of LU, and action plan and resource mobilization for combating desertification.

5.5 Resources and sustainability

5.5.1 Main issues

AD faces many problems and challenges. The following list doesn't give a full account of problem, constraints or challenges facing the future development of agriculture, but focuses on the main issues with important future consequences. Among these problems and constraints are:

a. Availability of water resources*:* More than 91% of the country is dominated by arid climate. Therefore any additional development of AL depends entirely on the availability of water resources, considering that Jordan is classified among the top 4 driest countries in the world in terms of water shortage. On the other hand, irrigation water utilizes 71% of water demand and 64% of water supply in 2007. Thus, improving water use efficiency represents a great challenge for saving water, before developing new areas under irrigation. The increasing domestic water demand is met by reallocating fresh water resources from JV and UL. The irrigation water deficits is compensated by increasing use of TWW, which mean AS has to deal with new environmental threats related to productivity, production of safe food, reduction of land degradation, and, at the same time, compete in local and external markets.

b. Resource management: It is faced to the following:

- Continuous reduction in the area of productive AL as a result of random urban expansion activities, poor regional planning, and inadequate legislations, which protect resources from competition for other uses (Taimeh 2001).
- Fragmentation of agricultural ownerships, which result in loss of production or degradation of land.

- Lack of clear national sustained policy which advocates regional LU planning to protect AL, and guide demographic changes.
- Absence of national integrated plan to develop and protect RL. Deterioration of the range land became immanent after registering about13 million d of RL to private citizens within the Steppe region. According to Agricultural Law No.20, 1973, this region was designated as RL of Jordan.
- Absence of any plans to tap LR of the dry region with promising potential, which protect it from further abuse, and degradation.
- Annual and seasonal fluctuation and irregular seasonal rainfall distribution, and the emergence of pattern suggesting clear reduction of annual rainfall, and the increase in the frequency of drought events. Future projections suggest an increase in temperature, and reduction of rainfall by 25% for the next 25 years.
- Continuous reduction of the available quantities of fresh water from surface and ground resources for irrigation. The reduction is also associated with continuous deterioration of its quality of irrigation due to the increasing use of TWW in irrigation.
- Ground water resources are continuously depleted, which causes soil salinization, deterioration of its quality, at some locations, by pollution caused by wastewater seepage. Furthermore, cost of pumping of groundwater is also increasing due to increasing cost of energy.
- Poor marketing tools may force farmers to leaving AP due to unprofitable return, which is captured by retailers, lack of government interventions during disasters, and diseases or insects epidemics.

c. Resources productivity: LR suffers from low productivity for many reasons. Among these reasons:
- High seasonal rainfall variation and increasing drought frequency.
- Poor management coupled with improper selection of crop to match land potential suitability.
- Lack of adopting integrated management practices including soil, water and fertility conservation.
- Land in many rainfed and IA are managed by individuals who are not totally dedicated to farming.
- Productivity of IA is low due to poor inputs use efficiency, marketing problems, low water use efficiency, and improper selection of soil.
- Deterioration of quality of irrigation water due to increasing ratio of TWW in irrigation.
- Lack of integration between plant and animal production which increases the product added values, and encourages farmers to invest in modern production practices.
- The continuous increase in the cost of inputs and marketing problems.
- Low level of chemical fertilizers' application in RA, due to low return and climatic variation, which discourage farmers from investing in fertilizers' application in RA.

d. Policies and governance: Related problems can be identified as following:
- Lack of comprehensive and stable policy, or adoption of strategic planning, which ensure of long-term implementation of action plans.
- Governmental interventions had been dominated by actions that deal with problem when it occurs rather than treating the causes. This resulted in reducing ability of the government to solve them, which increase in magnitude with time.
- Lack of proper legislations, and weak enforcement of existing ones.
- Participation of PS had been very weak or even absent in planning and implementation of many activities. This resulted from the centralized planning, and the envisaged role of PS as compared with other sectors of the economy.
- Weak institutional coordination between governmental organizations relevant to AD. This is partially attributed to mandates of these agencies as stipulated by legislations governing their activities. Sometimes their mandates contradict each other, which very often results in abusing of AL resources (Taimeh, 1990).
- Absence of clear vision regarding the designation of specific department or ministry responsible for management and protection of LR. For example, LU planning (in reality what is done is zoning) is mandated to MMA, while protection of LR from degradation, biodiversity conservation is mandated to MoEn. In many cases, MoA is not given the opportunity to participate in setting polices highly relevant to AL resources.
- Lack of financial resources allocated from core national budget needed to carry long-term developmental programs or support services.
- Lack of accessible national agricultural information system to provide decision makers, PS, and farmers with up-to-date information needed to advance AD.

- Weakness of national agricultural research system and extension services. National efforts in this area is still inadequate and do not provide required support to solve challenges facing LR. Although a special center (NCARE) was established as national umbrella to coordinate research activities between national research institutions.
- Lack of policies conducive to PS to invest in AS and to contribute to its development.
- Absence of private organizations to act as a lobbying body to force the government to pay proper attention to the development of AS.
- Poor integration between AS and other important resources such as water sector. No vision to integrate the activities of these sectors was ever implemented.
- Long-term plans to provide well trained human resources to meet the changing need of AD were never adopted. Workers in this sector did not receive their share of governmental attention.

e. Strategic planning: Agriculture sector is assessed through its economic, social and environmental contributions. Sound AD plays a major role in the protection of the environment, including the protection of agro-biodiversity, ensuring an environmental balance that would secure sustainable use of resources and preserve them for future generations. These principles have been the backbone principles stressed during the preparation of the NASD. This was clear from the nature of the proposed, programs, projects, and enabling environment. The NSAD action plan and implementations gave higher priority to sustainable development. With this respect it is recommended that:

- The government should adopt and enforce a clear policy towards adoption of agricultural research strategy with clear role of all relevant public institutions, which involve universities and Higher Council for Science and Technology, etc.
- A national institution should be designated as a leading institution responsible for the implementation of the research action plan, and coordination between different stakeholders. The adopted research action plan should directly support the objectives of the National Strategy for AD. This may be achieved by upgrading the role and capability of NCARE.
- Activate the role of agricultural council in coordination between the different government organizations, with clear mandate to prepare policies and monitor and assess the implementation of action plans, in a manner which ensures that these organizations fulfill their mandates.
- The government should encourage the establishment of quality unions for the production and marketing of the quality products, which meet export requirements.
- MoA should be responsible for preparing plans for land utilization. Such plan should be carried out according to suitable soil maps, and after amending current legislations to ensure, that LU planning and allocation for different utilizations is an upfront issues subjected to priority for protection of AL.

5.5.2 Sustainability of different sectors

a. Irrigated land in Jordan Valley

a.1. Resources in the Valley

Water resources development in JV depends on the development and utilization of the Yarmouk River, and runoff water stored behind dams overlooking at the Valley. Few areas are irrigated using ground water north of the Dead Sea area. The Yarmouk River water is currently pumped to Amman city. Therefore, future quality of IL in JV will depend on annual runoff and annual discharged TWW. The quality of Jordan River deteriorated due to increased concentration of salts, and is not unsuitable for irrigation. In JV, irrigation consumed 293 MCM of water for irrigating of 312,611d, in 2007, of which about 60 MCM are TWW. A Large IA use drip irrigation. The quality of irrigation water, especially from King Abdullah Canal, a major water canal in JV, had suffered from pollution and high salt content. The effort to increase the efficiency of water use in agriculture is a major goal instituted within recent development. Efforts included introduction of water tariff to recover operation and maintenance cost, and the implementation of volumetric metering at all public and private wells. The cost of agricultural inputs (fertilizers, pesticides, seeds, fuel, electricity, hired labor, packing and transport) had increased due to general macro-economic changes in the country. The construction of infrastructure increased to cover water distribution network, canals and farm water drainage network in the middle Ghor where soil has high salt content.

Water distribution system was changed from open channels to pressurized system which increased the efficiency of water distribution. Land developed in the valley is about 360,000 d in the Ghor north and south of the Dead Sea area is a part of the 427,000 d, pending on the completion of the developmental

plan by the year 2020 after the completion of suggested projects for irrigation and the gradual change to drip irrigation. The JV development plan is based on the basis of water availability of 428 MCM in 2020, and the use of increasing quantities of TWW, which will increase to 144 MCM in 2020.

a.2. Land use allocation in Jordan Valley

About 92% of areas of irrigated vegetables use drip irrigation in the Ghor north of the Dead Sea, and 100 % in the south Ghor and Wadi Araba. The use of drip irrigation was limited to vegetable plants. Currently, about 52% of irrigated FT uses modern irrigation system. The wide use of drip irrigation led to the improvement of on-farm water distribution and use efficiencies. Area cultivated with vegetables, in 2007 was 278,971 d, of which 243,041 d was open and 35,930 d of covered area. Area under plastic houses was 5,678 d, and plastic tunnels were 12,722 d. Area planted with FT was 100,510 d, of which 65,184 d was citrus, and 6,979 d planted with Date. Area of plastic houses used for production of vegetables reached 9,000 d, while area of plastic tunnels reached to 5,800 d in 2007. The continuous increase of protected agriculture was accompanied by the use of advanced production techniques. Production using intensive protected agriculture is rapidly increasing. Some farmers started to produce vegetables according to the Euro-Gape specifications, which improved the quality of their products and export to the European market. Some efforts to introduce integrated pest control have started, but until now, it is limited to vegetables. Planting trees in the Valley is limited to banana and citrus. Lately other types of fruit tree were planted such as grapevines. Date palm was introduced in the Middle Ghor and Wadi Araba. Some irrigation projects were implemented in Wadi Araba to take advantage of early production of vegetables and fruit.

a.3. Reforms

Resources in the valley are managed according JV Development Law No. 30, 2001, after amending Law No 18, 1988. The Law of 1988 limited the sale and purchase of the farm units by the JVA, while the amended law of 2001 allows the sale and the purchase of farm units for the purpose of aggregating them together to 250 d per owner with the purpose to promote investment in the Valley. The law gave the JVA the right to determine the prices of irrigation water according to the total cost, manage some of its businesses on commercial basis and the participation of the PS in the management of irrigation projects.

A progressive water tariff is implemented on irrigation water increased, in 1994, to reach 18 and 35 files per CM of monthly consumption in excess of 3,000 m^3 per agriculture unit. The government increased the water price to 15fils/CM in 1995, and pledge to increase it to a minimum of 25fils/CM in order to cover operation and maintenance. Instead, the government adopted a block tariff system in 1995. According to this system average water price per cubic meter is estimated at 18fils/CM**.** The objective of this reform was to increase water use efficiency, eliminate cereal production, and reduce areas with high water requirement

a.4. Environment

TWW had been used in irrigation in Middle Ghor since the construction of the Al-Samra wastewater treatment plant in 1985. The use of this source of water is recently extended to north region of the valley. Several new environmental issues pertinent to soil salinity, quality of products and public health resulted from the use of TWW in irrigation, and the irrational use of fertilizers, and pesticides (Taimeh, 1988).

a.5. Constraints facing irrigated land resources, JV

a.5.a. Resources management

- Fresh water resources available for irrigation is substituted with TWW to compensate for fresh water pumped to Amman. This will result in the deterioration of irrigation water quality over all over JV.
- Low water distribution and use efficiency of water on farm level, especially for those farms which do not use modern irrigation methods.
- Gradual deterioration of soil physical properties and increasing, using water of high salinity, irrational use of fertilizers; and lack of water for leaching.
- Annual amount of available water for irrigation, and its quality depends greatly on annual rainfall and runoff. If the rainfall intensity was low, runoff yield to the dams along the Valley will be low, and ratio of runoff water/TWW will be very low, which results in low water quality.

a.5.b. Production and productivity

- Productivity of most crops per unit land and water and the net return per cubic meter of water is low due to: low quality of produce, deteriorating water quality, poor irrigation management; and absence of legislations that regulate the use of fertilizers, pesticides, insecticides, and herbicides.
- Cultivation of land with crops which do not match soil suitability.
- Lack of long-term plan to monitor the status of LR needed to assess causes of low productivity and land degradation.
- Weakness of agricultural extension services and personnel specialized in modern production management and postharvest.
- Lack of trained technical staff in the field of planning the use of LR and the absence of farmer training centers.
- Irrational use of AP inputs such as fertilizers, pesticides, and irrigation water, which pollute the soils and groundwater.
- Weakness of coordination between MoA, MWI, and MoEn in the field of management of IA, and LR.
- Weak enforcement of legislations in fields related to pollution of surface and ground water resources.
- Weakness of agricultural research and extension services in providing solutions facing production and optimizing resource use.
- Absence of modern organizational structure of the PS, especially Farmer Association, and lack of incentives to encourage PS to invest in modern technologies
- Large IA is poorly managed due to increasing reliance on foreign labor to mange farm production in the Valley.
- Weakness of post-harvest infrastructure needed to improve competitiveness of product in export markets.
- Market liberalization introduced greater pressure on farmers to improve efficiencies, quality of products, which can be met by the availability of proper post-harvest technologies, and securing marketing chains.

b. Irrigated land in the upland region

b.1. Resources

- Irrigated agriculture in the UP depends on surface water (estimated to be around 60 MCM), water springs (about 20 - 30 MCM) which is dominated by small land ownerships and traditional agriculture, and on groundwater, with an estimated extraction in 2000 of about 198.5 MCM for irrigation purposes.
- IA in the UL was 498,387 d, in 2007, or about 60% of the total IA in Jordan, which was 810,998 d. Most of the IA is found in the UL region, namely in the Mafraq, Zarqa, and Amman governorates.
- Area planted with FT, in 2007, was 334,137 d (67%), of which olive trees occupied more than two thirds of the area, followed by apples, grapevines, and stone-FT.
- Area cultivated with vegetables, in 2007, was138,330 d, or 28% of cultivated areas, of which plastic houses, with an area of about 5,000 d.
- Areas cultivated with FC, in 2007, was 25,920 d or 5% of the total cultivated areas.
- IA consumed about 304 MCM (Safe yield is 275 MCM of which 88.5 MCM of surface water (streams and springs), and 11 MCM of TWW. According to the government strategic plan, the quantities of pumped groundwater for agricultural purposes will be reduced to 86 MCM by 2020, Available TWW will be 220 MCM, and available water allocated for irrigation in the UL will be reduced to 191MCM, or 37% by 2022. This will result in deteriorating in its quality due to the increased use of TWW.
- Over-pumping of groundwater in the UP (for agriculture, domestic and industrial purposes was about 425 MCM in 2000), which is about twice the safe yield of estimated extraction (275 MCM), has resulted in the decline of water levels in these basins, and the increased salinity of others.

b.2. Management

- Area of IA in the UL witnessed clear expansion over the last three decades, due to poor enforcement of groundwater extraction regulations. This encouraged most farmers to exceed the limit allowed by license. Furthermore, many water wells are not legal; and the government failed to end such violation.
- Area of land planted under irrigation increased from about 130,000 d in 1980 to about 310,000 d in 1996, and 420,000 d in 2000, and 498,387 d in 2007(DOS, annual reports).
- The concentration of populations in the ULs resulted in the availability of high amount of TWW in these areas, which resulted in polluting some groundwater basins and Wadi water. The quantity is expected to reach 220 MCM in 2022.
- Some efforts were exerted to introduce the use of TWW for the production of animal feed.

b.3. Structural changes

b.3.a. Policy reforms

- Water sector (Focal point MWI): MoA have no mandates over water resources in the UL regions.
- A new water policy was adopted, which provides a coherent structure to enhance the management of water resources and reflects priority of water utilizations and define rules to be implemented in the management on the bases of allocation between different sectors, optimum return, consumers willingness to pay the cost in a framework which deals with environmental consideration, drought management, and enhance efficiency and conserving of resources**.**
- Reduction of cereal production in IA that receive < 200 mm of annual rainfall. This in principle targeted Disi area, which will be phased out very soon.
- Suspended the processes of granting new licenses for drilling since 1992 for the purpose of irrigation, expect for projects of maximum priority in areas of industry, education and truism.
- Established a unit to monitor pumping through metering.
- Introduced fees for using ground water by industry.
- A fee of 25 fils/CM above pumping quantity allowed by the license was introduced in 1999.
- The government cancelled, in 2011, contracts with agricultural companies operating in Disi (irrigated agriculture in areas < 200 mm), after reducing the pumping of water from 55 MCM/year to 35 MCM/year in 2000. The pipeline for pumping water to Amman is currently under construction.
- The government implemented, in 1999, a policy of installing volumetric metering on all public and private wells in Jordan**.** The objective was to reduce water pumping to a sustainable withdrawal level. The government wills also charge well users higher fees for pumped water that exceeds the licensed quantity, which varies between 50,000 - 75,000 CM/well years. The government decided, in 1999, to charge 250 fils/CM for each cubic meter that exceeds this level. The immediate effect of such policy is greater on many farmers who expanded their farms during the years when the government did not effectively enforced metering**.**

b.3.b. Reform at Ministry of Water and Irrigation

- Redefinition of the role and duties of institutions involved in water sector.
- The structural changes are expected to reflect, in principle, to increase the efficiency, unification of planning and management of water resources including processing of water information databases and their management through one system

b.4. Constraints to development of irrigated area in the upland region

b.4.a. Resource management

- Continuous decline of quantity and quality of water resources available for irrigation, depletion of ground water, resources allocation for domestic use, and pollution of surface water.
- Low water use efficiency at farm level.
- Excessive use of fertilizers and pesticides, which result in increasing production cost and deterioration of produced quality.
- Gradual deterioration of some soil properties and increased soil salinity, due to high salt in irrigation water caused by over-pumping and pollution of surface water by TWW.

b.4.b. Production and productivity

- Low productivity per land unit due to poor farm management practices, and the use of crop poorly matched with of soil suitability.

- Excessive use of production inputs such as fertilizers, pesticides, and irrigation water.
- In adequate agricultural research programs, weak agricultural extension activities, and reliable information oriented towards emerging problems facing producers.
- Lack of incentives to encourage investments in irrigation and production techniques.
- Increasing cost of farm inputs are imported and controlled by global prices.
- Farmers are facing problems related to increasing cost of pumping due the current cost of fuel. Farmers, who were accustomed to use cheap inputs, lack the knowledge to deal with increasing cost, or inability to increase water use efficiencies, or adopt modern technologies especially those more environments friendly methods, will be the first candidates to either lose markets or unable to produce. Competitiveness and product quality seems to be the main challenge for sustaining modern irrigated agriculture. If such constraints were not solved, many poor farmers might be forced, or will be the first candidate for leaving this sector.

b.4.c. Environment

- Poor enforcement of environmental legislations to stop pollution of surface water resources used for irrigation and depletion of groundwater.
- The irrational use of fertilizers and pesticides causing the pollution of soil and groundwater resources facilitated by the absence of proper legislations.

b.4.d. Research and extension

- The contribution of agricultural research outputs to AD did not reach the required levels despite of establishing a specialized center for research and agricultural extension, and four colleges of agriculture.
- National research efforts are still weak and poorly coordinated among relevant stakeholders, and are not development oriented.
- Inadequate financial allocation to cover research activities derived by low interest in research and extension services.
- Insufficient number of highly qualified researchers in different specializations in irrigated agriculture and related area at national universities and NCARE, in development-oriented research and transfer of technology.

b.5. Main issues threatening sustainability of irrigated LR

b.5.a. Irrigation water availability and quality

- In JV fresh water is committed to domestic use in Amman, and is being replaced by increasing amounts of TWW. Although mixing TWW with runoff water behind dams is practiced since 1985, the total withdrawal of Yarmouk River water will deprive areas North of Dier Alla from any chance of using fresh water, and reduce dilution of mixed water discharged from King Talal Reservoir. Therefore, the ratio of TWW/runoff water behind King Talal Reservoir will be low. This ratio may be further reduced due to rainfall reduction according to projection by IPCC reports (RSS, 1996).
- In the UL region, the issue of water is related to decreasing the quantity of available ground water, which is increasingly allocated to domestic use, and the expected increase of water salinity. This means, unless modern saving measures were used in farming, and new crops were introduced, otherwise production in this region will be subjected to many constraints, such as low productivity, poor quality products, poor marketing opportunities of the new crops, as well as suitability to local environmental conditions, and finally reduction of cultivated areas due unavailability of fresh water for leaching the soil.

b.5.b. Water use efficiency

Water use efficiencies for AP in IA are still low. Increasing such efficiencies is not only to increase water availability, but to reduce cost of water. According to the new water strategy, significant reduction of water allocated to IA will be achieved by the year 2022. To achieve this, the government will enforce metering on wells and enforce additional price on amount exceeding licensed limit. Water saving measures, use of modern production management, and higher level of investments, are among priority to avoid threat of water shortage for irrigation in the UL.

b.5.c. Enforcement of regulations

Government was reluctant for long time to enforce water pumping license in the UL. This encouraged farmers to exceed irrigated area far beyond the amount of water allowed by the licensee. The government is

planning to enforce such regulation to control future depletion of groundwater resources. The success of such regulation will force farmers to reduce IA unless action to increase water use efficiencies was employed.

b.5.d. Production and post-harvest technologies
Although most of the IA use drip irrigation, which improved water use efficiency, still the need to introduce technology such as fertigation, soil moisture conservation measures, and evaporation to increase and optimize irrigation scheduling is very important. Such technology is costly, requires trained human resources and investment, and above all better marketing conditions. The IA also still lacks modern post-harvest practices and post-harvest infrastructure, which hinders export capability.

b.5.e. Produce quality
Although produce with good quality are produced by few pioneering farmers, still, the production mass do not meet the requirements of export market. Jordan exports high quantity of vegetables to surrounding and Gulf countries, but the quality is not competitive and return is low in comparison with product from other countries. Increasing production of exportable product requires careful planning, trained human resources, provision of good water quality and uninterrupted supply, and advanced irrigation management.

b.5.f. Farmer's experience
The massive number of farmers in IA lacks the required experience and the financial liability to introduce modern production and water saving technologies to manage resources in order to increase exportable production, which will, in turn increase return/unit of water. This is a crucial goal to be achieved under the threat of diminishing water quantity. Moreover, farmer will be called upon to use irrigation water with low quality and are still required to compete in local and export market. Increasing experience and awareness on health requirements will be a bottle neck for increasing export opportunity.

b.5.g. Cost of production inputs
Production in IA suffers form increasing cost of inputs and cost of export. This increase applies to both irrigated regions in Jordan. However, IA in the UL region faces a significant increase in cost of fuel for pumping and distribution of water. Some farmers claim that pumping cost increased more three folds due to increasing energy cost. This cost will be in addition to fees imposed on water pumping beyond license limit in UL region, and on expected increase in tariff fees in the JV. Water saving measures, and advanced irrigation management seem to be the logical solutions, otherwise sustainability of this sector will be threatened.
Inadequate and sustained allocation of funding for programs designed to help farmers to introduce modern technology, or to use modern farming practices to improve productivity or to improve water use efficiencies, or to provide financial support in the area of post harvest and other marketing chains. Most important is the inadequate allocation of fund required for training farmers on modern production practices, and relying in most cases on foreign organization for providing such training, which weakened the extension service in the country.

b.5.h. Market liberalization
Strong competition is mounting between local and imported products after Jordan had joined the WTO. Although WTO regulations opened windows for exports, still competition is fierce, due to high production cost and low water use efficiency. The increasing awareness of the public concerning health issues will force farmers either to produce product with good and safe quality, or consumers will look for imported goods.

c - Rainfed land sub-sector

c.1. Resources
- Total cultivated RA in 2007 was 1,060,987 d of which 1,055,826 d in the UL region.
- Areas cultivated with FC, in 2007, was 694,862 d. An area cultivated with wheat was 194,862 d, lentils 2,566 d, chickpeas 6,144 d, and barely 465,186 d.
- Area planted with FT was 379,787 d, in 2007. Areas planted with olive trees were 596,480 d of the total area, followed by grapes 34,024 d, and apples 37,065 d. Area planted with olive trees had substantially increased over the last three decades due to the accelerating fragmentation of agricultural holdings and low return obtained from cultivation of FC.
- Land available for rainfed farming is continuously decreasing. This is particularly true in areas near or around urban centers due to the increasing demands for building, which also lead to increasing price of land.
- LF had increased after the recent enforcement of a new law, (Bylaw No.6, 1996) which permitted division of 10 d land unit to 4 d unit in all areas west of the Hejaz Railway. The new

land unit is not suitable for production of traditional crops. As a result, a large area is abandoned without cultivation every year. This further aggravated the permanent losses of AL to urban use. Cash obtained from land sale induced farmers to move from rainfed farming to other jobs.

c.2. Constrains facing rainfed area

The following is a summary of problems and constrains facing the RA:

- This sector suffers form the dominance of small size holdings and continuous fragmentation to smaller units that are no longer suitable for traditional farming, and the use of farm machineries. It is believed that about one third of the arable land is annually abandoned for various reasons. It is widely accepted that the size of the land unit is the most important factor with profound impacts on the economy of production in the RAs. The losses of about 33% of the land, and in addition to those left uncultivated annually for various reasons are among the most important constraints facing this sector.
- Loss of fertile land within the high rainfall areas due to random expansion of urban activities.
- Farming practices are still characterized by the use of improper agricultural machines, plowing along the slope, and the use of unsuitable soils.
- Lack of LU guidelines to control the allocation of land according to suitability for cultivation. For example, large area of the RL are cultivated with barley, wheat is cultivated in areas suitable for barley, while fruit-trees are planted in soil with physical problem.
- Inability of national research system to provide innovative solutions suitable for cultivating small holdings, production of high value crops, drought resistant varieties, management, soil conservation, introduction of water harvesting or relevant technology transfer.
- Lack of capability to commercially produce seeds of improved varieties to meet national demands.
- Current legislations, failed to control urban expansion on the expense of ALs. Some of the existing legislations even promote fragmentation of rainfed land.
- Governmental programs that support the RAs were mainly directed towards cultivation of olive tree. This had resulted in the dominance of one type of fruit tree crop in Jordan.
- This sector suffers from high level of instability because its reliance on annual rainfall, which extremely fluctuates in quantities and seasonal distribution. This inflects great negative impacts on productivity.
- Although a success story can be told about utilizing runoff water for irrigation, which is demonstrated in collection of watershed runoff behind dams for irrigating land in JV, however, on-farm water harvesting did not receive similar attention, which could increase production in RAs.

c.3. Issues threatening resources sustainability

c.3.a. Land fragmentation

LF is considered one of the most important challenges that threatened future sustainability of the rainfed LR. LF is not only enhanced due the poor enforcement or in adequate legislations, but existing legislations and heritage laws also contributed to such problem (Taimeh, 2003). This process, unfortunately, is still on-going, without any real effort, to halt or to reverse it. The result is predominance of small parcels that cannot be used for traditional farming, which leaves it as an easy meal for land degradation, or facilitates its use in land market.

c.3.b. Urbanization

Losses of land to urban use have been going due to deficiency or improper legislations. This issue is one of the most threatening problems to the very existence of rainfed land. Land had been lost on the average of 35,000 d during the last 40 years. It was about 44,000 thousand during the last ten years. This is ironic since the increasing level of land urbanization occurred after the adoption of NASD, which clearly called and proposed measures to deal with this issue. The government prepared a new bylaw under the claim to protect LR from urbanization, but close examination of the new bylaw indicates that it facilitates urban encroachment faster than the previous law of 1967. The loss of land is permanent, and the need for new residential areas increases with time. Furthermore, due to location of early settlements, new urban centers were established within productive land. Any further expansion will consume more of this land. LU planning empowered with strict implementation of legislations can only save this from a doomed path.

c.3.c. Enforcement of legislations

Legislations is real translation of governmental intention to ensure sustaining its national LR. The government demonstrated this intension by strict enforcement of Jordan Valley Developmental Law of 1988. The enforcement of this law protected this vital area, which Jordan enjoys these days. Unfortunately, the government failed to match this action in RAs, despite the continuous recommendations. Not only proper legislations were not prepared, existing laws facilitated the abuse of the LR. Furthermore, even after the clear recommendations of the NASD in 2002 were adopted, the government prepared new regulations in 2006, which will accelerate urbanization at a rate faster than before. The lack of political will seems to be the bottle neck. Thus, issue should be addressed first before suggesting any recommendations relevant to sustaining LR of the RAs.

c.3.d. Drought

Jordan had experienced gradual reduction in rainfall during the last three decades. Studies on rainfall trends suggested rainfall reduction of about 25% during the last three decades (Hadidi and Taimeh, 1996). Unfortunately, maximum reduction was within the high rainfall areas (> 250 mm rainfall). Projections by the IPCC (IPCC, 2007 a,c) suggest further 25% reduction in rainfall, increase in temperature, and high drought frequency, and higher rainfall variability. Increasing drought already dominated the southern part of Jordan for the last six years. According to local studies, the gradual rainfall reduction is also associated with the late beginning of rainfall season, which will affect the length of growing season. This calls for reconsideration of a new crop calendar, introduction of new crops, and assessing their impact on productivity of rainfed crops. Furthermore, the uneven distribution of rain will reduce amount of moisture storage in soil, which requires different types of soil moisture management.

c.3.e. Investment

Agriculture production in RA has never been attractive to investors due to high risk caused by climatic variation, lack of proper incentives provided by government. Investment in this sector is restricted to provision of imported inputs. PS investments can be observed in olive oil production by providing modern oil presses, and export of packed olive oil bottles to several countries. The production of large high cash crops on large scale is not available to encourage involvement of PS. Few NGOs are involved in production of some crops with good cash value such as herbal plants. The government so far did not provide any effective interventions to promote investment in this sector. The success of any interventions should, in the first place, starts by preparing a law for protection of resources, coupled with incentives for investment.

c.3.f. Integration with livestock sector

Agricultural byproducts are good row materials that can be used by other sector such as livestock sector. This help to increase added value of such products. Results finding from projects carried in Jordan, such as Mashriq and Margib, (ICARDA, 1995) indicated that integration can improve return from rainfed crops byproducts for the benefits of both sectors. The project proposed simple and effective practices which can improve the integration between both sectors. The role of extension is not adequate. Government could encourage farmers by providing them with incentives to achieve better integration, which in the first place improve their livelihood and reduce poverty; which the government is trying to reduce.

c.3.g. Land market

Several factors had contributed to changing land from a valuable heritage for older generation, who were proud of how much land they own, to a new generation, who considers land as an investment opportunity. Price of the land is very high and is increasing at a high rate very quickly. Although increasing land price changes depending on the economic conditions, however, flow of cash in land market is astounding. Several factors facilitated the emergence of such market. Among them LF around urban cities is most important. Low land productivity, migration of land owners looking for better job opportunity, increasing demand for residential areas, lack of legislations, and placement of urban areas among arable land. The emergence of young generation who are not interested, or lack the knowledge to cultivate the land also reduce the importance of land in their life, where they consider land as a source of securing quick financial support.

c.3.h. Land use

LU is the most effective tool for regulating land allocation between different users. It secures land from degradation, reduces unfair competition among different users, and, provides means to select the best crops and matches it with optimum soil suitability. On the long run, balance between urban and AD, distribution of the population center according to the distribution of natural resources are achieved. Enforcement of proper LU is carried out through strict legislations. To date, such principles, although were proposed by many strategies adopted by the government, but no such planning is yet employed. Information required for regional

planning are not entirely sufficient, however, using modern technology such as remote sensing could fill in the gabs very quickly, and Jordan is equipped to do this.

c.3.i. Crop diversification

This sector suffers form low level of crop diversifications. Examining crop distribution indicates the dominance of three crops namely, wheat, barely and olive tree. Other crops such as grapes used to be a primary crop in Jordan. Summer vegetable, which constituted the main export produce to Gulf States, during the sixties to seventies of the last century, is on the brink of extinction. Large area used to be cultivated with legumes is also decreasing due to: high labor cost, lack of mechanization, and high rainfall variability. The increasing areas of fragmented parcels will further aggravate this situation in the future.

c.3.j. Land degradation

Land degradation is a global phenomenon, which affect LR. In Jordan, land degradation is caused by erosion by water, and degradation of its organic content. The government had exerted good efforts to reduce erosion in RAs, but such effort focused on steep land .The rest of the productive land still requires not only proper protection form erosion by water, but preservation of its organic content, which depends greatly on its management. Availability of animal feeds had placed great pressure on such land, because very little crop residues are left in soil to improve its organic content. Proper soil moisture conservation also helps soil to provide better plant cover, which helps the soil to resist land degradation**.** Government efforts in protecting rainfed land from degradation are not sufficient. Degradation of soil properties is among reasons for lower productivity, which did not improve over the years in spite of introducing many new varieties.

d. RangelandrResources

d.1. Resources

Land traditionally designated as RL occupy about 90% of the total areas of Jordan. According to the Agriculture Law No.20,1973, land which receives rainfall between 100 and 250 mm of annual rainfall was designated as RL of Jordan where plowing was prohibited.

d.2. Factors affecting resource sustainability

d.2.a. Land degradation

Land degradation including soil and vegetation cover has ravished this region for long time. Erosion by wind and water, destruction of vegetation cover, soil compaction, surface crusting is caused by many factors. *(See section on land degradation for more details).* National effort in this regards is very minor. Although many studies were carried within the dry regions, even the few attempts to curb degradation were not successful. Research results on experimental station indicated the possibility of increasing land production, but transferring such results to the field did not succeed. Many reasons were sited, such the unclear land ownership, rainfall characteristics, frequency of drought, unclear definition of local communities, adopting wrong packages for improving productivity etc.

d.2.b. Developmental program

Governmental programs carried within his region have been executed over short period of time, while improving vegetation cover, requires long-term programs. This explains why vegetation cover deteriorates again very quickly. Furthermore, some of the projects' sites were selected without proper attention to the soil suitability, because this region includes large areas with problematic soils such as saline soils and soils rich in gypsum content. One of the main factors which hinder the success of many programs was the lack of participation by the local communities, and project implementation on governmental owned land with open access. One of the main deficiencies in programs implementation by the government is attributed to lack of adopting integrated approach.

d.2.c. Land distribution

Recently, the government started distribution of the land within the Steppe region. More than 14 million d are already registered in this region. Sale of land as an investment, and land market is very active in this region. Distribution of this land without imposing and adopting any specific LU, facilitated fragmentation to 10 d parcels, and encouraged extensive land sale. This will complicate the implementation of any future developmental activities.

d.2.d. Land tenure rights

RL is still open area. About 80% of the land below the 100 mm isohyets is still a state land. Large areas are under the control of mining companies, army, quarries, or other land rights. The rest is open areas without access restriction. Unfortunately, any of those who has right to use the land carry their activities without any consideration to protect the resources under their control. Poor definition of property right in this region is an obstacle for proper implementation of developmental project.

d.2.e. Participation of Local Community

Participatory approach with active involvement of local communities had proven to be sound approach for sustaining RL development activities. Although there is good realization of the significance of this issue in Jordan, implementing this approach faces some difficulty due to the poor definition of what is the geographic boundary of the targeted local communities. Among suggested approaches is to delegate land to ccooperatives. However, better governmental involvement is still needed.

d.2.f. Legislations

Range land suffers from lack of proper legal protection. Except for few articles, which prohibit abuse of RL, which in reality were never enforced, almost all activities carried within the RL are not checked according to any specific law. Legislations to enforce actions aiming at resource protection or implementation of programs for combating desertification are highly needed.

d.2.g. Drought

The RLs fall within region, which receive < 200 mm of annual rainfall. This amount occurs as isolated short, but intensive showers causing high runoff, which increase water losses and reduce water storage in the soil. It had been estimated, due to rainfall intensity and presence of soil surface crust that, about 30 - 40% of the rain only enters the soils (Taimeh, 2010). The high rainfall variation is also associated with increasing drought frequency prevailing within this region. Projections indicate that drought frequency will increase. Understanding rainfall pattern provides the base for formulating proper approach to optimize water utilization using appropriate water harvesting techniques.

d.2.h. Investments

This area is the least attractive region for PS investment, due to the nature of resources and high investment risk. Therefore, it is expected that government should initiate proper programs for the benefits of both local people and protection of these resource.

d.2.i. Overgrazing

Despite the implementation of many projects, still guidelines to control gazing within different region with different carrying capacity have not been yet established. This is attributed to the lack of detailed soil information and the fact that carrying capacities for different soils were never evaluated.

e. Forests

e.1. Resources and management

- Area of natural and artificial forest covers only 1% of the total area. According to 2000 statistics, natural forest covered 506,000 d, of which, 38,000 d is governmental forest, and 127,000 d are privately owned. Area planted with artificial forest trees is 450,000 d.
- Forest had been continuously abused despite continuous afforestation efforts exerted during several decades. As a result, forest land did not increase, due to conversion of forest to orchards, or forest abuse.
- Conversion of forest to orchards was not coupled with implementing soil conservation measures to protect soils from erosion.
- Six reserves were established to protect plants, animals and birds that are threatened with extinction as a government response to its commitment to protect biodiversity.
- Afforestation Program: This program started in 1924 and is considered the most sustained program in Jordan. Afforestation is carried with the participation of public, lead by MoA and private institutions. Different public and private institutions participate in annual festivals for planting forest trees on land registered as forest land.

e.2. Constraints

- Despite the fact that afforestation program was started and sustained since 1924; the told area of forest did not increase. This suggests that rate of newly forested areas are equal to those cleared form forest.
- Many forest areas are still privately owned. The new law prohibits even cutting a forest tree within a garden, or old orchards without permission.
- Forests occupy rough topography. Access of many forest areas is still impossible, which makes hazards of annual fires very high.
- Wood is still used to make charcoal used for heating and as fuel. Therefore, forest is continuously abused to produce charcoal.
- Previous regulations allowed land owners adjacent to forest, if he reclaims land and cultivate it for five year to request ownership of the land. However, the forest cover should be < 25%.

6 Land legislations

6.1 Introduction

Legislations play an important role in protecting LR from competition and degradation. All national developmental attempts can fail if not supported by proper legislation to enforce, harmonize and sustain the country's efforts. Legislations reflect the country's continuous commitment to protect its natural resources.

6.2 Assessment of legislations affecting land in Jordan

6.2.1 Development of LU legislations

The following section examines the role of some of the important legislations with clear negative impacts on the allocation and protection of LR and competition on LR in Jordan. Legislations with direct impacts will be examined in detail. Other with less or indirect impacts will be listed.

6.2.2 General land allocation laws

a. Legislations with significant impacts on land resources:

- Law No.79, 1966: Organization of cities and villages, and buildings:
This law was prepared as a result of increasing urban activities. Among the aims of this law was to regulate establishment of villages and cities boundaries, to prepare a plan to allocate land within the boundary of the city or village to different users, and regulate building specifications. (Note: In 1965, the area of AL was 3.9 million donums. Rainfed farming dominates the UL where more 95% of the population reside. Rainfed farming dominated agricultural production). The law and the bylaws were implemented through different committees at high, intermediated, regional, and district level. These committees were composed from different authorities, but unfortunately, none of these committees, at any level, included representatives form the AS.

The following discussion examines articles with relevance to LR, which revealed the following:

- The law did not include any article that clearly aims at protection of AL, except for article No.40, which deals with the protection of forest land in cooperation with MoA.

- Law No.48, 1953:
This law allowed division of land, regardless of its use to minimum of 10 d outside the municipal and village boundary. This law had encouraged land fragmentation within rainfed areas. Taking into consideration scale of economy, and the facts this law applies in the UL only, cultivation of field crop would be most affected by such law. This explains why PS investment is in RA is weak. Increasing owners makes it hard to implement certain production packages. Division between brothers and relatives alone is sufficient to cause enough division of such land. The danger stems from the absence of any LU laws to dictate and prevent the conversion of AL to other use.

- Bylaw No.6, 1996: Land division between partners:
This bylaw was issued in the provision of paragraph (6) of article No.2 of division of non mobilized properties Law No.48, 1953. This bylaw allowed the division of parcels within specific governerates (Irbid, Jarash, Ajlune, Balqa, and Tafila), and some other specific villages, west of the Hijaz Railroad, and receives > 250 mm of annual rainfall, to 4 d between partners. Moreover, if the land had irrigation right, the land can be further reduced by 30%. This bylaw can be applied outside boundaries of regulated urban center. Moreover, it is applied in RAs, which is considered the area with best soils and highest rainfall in Jordan. Therefore, potentially all the rainfed land outside the villages and cities would eventually be divided to 4 d. Such bylaw clearly accelerates the LF up to four donums, since the law is applied outside the municipal and village boundary.

- Land Use Bylaw No.6, 2007:
It was declared that this bylaw was prepared with the aim to protect AL form urban expansion. Examining the different articles indicated the following:
According to Article No.4, land is divided into the following categories:

- Category A: Called agricultural land.
- Category B: Called rural land.
- Category C: Called Steppe or transitional land.
- Category D: Called desert or dry land.

Each category is divided to sub-categories, i.e. A1, A2, and A3 etc.
Examining the LU allocation according to these categories revealed the following:

- The classification of land of given categories were not established according to any known land classification system. No reference was cited suggesting which system was used to establish such land categories.
- Land suitability assigned to different categories was not based on information extracted from soil maps with suitable details and scale suitable for such classification. It was indicated that soil maps prepared by MoA was used to establish the different land categories.
- *Article No.6B-2-A:* According to this article, it is permitted to build one or two houses with an area of 15% of the total parcel area or equal to 1000 m^2.
- If we consider that the Law No.79, 1966, which contributed to the development of urban centers on the expense of AL. It can be concluded that the new bylaw provides less restriction on expanding buildings on the AL. Moreover, as a result of random establishment of more than 95% of the urban centers on or within AL, the new bylaw will accelerate the rate of losses of land to urban activities at rate higher the Law No.79, 1966.
- The impact of such bylaw stems form allowing land owners to build their houses outside regulated areas, and on AL. This will result in scattering of houses without any plan. Eventually, it allows housing to be scattered outside boundaries of regulated areas.

b. Legislations with positive impact on environmental protection and resources include:

- The Jordanian Specifications for Industrial Wastewater No.202 of 1991.
- Sewage By-law No.66 of 1994, Water Authority.
- Jordanian Specification JS 1145/ Sludge. 1996, Water Authority
- Industrial and Commercial Wastewater Disposal into the Public Sewage No.1, 1998, WAJ.
- Ground Water Control Bylaw No.85 of 2002, Water Authority.
- Jordanian Specification No.202/ Water: Industrial Waste Water of 2003, WAJ.

c. Legislation which has adverse impacts on environment:

Several legislations were prepared in Jordan with direct and indirect influence on the environment. Although most of them were not prepared, with protection of environment as an upfront priority, they had various negative or positive impacts on the environment, especially those related to LR status, degradation, and their future performance.
Legislations with direct impacts on LR were previously assessed.

The following laws are indirectly related to an important environmental issue in Jordan, and were previously examined:

- *Law of organization of cities, villages and buildings No.79 of 1966 and its amendments:* This law was mandated to MMA and was amended several times. This law deals with LU in Jordan. However, it neglected the agricultural component of the LU allocation and concentrated only on

LU for urban land utilization. As results of urbanization, AL was fragmented and left for degradation since land was converted to a commodity which entered the land market.

- *Law for division of the non-mobile property No.48, 1953 and by laws issued in accordance with the provisions of the law:* This law allowed division of land, regardless of its use to minimum of 10 d outside the municipal and village boundary. This law had encouraged LF within rainfed areas.
- *Bylaw No.6, 1996: Land division between partners:* This bylaw was issued in the provision of paragraph (6) of article No.2 of division of non mobilized properties No (48) for the year 1953.
- *Interim Law No.22, 2005 and Interim Law No.21, 2005, and amended Law No.22:* which allows companies to carry out projects over state properties and land registered for exploitation purposes. This means more areas will be subjected to increasing levels of desertification.
- *State property Administration Law No.17, 1974 and its amendment, Interim Law No.21, 2005:* All articles of the law are concerned with transaction over state land. Without predetermined LU plan which consider possible improper LU onsite and off-site impact on degradation.

6.3 Legislation reforms

The following section discusses prepared or reviewed legislations with clear impacts on resources management and their future sustainability. Among these legislations:

- *Agricultural Law No.20, 1973:* MoA mandates are performed according to Agricultural Law No.20 since 1973. The law had been partially amended. Recently, after the structural adjustment program of the AS in 1995. According to the new law, the role of MoA was redefined and areas which are left for the attention of PS were identified. The new law was given number No.44, 2002. To date, the final draft has been ready since 2002, but it is still waiting to pass through different legislation steps before the final version is adopted.
- *Agricultural Law No.44, 2002:* Agriculture Law No.44 of 2002 covers many areas, but most important, it defined the new role for MoA as a authority responsible for development, regulation and monitoring the AS in Jordan, and the role expected form the PS.

Among important article related to resource protection in the previous and amended laws are:

- *Management of forest:*

Among areas with clear relevancy with resource protection with special significance is management of forest. Many articles included in this law about the protection of forest in Jordan reflect strong commitments to protect this sector which started since the creation of the Emirate of East Jordan. Among these articles: *Articles No.28-40:* These articles deal with different aspects of forest protection and various means of miss-management. The new law includes a very important article, which prohibit sales or changing the status of forest for any reasons without approval of the cabinet. This article represent a very important step towards the protection of forest land, which had been abused for more than 8 decades in many ways such as conversion of land from forest to orchards, illegal cutting for production of charcoal used for cooking or for heating, and fires due to careless behavior.

- *Management of rangeland:*

Different articles state: The law defines rangelands as all registered state land, or any state land where annual rainfall average is < 200 mm will be considered as range areas. Although these articles provide some means to protect and manage rangeland. However, none of these articles were enforced, partially because most of the rangeland is converted to private land. Moreover, many of these articles is not well defined what is really prohibited.

JV Development Law No.30, 2001: This law was prepared as an amendment to the previous JV Development Law No.19, 1988.

The 1998 law was one of the best laws prepared in Jordan, which contributed to the protection of AL in one of the best AL in Jordan form non-agricultural competition. The land capability classification was used as a base for dividing the farm units into different areas according to its suitability.

The main differences between law No.19, 1988, and No.30, 2001, with regard to LU or protection of LR are:

- According to law No.19, areas under the mandate of the previous law included area north of the Dead Sea, and to elevation of 300 m a.s.l. According the new law, the mandate is extended to Qatar village (North border of Aqaba Special Economic Zone) located south of Wadi Araba, and to elevation of 500 m A.S.L, and Eastern border of Jordan.

- The new law permitted sales of land to Jordanian, provided total ownership does not exceed 250 donums and for agricultural purpose only. This was not permitted in the 1988 law.
  This amendment is the most important deviation from the previous law, which prohibited sales of land within the valley but to JVA with pre-fixed price.
- Under special cases, ownership could be divided, but not to exceed areas the previous minimum area as specified in the respective article.
- Farm unit owner can sell his unit to other Jordanian. According to the 1988 law, farm sale was restricted to only to JVA.
- With regards to other articles related to land and water utilization or management, differences between both laws are minor.

Impacts on land resources:

- ✓ The division of LR used in the 1988 law was based on international land classification system. This system was developed according to economic requirement of land development. This system is usually employed prior to development of irrigated areas. The use of this approach was appropriate approach for such development. However, LU allocation based on land suitability was not used to select most appropriate cropping pattern. Consequently, crop production was not well organized and production congestions occurred very often.
- ✓ The law of 1988 forbids any division of farm units to smaller parts, or sale of any unit, but to JVA. This provided protection to the agricultural farm unit against land fragmentation, which maintained the production base in the JV contrary to legislation controlling allocation of LR in the UL.
- ✓ The new law permitted the sale of a farm unit to other Jordanian. When JV development was initiated, the farm units were distributed among local people, or to those with original land right. Allowing sales of land, although to Jordanian, may result in sales of land to citizens residing outside the valley and promote migration of local people from the valley to cities creating problems associated with migration.
- ✓ The new law allowed grouping of ownership up to 250 d. Reasons given for such amendment was economic one. It was argued that land consolidation will encourage PS to invest in the valley and enhance production efficiency, and improve produce export quality. Impacts of such change are not clear yet.

- *Environmental Legislations:*

The law of environment No.12 was adopted in 1995. The Law was replaced by a new law under the name of environment protection No.52, 2007. MoEn was mandated to implement the law. The law provides general guidelines for action to be taken in environment protection. Specific actions is specified in the by law.
The law permits preparation of bylaws. Those related to LR are:

- *Protection of soil bylaw, 2005;*
- *Protection of environment against pollution during emergency;*
- *Protection of water resources against pollution;*
- *Storage, transport, trade and use of organic fertilizers, 2003;*
- *Protection of soil bylaw.*

7 Recommendation relevant to land issues in Jordan

7.1 Cross-cutting issues

1. Ensure the complete and effective implementation of different adopted strategies by providing enough funding for implementing their action plans, especially programs requiring long-term funding.
2. Establish an integrated information system and database, to collect, classify and interpret available information, examine trends affecting future resources, and collaborate with universities by providing advance training in related issues.
3. Increase the awareness of decision maker about the benefits of sustaining the production of LR by providing clear economical and social and environmental indicators, and factors affecting future sustainability of LR and accompanied by list of issues to be given highest priority during the preparation of governmental developmental plans.
4. Government should allocate enough funds from national core budget to ensure the sustained implementation long-term projects, and reduce or eliminate risk of terminating such projects before achieving their objectives.

5. Issues threatening resource sustainability should be given priority on equal footing with other national issues due to its significant impacts on food security and its role in absorbing negative environmental consequence expected in the future.
6. Promote relationships between different stakeholders whose integrated activities play a leading role which could put resources on road of sustainability, by narrowing the gabs between the PS and the local communities on one side, and decision makers on the other side.
7. The government should ensure providing proper incentives based on achievements to improve the implementation of supported activities. The government should adopt the approach of no free lunch without proven results. This will encourage participation of serious farmer and ensure better results.
8. Establish a national body, empowered with suitable legislations, responsible for planning and implementation of agricultural research and extension and governed by governmental and NGOs. This body should be responsible for strategic planning, preparing polices, and plan, and implementation of all research activities, technology transfer, carried by different institutions, and ensures allocation of adequate funding for research and extension activities, infrastructure, and trained human resources.
9. Academic programs and training activities provided by colleges of agriculture should be oriented towards meeting the demands of changing requirements of AD in response to emerging issues such as biotechnologies, urban agricultural, water harvesting, environmental mentoring, climate changes, advanced data collection and evaluation, social economy etc, and qualify graduates in these areas to improve their technical knowledge.
10. The government should create conducive environment which encourages the PS to invest in agriculture and to improve the PS's organizational and planning capabilities to invigorate their ability to participate in implementation of projects and to take over some of the services provided by the government.
11. Amend existing legislations and enforce their strict implementation. Amendment should include new agriculture law by legalizing role for MoA to participate in planning and management of IA in JV, review and upgrade environment legislations to protect LR from deterioration, preventing its misuse, and pollution, and amending Law of 1967 and by law No.6, 1995 to include articles dealing with protection of LR form competition.
12. Develop and institutionalize collaborations between MoA and MWI in areas related to management of IA, water resources, and their developmental plans.
13. Request DOS to expand the collection, classification, and presentation of agricultural statistics to meet the demand of (AS) by using ecosystems as a base for presenting statistical data.

7.2 Recommendations relevant to irrigated land resources

1. Implement national programs to encourage farmers in IA to introduce water-saving measures and to adopt modern production technologies.
2. Provide incentives to farmers who adopt water saving measures to improve water use efficiency to help them to coupe with expected water shortage that resulted form withdrawal of fresh water for domestic use in the UL region.
3. Provide special assistance to farmers who introduces new crop with high export opportunity and highest return/unit of water.
4. Improve the quality of the produced TWW allocated for irrigation, and support national research institutions to investigate their best use to avoid environmental damages, which ensure highest food safety to enhance their marketability.
5. Take all necessary measures to protect ground and surface water resources from pollution.
6. Encourage the PS to invest in post harvest infrastructures including packing, transport and storage.
7. Implement a long-term training programs for farmers and university graduates to provide training on soil moisture conservation measures, irrigation scheduling, fertigation, and other irrigated farming practices.
8. Implement special training programs to increase awareness of farmers about the health and other quality requirements to improve product penetration into to international market and to convince farmers to adopt improved production practices.
9. Improve farming practices to increase ratio of exportable produce with efficient production measures, which requires careful planning, trained human resources, availability of good water quality and uninterrupted supply of good water, and advanced irrigation management.
10. Provide special training for farmers on modern production and water saving technologies to enable them to manage resources in order to increase productivity and exportable production, which turn increases return/unit of water, and increase their experience and awareness on export requirements.
11. Formulate and implement a national plan to reduce the cost of imputes based on providing incentives to farmer in the form of tax reduction for using modern production equipment, adoption of water saving methods and equipment , and advanced irrigation management.,

12. Encourage the establishment of Farmers Association to be responsible for managing irrigation water within specific areas.
13. Redefine and institutionalize cooperation between MIW and MoA in the area of resources planning and management.
14. Commission universities to conduct research on various issues affecting sustainability and use of irrigated LR.
15. Establish modern laboratories, with international standards, equipped with equipments to ensure product safety and quality, and to be charged with monitoring the environmental and other emerging issues.
16. Establish a modern system to monitor the status of LR and risk of degradation and to implement timely measures to avoid high rate of degradation, or pollution.

7.3 Recommendations relevant to rainfed sub-sector

1. Review existing legislations and amend those facilitating LF, and ensure their effective and strict enforcement of Law No.79, 1966. This includes Land Use Bylaw No.6, 1995, and bylaw No.7, 2007. New legislations, which govern the allocation of land for specific use, should be based on land potential suitability and according to land classification system to halt the unjustified expansion of urban areas on AL.
2. Prepare suitable legislations which introduce special high fees and taxes on sales of land suitable for agriculture inside and outside villages and cities to reduce conversion of AL to other uses and reduce competition on such land.
3. Freeze the expansion of rural and municipal boundaries until the preparation of special law which freezes expansion of current villages and cities boundaries, and prepare a new law which advocates LU system as guidelines that aim at protection of AL from competition.
4. Adopt a national declaration that AD is one of the main principle ways to achieve rural development and reduced poverty in these areas.
5. Commission specialized research institution to formulate and test innovative farming system suitable for small holdings and high value crops. The institution should be responsible for preparing national integrated plans for the development of LR of rainfed region The plan(s) should focus on utilization of small holdings, means to integrate plant production with livestock sector, improve livelihood of rural population to reduce migration to cities, and should be given high priority since it will contribute to poverty alleviation in rural areas.
6. Reduce competition on agriculture land through allocation of land according to LU classification with priority to protect land suitable for agriculture, and empower such allocations with suitable legislations.
7. Increase awareness of decision makers about the future economic, social and environmental consequence of reducing resources capabilities to strengthen the decision process related resource protection at the high level possible, which should transpire to preparation and strict enforcement of proper legislations, and implementation of strategies and their action plans.
8. Prepare a drought mitigation strategy with proper action plan to respond to projected climatic change and possibility of increasing drought events, and measures to reduce their impacts on LR. The action plan should include establishing special fund to assist farmers during drought events, which enable them to maintain their livelihood and farming during drought events.
9. Establish a program for assessing risk of climatic change on productivity of different crops, and degradation of LR and establish prepare mitigation measures to reduce the impact of increasing drought on resources degradation.
10. Test and introduce the best farm management practices suitable for increasing drought conditions and climatic changes. Crop diversification focusing on the introduction of high value crops adapted with to small agricultural ownerships, and drought resistant should be encouraged by providing special incentives to farmers who introduce new crop varieties with high cash values, or have industrial use such as herbal or medicinal plants.
11. Implement new innovative programs which includes component conducive to the participation of PS and farmers associations, such as land reclamation, wide scale soil conservation measures, nurseries etc post harvest, packing, and production of inputs.
12. Provide incentives for farmers who achieve better integration, between livestock and plant production sector, and enable them to improves their livelihood and reduce poverty.
13. Provide proper incentives and training for young generation to encourage their involvement in AP especially in rural areas to reduce migration to cities looking for jobs, with special focus on new graduates.
14. Regional LU planning should govern and coordinate national developmental activities, and the allocation of land for various activities including industry, urban activities, and be carried out by different public and private institutions. LU allocation should be enforced by proper and strict

implementation of regulations. Priority of allocation should aim at protecting land with agricultural suability form non-agricultural competition

15. Implement long-term programs with the aim to protect LR from soil erosion by water, and encourage farmer's participation by providing different types of incentives and measures to encourage them to introduce new crop varieties, adopted improved management practices, and integrate on-farm water harvesting techniques with their farming practices.

16. Sustain and improve productivity of LR by encouraging the use of improved management practice through using proper mechanization, increasing use of plan stubble as organic fertilizer and inorganic fertilizers, use of improved seeds, and improved soil moisture conservation practices.

17. Establish special fund for reclamation of steep rocky land within the high rainfall areas and integrate with proper management practices such as soil conservation measures, water harvesting, and use of crops with high values for industrial use. Studies indicated that about 1.5 milion donums of such land can be included in this program.

7.4 Recommendations relevant to rangeland resources

1. Implement long-term programs to fight land degradation, and protect areas with high potential from increasing risk of degradation. Such programs should be based on field data, site specific, and priority listing of areas with highest potential and at the same times, suffers from high rate of land degradation, and which provide highest return possible.

2. RL development alone is never sufficient to support livelihoods of local population. Therefore, integrated developmental programs proposed for this region should be based on integrated approach including support of farmer livelihood, creation of additional income generating activities, such as off-farm activities, i.e. milk processing, wool netting etc. These programs should be an integral part of long-term RL program with full and active participation of local communities taking into consideration site specific problems.

3. LU plan that serve as a guideline for land allocation should be prepared and supported with special legislations to serve as a guideline during the distribution and registration of new land which dictates its potential use, and that forces owners adhere to such use.

4. New guidelines, supported with proper legislation for defining property right in the range areas should be prepared. These guidelines should be supported with specific obligation to implement activities that cause no degradation, with special attention to those areas delegated to companies, or new land registered to private citizens. Property right also should cover those areas given to range cooperatives, which are wiling to implement range developmental programs. .

5. Measures should be taken to ensure and empower the implementation of participatory approach and invigorate the active involvement of local communities in planning, and implementation of RL developmental programs. Definition of geographic boundary of the targeted project area and LU property right should be part of the integrated approach. It should be clarified to the local inhabitant that not all the RL areas are open for free access.

6. Prepare a comprehensive law aiming to regulate the use, allocation and protection of different resources in the dry land. The new law should also stress the nature of activities permitted in the range areas, as well as those to be implemented to combat desertification.

7. Land degradation in the RAs are partially attributed to wind erosion originated in the range areas, especially those under the control of companies, or farmers who clear land from stones, or quarries, should adhere to regulations aiming to reduce wind erosion in these areas.

8. Encourage the formation of local communities to serve as a focal body, or as an entry point to participate in planning and implementing community action plans. These local communities should have a legal status, capable of vetoing the implementing developmental activities with clear definition of land property right.

9. Establish special fund to assist farmers during drought event in order to reduce pressure on the rangeland and avoid further land degradation. Fund should be attached with special regulations such as membership with local community action plan, local society established for range developments.

10. Commission research institutions to monitor climatic change to assess the risk of climatic changes on land and water resources and establishing a priority list for suffering from maximum risk and those with best potential land for development.

11. Commission research institutions and universities with a clear task to develop grazing programs for different areas according to the land potential, carrying capacity, and risk of degradation to be used as guidelines when implementing any range developmental plans.

12. The government should open window of opportunity to encourage PS investment in activities related to improving livelihood of local people, with special focus on communities who adopt water harvesting in production of food such as rehabilitation of roman cisterns and establishment of new water collection facilities.

13. Range developmental programs should always be integrated with suitable water harvesting techniques to increase availability of soil moisture, and reduce hazard of erosion by water.

7.5 Recommendations relevant to land legislation

Several attempts were made to introduce amendments to legislations with the aim to protect, conserve, and sustain the function of LR in Jordan. One of the most recent and comprehensive recommendations were those proposed in the National Strategy for Agricultural Development (NSAD) adopted in 2002. The strategy discussed the issue of LU and land allocation between different users and suggested several recommendations. However, among most urgent and important recommendations are:

1. A strategic decision should be declared and translated to proper legislation which includes articles, the forces the adoption of the following:
    - LU planning based on internationally recognized land suitability classification should be adopted as a first step for protection of land resources, form unfair competition.
    - Protection of land suitable for AP should be given first priority for protection among other uses.
2. Should immediately cease implementing bylaw No.6. 1996.
3. Freeze current village and municipal boundary including Greater Amman whose current plan is expected to expand Amman municipality boundary to cover 1200 km^2.
4. Cease implementing bylaw No.6, 2007 until the following are meeting:
    - Establishing clear practical standard guidelines for land classification in order to identify and protect land with good agricultural potential productivity.
    - Prepare soil map, at a level with details enough to allow preparation of proper sustainable land sue recommendation.
    - Including special article which clearly aim at the protection of land suitable for agricultural production form the increasing competition of other non - (AS).
    - Establish heavy tax on sale of land suitable for agricultural production.
5. Amend law No.52, 2007 by including articles with clear targets and applicable methods. Mandate articles dealing with general environmental issues to MoEn, and those related to conservation of land resources should be included with Agricultural law No 44,2002, under the supervision of MoA.
6. Legislations should include article that clearly indicate that, in dealing with matters related to allocation of land, MoA should be consulted, and should be represented in committees, if the implementation of these article requires formulation of such committees.

PART TWO

1 Ecosystems of Jordan

1.1 Introduction

The total area of Jordan is 89,342 km. The land's area is 88,779,000 d, of which the dry area ,called locally the Badiah, and the rainfed area ,called locally the High land, cover 80,550,000 d, and the Jordan Rift Valley (8,252,000 d).

The availability and suitability of the LR for AP in Jordan is very much controlled by the variation in climate and topography.

Jordan is divided into three main topographic regions (Ioniddes 1939). Climate, in Jordan, is affected to great extent; by the distribution of topography. This is well demonstrated by the climate of JV, a part of the Jordan Rift Valley, which extends to Africa. The climate in the JV is sub-tropical and different from the other topographic unit of the country, where the climate is Mediterranean climate.

1.2 Topographic regions in Jordan

Jordan Rift Valley: This unit extends from Tiberia Lake in the upper North to the Gulf of Aqaba at the South. Altitude varies from 19 m at the Northern part, to -392 m b.s.l near the Dead Sea. The width of the valley varies from 1- 8 km.The topography within the valley floor is rather level. This unit is part of the continental rift valley, which extends from Lebanon to Africa. The area of Jordan Rift Valley is 8,252,000 d.

Uplands: This unit is divided into two main units:

i. **The Eastern Plateau**: This unit occupies area adjacent to JV. It descends sharply towards to JV from the west side, and gradually towards the East. Elevation varies from 150 m, at the Southern part, to > 1000 m, at the Northern part. The north areas are mountainous, while the slopes become less steep towards the south. Most of the rainfed farming is practiced within this region. Area of this region is 8.9 million donums.
ii. **The Steppe and the Eastern Desert**: This topographic unit lies east and south of the second area and descends gradually toward the East and levels of towards the South. Altitude varies between 60-80 m a.s.l. The topography is dominated by level slopes, with some undulating topography, especially at the western side.

1.3 Climate

Climate has been classified using different systems. Each system utilizes certain parameters, and serves different purposes. Among these classifications:

- Emberger classification system:

According to Emberger classification, Jordan can be classified into three major zones with minor sub-zones:

a. Semi-arid: Dominates the UL areas and can be divided into the following sub-zones:
   1. Semi-Arid: Warm in the winter - Dominates the North regions and Moa'b Mountains.
   2. Semi-Arid: Moderate in the winter - Dominates in Ajlun and Balqa Mountains.
   3. Semi-Arid: Cold in the winter - Dominates in Sharah and Shoubak mountains.
   4. Semi-Arid: Hot in the winter - Dominates the North region of JV.
b. Dry climate: JV and Northeast regions: can be divided into:
   1. Dry: Hot in the winter - Dominates in JV down to the Dead Sea area.
   2. Dry: Warm in the winter - Dominates in the eastern part of the UL.
   3. Arid: Moderate in the winter - Dominated Amman, Mafraq, and Duleil areas.
c. Very Dry: Dominates the desert area and from the Dead Sea to Golf of Aqaba. Subdivided into:
   1. Very dry: Hot in winter - Dominated between the Dead Sea and East of Aqaba.
   2. Very dry: Warm in winter - Dominates in a narrow strip along the western portion of the UL.
   3. Very dry: Moderate in the winter - Dominated the desert area and covers about 70% of the total area.

- Koppen classification system:

According to Koppen classification system, the following types of climate exist in Jordan:

1. Bwe: Arid (Warm Hot Desert).
2. Bsc: Semi-Arid (Cool Desert).
3. Bse: Semi-Arid (Cool or Hot Steppe).

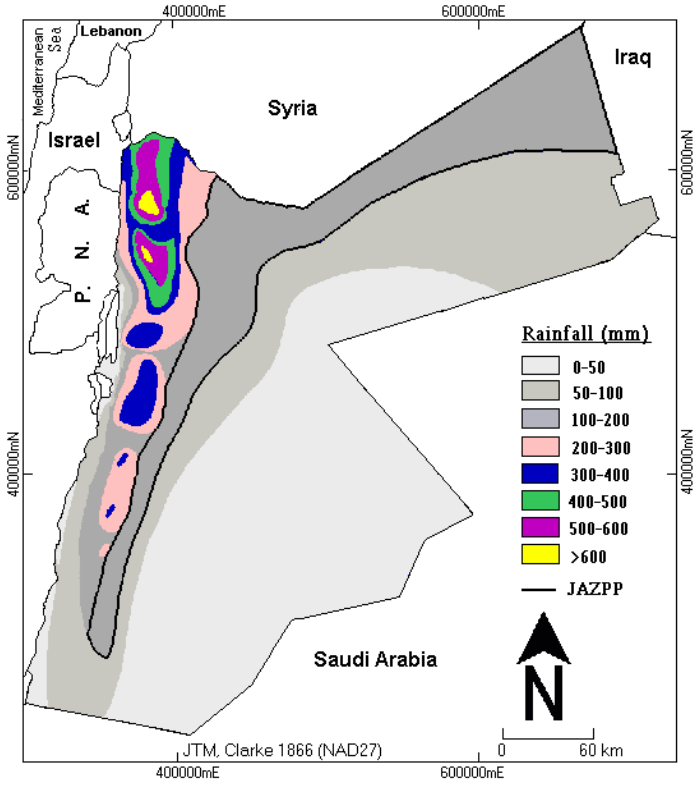
4. Bse: Semi-Arid (Cool Steppe).
5. Csi: Mediterranean-Subtropical (Dry warm of hot summer and rainy winter).
6. Csa: Humid Mediterranean (Dry cool summer and rainy winter).

- Thornthwaite classification:
According to this system, four types of climates are present:

1. Arid E(c)
2. Dry Semi-Arid (D1)
3. Semi-Arid D2(c)
4. Moist Semi - Arid (D4)

General characteristics of climate:
The previous classification systems suggest the presence of three main climates namely, Mediterranean Semi arid, Sub-humid, and Arid climate, which dominate the Eastern Plateau (will be referred to as the Uplands (UL) areas), Sub-tropical climate which, dominates in the JV. The distribution of the climate is correlated with geographical division, namely the JV, the UL and the Dry region as presented in Figure 1.1:

Figure 1.1: Rainfall distribution in Jordan



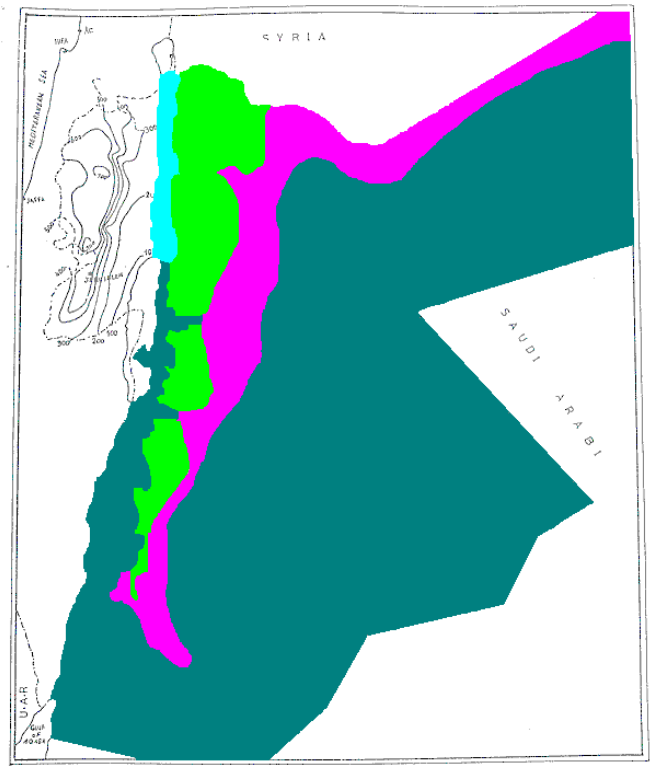
Source: Awni Taimeh, Soils of Jordan, 2009

Jordan is located on the eastern margins of the Mediterranean climatic zone of the eastern Mediterranean. A dry Mediterranean climate in Jordan dominates the limestone plateau immediately to the east of the Wadi Araba- JV Graben. While to the east of the UL plateau, dry continental desert conditions prevail. Accordingly, rainfall amounts decrease rapidly along West - East direction, and gradually, from North to South.
The winter months have moderately cool and sometimes cold weather, with January as the coolest month, except in the JV. The summer season extends from mid of May to the end of September.
The rainy season extends from October to May. About 80 % of the annual rainfall falls between December and March. Rain events, after March, occur as strong short thunderstorms which, causes intensive erosion.

1.4 Agro-climatic region s in Jordan

The following Agro-climatic regions are found in Jordan (Figure 1.2):

Figure 1.2: Main climate regions in Jordan



Source: Awni Taimeh, Land Use in Jordan , 2011

- **Subtropical climate**: This climate dominates the Jordan Rift Valley. Two types of climates can be found in this region.

Semi-arid sub-tropical climate: Dominates area north of Deir Alla with an annual rainfall > 250 mm. Elevation varies from -197 m below sea level at El- Baqura, at the northern edge, to -224 m below sea level, at Deir Alla at the Southern edge, and decreases to -300 m below sea level toward the southern end of the Dead Sea southwards. Average annual rainfall varies from 250 mm at Deir Alla to 400 mm at El-Baqura (Taimeh, 2009). Annual potential evapotranspiration at El-Baqura is 1,300 mm. Area occupied by this eco-system has high summer and winter temperature. Mean annual temperature is 24 ^{o}C Mean maximum and minimum air temperature in January is 10 ^{o}C, and 18 ^{o}C, while maximum and minimum air temperature in July 38 ^{o}C and 24 ^{o}C. Mean annual relative humidity is 50%. Cultivation of crops under rainfed conditions is possible in this area.

***Arid sub-tropical climate*:** The climate dominates the region south of Deir Alla with annual rainfall < 200 mm to 25 mm at Aqaba. Temperature is high during summer and winter seasons. Dry condition increases substantially south of the Dead Sea in Wadi Araba.

- **Mediterranean climate**: Three ecosystems are recognized:

Mediterranean sub-humid to sem -arid climate (UL): Dominates about 9% of country and in the UL region east of JV. Average annual rainfall varies from 250 mm, at the southern parts, to about 600 mm at the Northwest parts. Temperature is cool during the winter and warm during the summer. This region is the main area for AP under rainfed conditions. The rainy season starts from November until March. Thunderstorms or scattered showers occur during March and May. Annual and seasonal rainfall variation is very high. The average summer air temperature is 24.5 ^{o}C, Maximum, and minimum air

temperature is 30 °C, and 19 °C, respectively. Relative humidity is maximum during winter season and very low during the summer.

Mediterranean semi-arid to arid (steppe region): Dominates about 11% of Jordan, and occupies the region east of the UL. The winter season has cool temperatures. Average winter temperature is 9 °C. Maximum and minimum air temperature during winter is 15 °C and 3 °C, respectively. Annual rainfall varies from 100 - 250 mm. Rainy season extends from late November until the end of February and is characterized by very high level of seasonal and annual rainfall variation.

***Mediterranean arid climate: (Called locally the Badiah)*:** This ecosystem dominates about 80% of Jordan. Annual rainfall is 50 - 100 mm with extreme level of annual and seasonal variation. Most of the rain occurs as scattered, but intensive showers. Temperature is high during the summer and cool during the winter with high frost incidents. Mean daily temperature varies from 14 - 22 °C. Mean minimum air temperature during winter is 4-12 °C, and mean maximum air temperature during the summer is 20-28 °C. Mean annual relative humidity is 50-60%, and reaches 40-50% during the summer months, and 60 –70% during the winter months..

1.5 Distribution of land according to slope (MoA, 1973)

Table 1.1 shows the distribution of area occupied by different climatic zones, which suggests that 91% of the total area of Jordan receives < 200 mm of annual rainfall.

Table 1.1: Agro-climatic zones in Jordan

Agro-climate	Rainfall (mm)	Area (Ha)	% of Total Area
Arid	< 200	8,094,237	91.00
Marginal	200-350	563,400	6.09
Semi-Arid-Sub-humid	350-500	135,900	1.47
Sub-Humid	500-600	98,900	1.07
Total		**88,924,370**	**100.0**

Source: Awni Taimeh, Land Use in Jordan , 2011
Area in all the tables is in Donum

Land classification according to climate indicated that 91% of Jordan falls within < 200 mm of rainfall (Table 1.2). The rest of the land, where rainfall is suitable for rainfed farming is about 9%. It is estimated that about 87% of the total area has slope < 8%, of which 84%, lies in the arid region (< 200 mm). This explains why wind activity is very active in the region. The dominance of the flat topography from the Eastern and Southern sides, adjacent to the Arabian Desert, is responsible for strong wind blowing from the South and Southeastern region carrying enormous wind sediments towards the East. Semi-Arid to Sub-Humid climate occupies only 2.5% of the total area. Marginal land which lies as transitional zone that lies between semi-arid to arid regions, occupies 6.3% of the total area. Area occupied by arid and marginal land in Jordan, which have slope of 0 - 8% is indicative of resources availability for rainfed farming.

Table 1.2: Classification of agro-climatic zones by slope classes

Zone	0-8%	%	9-25%	%	>25%	%	Total	%
Arid	7459615	83.9	414060	4.5	22062	2.4	8096337	91.0
Marginal	236170	2.6	228343	2.4	98887	1.1	563400	6.3
Semi-Arid- Sub-humid	26291	0.3	64872	0.7	44737	0.5	135900	1.5
Sub-Humid	606	<0.01	61903	0.7	36391	0.4	98900	1.1
Total	**7724782**	**86.9**	**769178**	**8.2**	**400517**	**4.4**	**8894537**	**100.0**

Source: Awni Taimeh, Land Use in Jordan, 2011; *Percent of the total area in Jordan. (Hectare)
Source: Agricultural Zoning in Jordan, Ministry of Agriculture.

The analysis of land according to rainfall categories indicates that 63% of the total area receives < 50mm of annual rainfall (Table 1.3). Area which receives rainfall>300mm of annual rainfall covers about 2.3% of the total area. Area with marginal rainfall (200-300mm) occupies 4.3% of the total area. This area suffers from the intensive Land Fragmentation (LF), and the rapid expansion of urban

centers, which are located with rainfall zones higher than 250mm. Therefore, it become clear why Jordan has limited LR for agricultural production (AP), and how much it is critical to protect these resources from competitions.

Table 1.3: Areas of different rainfall zones Jordan

Rainfall (mm)	Area (Ha)	%
< 50	5,570,037	63.2
50 –100	1,385,100	15.0
100-200	1,139,500	12.4
200-300	394,800	4.3
300-400	178,800	1.9
400-500	125,300	1.3
>500	97,900	1.0
Total	**8, 894, 537**	**100.0**

Sources: Awni Taimeh, Land Use in Jordan, 2011.
FAO, Regional Study on Rainfed Agriculture and Agro-climatic, Inventory of Eleven Countries in the Near East Region, Rome, 1982.

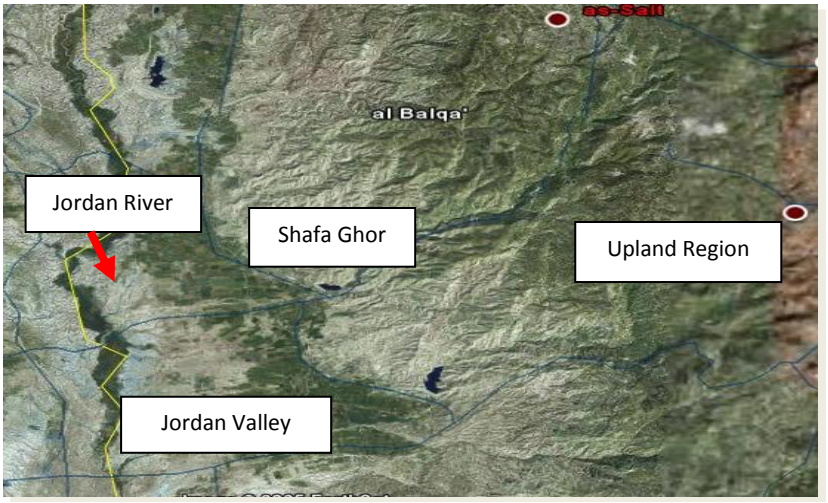
2 Land resources

Jordan may be divided into six main regions. These regions were established using criteria such as climatic, physiographic, geomorphology, and geological formations. The integration of these criteria produces regions with homogenous LR which provide good idea about the potential suitability of each region for AD. These regions are:

2.1 The Jordan Rift Valley: (Figure 2.1)

This is a narrow Graben, which extends from the Gulf of Aqaba to Yarmouk River South of Tiberia Lake. Altitude varied from 19 - 392 m b.s.l near the Dead Sea (Climate subtropical Arid-Semi-Arid) The valley floor is rather flat in many parts due to the presence of more than one terrace. The occurrence of gentle slope from the East towards the river promotes natural drainage. The Jordan River flows through Lacustrine Sediment, called locally Katar, forming a narrow flood plain (called locally Zhor) (Figure 2.2). The Katar covers the whole valley floor north of the Dead, and is overlain with colluvial sediments eroded from eastern mountains ((Figure 2.3, 2.4).

Figure 2.1: Jordan Valley, Shafa Ghor, and Upland region main land resources in Jordan



Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.2: Flood plan of Jordan River, most fertile land

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.3: Colluvium sediment forming soils at South Jordan Valley (Dry climate)

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.4: Colluvium sediment forming soils at North Jordan Valley (Semi-arid climate)

Source : Awni Taimeh, Soils of Jordan, 2009.

Farming in the JV depends primarily on surface water of Yarmouk River and runoff water flowing from Eastern UL region collected behind dams constructed on the side wades of the Eastern Mountains. This region is intensively used for production of vegetables under drip irrigation (Figure 2.5).

Figure 2.5: Drip irrigation and vegetablesis main crop produced in Jordan Valley

Source : Awni Taimeh, Soils of Jordan, 2009.

Area south of the Dead Sea has similar topography to the area north of the Dead Sea. Geological processes characteristic of dry and very dry climate dominate the region south of the Dead Sea. Sandy soil is the dominant soil in Wadi Araba along with old stabilized young and active sand dunes (Figures 2.6, 7, 8). Erosion by water and wind is responsible for the formation of sandy sediments that cover the valley floor. The soil of Aqaba-Ghor Safi- Wadi-Arab has good potential for AP, if water resources (WR), and appropriate farm management were provided (Figure 2.9, 2.10).

Figure 2.6: Sand dune reworked by erosion by water (Wadi Araba, Jordan Rift Vlley)

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.7: Dominance of sand dune (Wadi Araba, Jordan Rift Valley)

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.7a: Migrating sand dune outside Wadi Araba indicating the severity of wind erosion

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.8: Stabilized sand dune in Wadi Araba, Jordan Rift Valley indicating climatic changes

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.9: Introduction of high value crop such as palm trees in Wadi Araba

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.10: Production of vegetables is possible when water is available

Source : Awni Taimeh, Soils of Jordan, 2009.

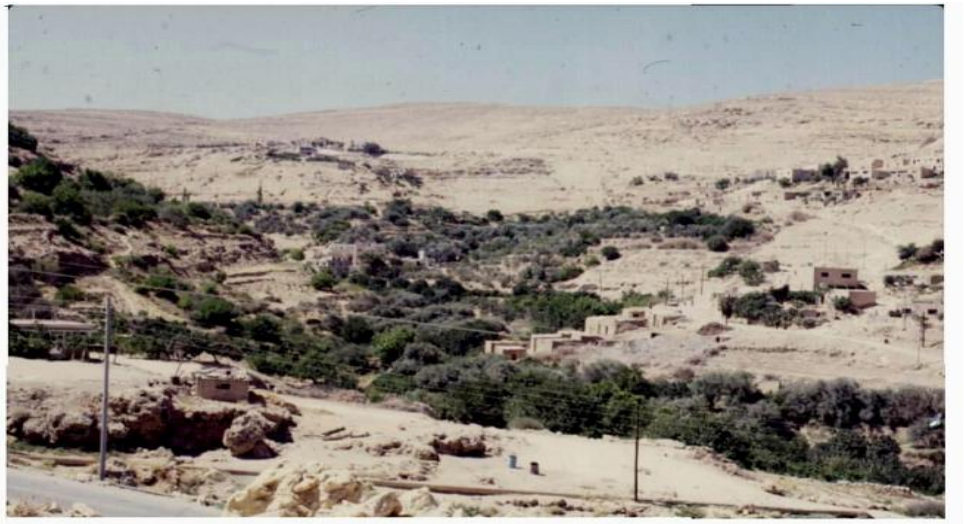
2.2 Mountain ridge and Uplands (Shafa-Ghor)

Mountain ridge is a transitional area located between JV and the UL region, and is locally called "Sahfa Ghor area". It occupies a narrow strip, which lies almost parallel to and East of the JV. This region descends gently eastwards and steeply towards the JV. Many major East-West wades such as: Wadi Mujib, Zarqa River, Wadi Ziglab, Wadi Shouaib, Wadi Mujib, and Wadi El- Hissa traverse this region. Agricultural potential is very limited in this area due to steep topography, dominance of highly eroded soil (Figure 2.11) and low rainfall. Small area is suitable for AP, when the soil is deep, level slopes, and areas with spring water (Figure 2.12).

Figure 2.11: Erosion by water resulted in sever soil losses (Shafa-Ghor Region)

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.12: Agriculture production around springs (Shafa-Ghor Region)



Source : Awni Taimeh, Soils of Jordan, 2009.

2.3 Upland region (UL)

This region has a Semiarid –Sub-humid climate. Rainfall varies from 250-600mm and increase along southeastern- Northwestern direction. This area occupies about 9% of the total area in Jordan. Some areas with steep topography, which occur at the Northwest corner, are covered with forest and shallow soils (Figure 2.13). Most of region is used cultivation of FC (Figure 2.14**)** and FT, mainly olive tree (Figure 2.15), under rainfed conditions. Steep shallow soils are used as range areas. Early urban settlements started within this region around springs and within arable land, where rainfed farming was the primary production system. As time passes, rapid urban expansion to meet the demand of increasing population was carried on the expenses of good AL (Figure 2.15a).

Figure 2.13: Natural forest is restricted to high rainfall areas within Upland region.

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.14: Production of field crops is main crop in rainfed area (Upland region)

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.15: Old olive (Roman) trees found everywhere in rainfed areas(Upland region).

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2.15.a: Random building on agricultural land is a main threat to rainfed land

Source : Awni Taimeh, Soils of Jordan, 2009.

2.4 Steppe region

This region lies east of the UL region and have semi arid to arid Mediterranean climate. This region is called marginal or transitional land, since it has a transitional climate.
Low and highly variable rainfall, high evaporation demands, strong wind, and low relative humidity characterize this region. The soils of this region are rich in by silt, calcareous, and poor organic content (Figure 2.16). This region had apparently suffered, during the last 5,000 - 10,000 years**,** from continuous accumulation of calcareous silt transported from the East and Southeastern regions (Taimeh, 2010). Sporadic grass and shrubs vegetation cover dominate this region (Figure 2.16a). Open and level topography coupled with poor vegetation cover (Figure 2.17), especially towards the eastern part, explains why wind activity is very effective. Degradation active in this region have great impacts on land recourses of the UL region (See section on land degradation).

Figure 2.16: Dominance of silty calcareous soils in the Steppe region

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure 2. 16a: Sporadic small shrubs and grass dominate Steppe Region

Source : Awni Taimeh, Soils of Jordan, 2009.

Figure (2.17): Open topography in Steppe region, a factor for active wind erosion

Source : Awni Taimeh Soils of Jordan, 2009.

2.5 Arid region

The climate in this region is Mediterranean arid climate. Rainfall is < 200 mm at the northwestern apart, and decreases to 20 mm at the Southeastern part. Thus, aridity increases along this direction. This region can be divided into the following sub-regions (Taimeh, 209).

- Southern mountainous desert:

This area lies south of the Ras El-Naqb escarpment. This region has a rough rugged topography and steep mountains, which rise up to 1555 m a.s.1. The topography is responsible for the formation of different soils, and the formation of topography configurations that ranges from mountainous type at the Eastern edges, to undulating flat topography at the Eastern part. The topography is closed at the Western part. Therefore, the influence of wind is localized (Figure 2.18) While at the Eastern side, the topography is open, and the area suffers from strong wind blowing from the Eastern direction. Sandy soils around mud flat in Disi area (Western side) and sandy saline soils (Eastern side) are cultivated under irrigation during the last three decades. (Note: Farming will be terminated very shortly after reallocating water for domestic consumption in Amman).

Erosion by water and wind is very active in this region. Erosion by water is the single geological process responsible for the formation of soils.

Figure 2.18: Migrating sand dune due to active wind erosion (Southeastern dry region)

Source : Awni Taimeh, Soils of Jordan, 2009.

- Central plateau:

This region is situated East of the Steppe region and is bordered at the North and the East by the Azraq-Wadi Sirhan depression. In the South, it ends at the escarpment of Ras El-Naqb. The central part of the West side is covered with hundreds of sq.km of soils affected by wind. The drainage pattern, at Southern part is centripetal and is directed towards the center of the Jafr basin. Many types of problematic soils such as gypsiferous, saline, and calcareous soils dominate large areas. The natural soil properties of these soils determine the risk of degradation occurring in this region. Due to the dominant Mediterranean dry climate in this region, most of this area has been used for grazing. Some areas are cultivated using ground water.

- Azraq - Wadi Sirhan depression:

This depression is located in the Eastern part of Jordan. It is intersected by many wadis extending along the North-South direction. Dry climate and erosion by water and wind were responsible for the formation of problematic soils. Very small area irrigated from the limited WR. The soils potential suitability is low due to dominance of gypsiferous, gravely and stony soils. This region is primarily used as a range area.

- Northeastern desert:

This region comprises two major morphologically different regions. The first region is covered with basalt rocks at the western part. The second region is the flat stony desert, which extends eastward beyond the eastern border of Jordan. It is interrupted by small scarps. The dominance of dry climate contributed to the development of large area covered with desert stony basalt pavements. The basalt cover, coupled with low rainfall and flat topography contributed to the development of closed drainage systems. On the other hand, the second region although, soils are problematic, and topography is flat, some short grass could be found in depressions or along waterways. Erosion by water and wind had shaped the topography and properties of soils in that region. The dominant land use is range.

3 Resource development

3.1 Resource availability

3.1.1 Land resources

Availability of LR in Jordan is controlled by factors such as climate, topography, WR, and suitability for AP. Dry climate covers about 91% of the total area of Jordan. The rest of the country (9%) represents the maximum area where rainfed agriculture is practiced. This area has been for long time, subjected to various pressures and constraints such urbanization, and LF, which limits area available for production.
Considering the limited availability of LR in Jordan, development of additional LR for AP will not be possible without careful consideration of quantity, and quality of available WR.

According to available data (Table 3.1), area of land with slope < 8% is 76,420,000 d, (86.07% of the total area) ,while area of land with slope < 8%, but with rainfall > 200 mm, which, could be considered as areas suitable for FC, is 3,499,000 d or, 3.9% of the total area of Jordan. Area of land with slope 8 - 20% is 7,387,000 d (8.32%), while area of land with the same slope but with rainfall > 200 mm is 3,055,000 d or 3.4% of the total area. This area should be considered as the maximum area of land that could be available and suitable for FT, regardless of the soil suitability. Area of land with slope > 20% is 4,973,000 d, while area of land with the same slope, but with rainfall > 200 mm is 2,311,000 d (2.6%). These figures are very important and should be considered with utmost attention since they represent maximum area where AP is feasible. Among available LR, 91% of the total area of Jordan cannot be used for RA, due to prevailing dry climate or unavailability of water for irrigation. Therefore, the only possible opportunity for AD, if soils were not suitable, would be for range. AP of any other types would be possible only, if WR and suitable soils were available.

Examining the distribution of areas suitable for RA would clarify this point. Area suitable for FC is concentrated mostly in Irbid, Madaba, and Amman, Karak, Tafila, Balqa governerates (Table 3.1), while area suitable for FT is distributed among most of the governerates, except for Ma'an and Aqaba. Area suitable for forest also is distributed among all governorates with rainfall > 250 mm of rain, except for Zarqa, Ma'an and Aqaba.

The available data indicates that 37.4% of the land potentially (Table 3.1) suitable for FC and FT can be found in Irbid, Ajlune Governorate, while 28.7% is found in Amman Governorate followed by Karak (17.3%), and Tafila governorate (17.1%). It seems clear that land potentially suitable for FC are concentrated in Irbid, Amman, Madaba, and Karak, while land potentially suitable for FT is concentrated in Irbid, Ajlune, Tafila, Karak, Amman, and Zarqa (This conclusion is based on the presence of favorable slope and climate). Although Ma'an is the largest governorate, the potential LR available for FC and FT are about 8.8%.

Based on land suitability criteria, maximum land suitable for crop production under rainfed condition is about 3.5 million d, while according to suitability criteria for FT, about 3.0 million d can be developed for such utilization. These figures represent maximum area available for AP without taking into consideration some local constraints such as LF, land occupied by urban centers, and soil problems. These figures are also based on the assumption that soils and climate and size of holdings do not limit the suitability for specific utilizations. Unfortunately, most of the urban activities are concentrated within RA, thus limiting the development of new areas for AP within the RA in Jordan.

Management of LR is also affected by the national framework and institutional setup of organization mandated with this task. Their efforts to develop and protect these resources from competition from non-agricultural activities created additional constraints which reduces land suitability for traditional AP. Moreover, the above described distribution represents maximum availability of land for different agricultural utilization, if land use planning was carried according to their potential suitability, and protection of AL was considered as top national priority. Such figures should represent resources for production now and in the future in Jordan. This is not to forget that part of this land may include soils with unfavorable characteristics, and land, which had been used for non-agriculture purposes. Therefore, these figures could be used as a reference to judge whether we had preserved available national land resource or not, and if we had improved their potential productivity for future generation.

Table 3.1: Distribution of land that receive > 200 mm of rain.

Slope						
Governorate	<8	of total*	8-20	of total*	>20	Total*
			%			
Irbid	793	22.7	448	14.6	299	1540
Ajlune	48	1.4	189	6.2	180	417
Jarash	60	1.7	208	6.8	138	406
Balqa	166	4.7	265	8.7	267	698
Zarqa	38	1.0	312	10.2	52	402
Mafraq	237	6.8	173	5.7	37	447
Amman	607	17.3	348	11.4	125	1080
Madaba	430	12.3	151	4.9	145	726
Karak	665	19.08	353	11.6	411	1429
Tafila	172	4.9	403	13.2	430	1005
Ma'an	143	4.1	144	4.7	133	420
Aqaba	140	4.0	61	2.0	94	295
Total	3499	100.0	3055	100.00	2311	8865

Source: Awni Taimeh, Land Use in Jordan, 2011.
% of area with rainfall >200 mm, Area in Km^2

3.1.2 Water resources

The previous analyses indicate that additional resources development is possible if additional water is available for irrigation.
Information about available water during 2007 suggests that total available WR were about 1,805 MCM for all sectors (Table 3.2), while the demand for AS was 1,080 MCM (Table 3.3). The supply of water for irrigation was only 64% of the demand, of which 87 MCM was TWW (Water Strategy, 2007).

Table 3.2: Water resources available in 2007 and projected resources in 2022

Source [1]	2007	%	2022	%
Developed surface	295	24	365	22
Non-renewable:				
-Jafr	25	3	15	1
Disi-Hissban	66	8	135	8
Treated waste Water**				
-Industry	4	1	27	2
-Irrigation	87	10	220	13
Desalinated Water	10	1	20**	1
Peace treaty	50	6	50	2
Safe Yield GW	275	32	275	17
Artificial recharge	55	6	25	2
Desalinization*		00	500	31
Total	**867**		**1632**	

[1] : Million Cubic Meter MCM, *Other than Abu Sieghan and Aqaba, **From Abu Sieghan and Aqaba
Source: Awni Taimeh, Land Use in Jordan , 2011.

Table 3. 3: Water demand and supply during 2007

Use	Demand		Supply	
	Quantity	%	Quantity	%
Municipality	366	24	284	30
Touristic	10	1	10	1
Industrial	49	3	49	5
Irrigation	1080	72	597	64
Total	1505	100	940	100

Note: Allocation of irrigation water: 293MCM (32%) allocated for JV and 304 MCM (32%) for Highland
Source: Awni Taimeh, Land Use in Jordan , 2011.

Table 3.4: Water supply and deficit in 2007 and projected for year 2022

Resource	2007	2022	
		with R-D	without R-D
Resources	867	1632	1132
Supply	1505	1637	1489
Deficit	638	5	357

Source: Awni Taimeh, Land Use in Jordan, 2011.

The total water deficit in 2007 was 638 MCM, which will be reduced to 357 MCM, if the Red-Dead Sea conveyor was not completed, or to 3 MCM, if the conveyor was completed (Table 3.4). Taking into consideration, the political situation and difficulty to reach agreement between involved countries, and economic situation in Jordan, the completion of this project within projected time framework is highly questionable. Thus, it will be more realistic to assume that a deficit of 357 MCM will be the level to deal with (Table 3.5).

Table 3.5: Water demand and deficit in 2007 and project fro the year 2022

Resource	2007	2022	
		without R-D	with R-D
Resources	867	1132	1632
Demand	1505	1625	1635
Deficit	638	503	3

R-D: Red-Dead Sea conveyor.
Source: Awni Taimeh, Land Use in Jordan, 2011.

According to projection for the year of 2022, based on data available in 2007, water supply for irrigation will be 665 MCM including 365 MCM of surface water, 220 MCM of TWW, (Water Strategy, 2007) and 80 MCM of ground water (Nasser, 2002). This represents 68 MCM potential increase in water available for irrigation compared with water allocated for agriculture in 2007. However, caution is to be exercised, since the increase will come from TWW quantity. According to strategy projection (Nasser, 2002), it will be possible to discharge only about 144 MCM of TWW to JV, and the rest should be used in the UL region. This will create additional environmental pressure in the UL region if such water was used in AP since fresh water will not be available for blending with TWW. Furthermore, it is expected that the use of such water will be very restricted in AP due to the prevailing climatic conditions and the dominance of heavy-textured soils in the middle UL region where such water may potentially be used for irrigation, which will lead to rapid land degradation and production of low produce quality. One option is to use this water in dry region. However, land use and transport cost may not justify this option.

Moreover, fresh water available for IA in the UL, which is estimated to be 400 MCM/year (Safe yield 275 MCM), will be reduced, by the year 2022, to 80 MCM from ground water, and 80 MCM from springs and side wades. Among IA in the UL, it is estimated that, in 2007, about 470,000 d is irrigated of which 250,000 d is planted with FT, mainly olive trees and rest of the IA is used for vegetable

production. The only additional water resource available for irrigation in this area, in the future, will be TWW. This means IA will be substantially reduced, even with the introduction of best water saving strategies. Soil salinization, due to low rainfall, heavy soil texture, lack of fresh water will be among threats to be expected. Finally, it seems that based on available amount and quality of WR, IA will be subjected to very sever constraints within the next two decades.

Population in Jordan is expected to reach 9.6 million by 2020 (Baker and Harza, 1998). Deficit in water available for domestic consumption by year 2022 is going to be about 357 MCM. But if desalinization project were carried out, deficit is expected be negligible. No projection was given beyond 2022 which is less than a decade from now.

3.2 Potential resource development in different regions

This section focuses on the available LR, and the possibility for developing additional resource for AP. The discussion will be carried out for diffident ecosystems in Jordan, and according to land current conditions, potential availability of different resources as well as expected constraints.

3.2.1 Jordan Valley

Factors controlling potential development opportunities:

- **Availability of water resources:**

According to projection made by the Water Strategy of 2007 (Water Strategy of 2007), Jordan is expected to face severe water deficit for urban and agricultural use (Nasser 2002) and an increase in the availability of urban wastewater. Water transported from JV to Amman area will be replaced with TWW (Projection estimates 144 MCM of TWW will be discharged to JV). Still, water deficit in JV by the year 2020 is expected to be around 60 MCM.
Currently, the government is constructing a pipeline to pump all the Yarmouk River water to Amman. Thus, runoff blended with TWW will be the only water resource available for irrigation. Moreover, larger quantity of TWW will be discharged into the Valley to compensate for the loss of the Yarmouk water. Higher portion of TWW mixed with runoff water stored behind King Talal Reservoir is expected, if the current climate pattern, which suggests one wet year out of 5 - 6 dry years (Taimeh,1999), remained unchanged. Such dry conditions will be associated with similar reduction of runoff discharged to the dams. Further reduction of rain according to (IPCC, 2007a) projection will be about 25% by year 2025. This will result in substantial reduction in runoff flow into dams and increasing the ratio of TWW: runoff water, causing further deterioration of water quality.

- **Land resources:**

The Valley includes soil of different properties sensitive to degradation. Soil with high salt content, poor permeability and high gypsum contents increases toward the Southern part of the Valley (Taimeh, 2009). Thus, even if the current irrigation water allocation continues, the risk of deterioration of LR is high. Further replacement of fresh water with TWW will accelerate the deterioration of the LR. The deterioration of soil conditions is expected to be higher south of Deir Alla region.

- **Management:**

The management of the LR in the Valley is expected to be conducted through utilizing LR subjected to various risks. Alternative cropping patterns should be introduced, which require different management of irrigation water. Several factors will control any possible future cropping pattern in the valley. Among these factors:

- Objective of the production: is the production intended for local or export market? Is it possible to maintain production level and quality of products that meet export specification from degraded water quality and land under the threat of degradation?
- Soils found at different location and their suitabilityfor the suggested crops.
- Farmers' experience with the proposed new technology to produce under emerging conditions.

- **Regional cooperation:**

Regional cooperation is expected to involve joint venture in production for export purposes. Such avenue requires willingness to share technology in areas such as post harvest, integrated pest management (IPM), production and export of flowers, research and development in areas such as use

of marginal water, crop varieties, waster water treatment technology, joint regional warning against epidemic of plant diseases.

3.2.2 Ghor Safi - Aqaba region

- **Water resources:**

WR are very limited in this in this region. Possible AD in this area must be planned in conjunction with possible WR available from the following resources

- **Ground Water**: Amount water available from this source is not fully assessed. Any substantial amount that could be made available will be classified as brackish water. Potential extraction from ground WR depends on regional cooperation.
- **Surface water**: Runoff water from surrounding wadis should be exploited for ground water recharging purposes**.**
- **Desalinated water resources**: This option assumes the construction of number of desalination plants either in Aqaba area or after the completion of the Red Sea - Dead Sea conveyor. The desalination of water does not need to be of drinking quality, but rather of quality similar to existing ground water. Mixing poor quality water with good water quality produced by the RS-DSC might offer another option. Desalination using sun energy for the production of high value crop should also be investigated.

- **Management:**

LR in Ghor Safi-Aqaba region is the only region, which offers LR with good quality, which could be added to the AP base after little amendments. In wadi Araba alone, about 700,000 d of suitable soils is available. Such soil possesses physical properties, which is very suitable for irrigation with brackish water.

Management based on advanced technology, and high value crops for export, or to meet expected increase in tourism, should form the backbone of AP in this area. Aqua-culture, biotechnology (Algae production), and technology using sun energy (sun pool) should be employed. Sizes of land holdings provide good bases for implementing contract farming to produce crops for specific purposes. Interventions to reduce further degradation of LR by wind activities should be employed.

- **Regional cooperation:**

True regional cooperation is best demonstrated in the construction of the RS-DSC, which embrace benefits for countries involved far more than other alternative solutions. The feasibility of the project should not be judged on the bases of water cost alone, but on the bases of associated activities, which could be initiated in the countries including, raising the level of Dead Sea, development of tourism sector, and potential agricultural activities.

3.2.3 Eastern Upland Region

a. Rainfed areas (RA)

- ***Land Resources:***

Distribution of productive land in Jordan indicates that increasing areas of productive land under rainfed conditions will be either within municipal or village boundaries, fragmented, or threatened by increasing drought. More than one million d is forced out of production since 1965, and a third of available rainfed land is left uncultivated every year due to LF or economic reasons. Those occurring around urban areas will eventually be fragmented through legal means.

During the last three decades of the 20th century, new opportunities for new land utilization technology had emerged. These opportunities were either related to expansion to new area, improvement of farming practices, and introduction of new technologies such as water harvesting, and environmental friendly practices, which improved productivity for a unit of RA. Opportunities for farming new areas depend on introducing improved practices and new technologies.

- ***Potential for increasing land resources***:

Opportunities for increasing LR suitable for rainfed area (RA) may include: Increasing interest by farmers to improve their living conditions in rural areas with sufficient annual rainfall encourages them to reclaim rocky steep land within the high rainfall zone. Such practice was encouraged by the increasing demands on fruit and olive, etc. It estimated (NSAD, 2002) that about 1.5 million d could be reclaimed, if reclamation method employed by farmers is improved.

- ***Productivity:***

Improving productivity is a task, which should be seriously given highest degree of attention to compensate for the increasing losses of good productive land in RA.

b. Irrigated areas within the upland region

- ***Water resources:***

Irrigated areas in the UL were about 498,387d, in 2007, and were concentrated mostly in areas which receive less than 200mm of annual rainfall. Irrigation in the UL region is based on ground WR as the main source of irrigation. This water resource is, however, facing increasing competition for domestic uses. Available WR for this sector, by 2025 will be as follows: about 80 MCM from ground water, 80 MCM form side wades, and 80 MCM TWW (Amount of produced TWW is expected to reach 220 MCM by 2022). According to 2007 census, the crop composition included: 379,787 d of FT, 25,920 d of FC, and 138,330 d of vegetables.

- ***Land resources:***

LR used currently for IA are somewhat considered moderately suitable for agriculture on the long run. This is due to soil properties which have either high in silt or clay content. Both types of soils present specific problem regarding land suitability of irrigation. All these soils are low in their organic content. Thus, improving physical properties of soil needs special attention to avoid high rate of salinization, since most of these soils occur within low rainfall region with high temperature and high wind speed. LR suitable for irrigation is available, but their development and farming is restricted by water availability.

- ***Development opportunities:***

Increasing IA in this region is subjected to water availability. No shortage of land availability in these areas. Among the most potential and promising opportunity for maintaining or increasing IA will depend on the degree of achieving high water use efficiency.

c. Steppe and Badiah:

- ***Available resources:***

Opportunities for development of resources in the Steppe-Badiah region will focus only on development of RL since IA was covered under UL region. Area targeted for RL production system includes the Steppe and Badiah regions which cover about 91% of the total area in Jordan (Taimeh, 2009). The area of the Steppe region is about 10 million d (13%). It was originally designated by Law No.20, 1973 as the range land in Jordan. This had changed since all the land in this region is registered and distributed among Jordanians. This unfortunately facilitated the division of the land to 10 d ownership, which lead large number of ownerships to enter the land market. Not only this, traditional packages that might be suitable for range development are not suitable for small holding anymore. In a study conducted within a small watershed, it was found that within few years about 30% of the land holdings were divided to 10 d parcels (Hadidi, and Taimeh, 1996). Better opportunity of range development is found within this region because of adequate rainfall and availability of suitable soils. This region however, suffers from the highest rate of desertification in Jordan, and increasing urban activities, which are the main challenge threatening the conservation of the resources of this region.

The Badiah region, on the other side covers about 78% of total area of Jordan. It suffers from low and highly variable rainfall, dominance of problematic soils, which is not suitable for any AD. Therefore, selection of sites with favorable soil properties is the first step before implementing range developmental programs. Erroneously, the land use for Steppes and Badiah land were designated as rangeland, this was not really based on any scientific analyses, but because no other type of farming is practiced in these regions. Such erroneous conclusion can be demonstrated by the presence of large areas which are not suitable for range development either.

- ***Development opportunities:***

Opportunity for development within suitable areas should focus on optimizing favorable local conditions and on modern technologies which improves soil moisture storage and improve plant cover growth. Among available opportunity might include:

- ***Integrating water arvesting:*** It needs no emphases to mention that improving availability of soil moisture storage is the most important constraints for range development in these regions. Therefore, integrating watershed and on-farm water harvesting must be an integral component

of any range developmental programs. Wide range of on-farm harvesting techniques is available and can be introduced for production of shrubs, or open range.

- ***Development of Marab:*** The Marab is local name given to wide shallow very level waterways in the dry region. The name mean healthy, which describe the soil and plant in the Marab. This healthy soil and plant results from slow water movement in the Marab, increasing sedimentation, and better plant cover. As a result, very good soils and vegetation stands cover the Marab. It is estimated that about (Taimeh, 2009) 10 - 14% of the Badiah region is covered with such wades.
- ***Development of land close to Mud Flat:*** Mud flats are depression where most of the runoff sediments in dry region are deposited. Therefore, such locations are good natural places for water harvesting. The soils of the mud flats themselves are not suitable for agricultural activities, but the lands located at the mouth of the mud flats are suitable for development.

4 Land use in Jordan

4.1 Farming systems in Jordan

The following farming systems are practiced in Jordan:

- **Rainfed farming system**: This system is practiced within the UL, where the climate semi-arid to sub humid climate. Region where rainfed agriculture is practiced occupies about 9% of the total area of the country.
- **Irrigated farming system:** Irrigated farming was practiced early in JV using groundwater. Later, it was extended to the whole Valley after the construction of King Abdullah Irrigation Canal. Outside the Valley, irrigated farming system is practiced mainly within the marginal, and dryland. Total irrigated area is 1,258,705 d, of which 274,300 is in JV (2007 Census).Scattered areas are also irrigated within the RA.
- **Range farming system:** This system is practiced everywhere in the country where irrigated and rainfed cultivations are not feasible. Most of the area which receives < 200 mm of annual rainfall is used as rangeland, and occupies about 81% of the total area in Jordan.
- **Forest farming:** Area of natural and artificial forests in Jordan covers only 1% of the total area. Forest land is mainly governmental state lands registered as forestland. Private forests could be found within different areas in Jordan planted by citizens. Private forest is used for conservation, or as farm fences, thus provide no direct revenue to farmers.

  The area of natural forest, in the year of 2000, was 506,000d of which, 381,000d is government forests, and 127,000d are privately owned forests. The area of artificial forests is 450,000d. Forest has not been treated as an important natural resource. Thus, its contribution has been confined to provide firewood and contribution to local tourism. The function for public and private forest in Jordan is for tourism and conservation of biodiversity.

  Forest land ownership:

  1. Government forest: This is land registered as forest under the stat ownership where forest trees can grow. It is divided into two types:
     a. Natural forest: In this land, forest trees grow naturally. It occupies about 260,000donums diftribted within areas of > 300 mm of rain.
     b. Artificial forest: Forest is artificially grown within state land. It occupies 520,000 dounms
  2. Bare land: This is state land. Plan is underway to plant it with forest trees. About 200,000 donums is suitable for forest, and about 140,000 is not suitable for afforestation.
  3. Land not surveyed yet: This land is partially covered with forest trees, and is registered as state land. It covers 122,000 donums, and located at the southern parts of Jordan.
  4. Road side forest: This is artificial forest planted along major roads. About 2000 km had been planted.
  5. Private forest: Such land could be privately owned natural forest, or planted as wind breaks. It occupied about 126,970 donums, and about 12,000 km of windbreaks around private farms.

4.2 Available land resources in Jordan

Total area, which receives > 200 mm of annual rainfall, is 8,865,000 d, or 9.9% of the total area of Jordan land area (Table 4. 1). Considering factors such as slope and climate, total area that is suitable for AP is 3,499,000 d, or 3.9% of the total area. This area can be found on land with slope < 8%. Areas with slope 8 - 20% include isolated pockets of land, or potentially reclaimable land is 3,055,000 d, or

3.4% of this area. Area with slope higher than 20%, which are unsuitable for FT without major land reclamation is 2,311,000 d, or 2.6%. These figures are indicative of land suitability for different utilizations, because land with slope < 8% is potentially suitable for FC. Thus, represents maximum area that is potentially available for such use. Considering, the presence of soil problems which makes unsuitable for such land. Accordingly, such figure can be used as an indicator to judge whether LR are used to maximum limit. Same principle applied to area potentially available and suitable for FT.

Table 4.1: Distribution of area slope that receives > 200mm of annual rainfall

Governorate	Slope %						
	< 8		8 - 20		> 20		Total
	Area	%	Area	%	Area	%	Area
Amman	607	17.3	348	11.4	125	5.4	1080
Balqa	166	4.7	265	8.7	267	11.6	698
Zarqa	38	1.0	312	10.2	52	2.3	402
Mafraq	237	6.8	173	5.7	37	1.6	447
Madaba	430	12.3	151	4.9	145	6.3	726
Irbid	793	22.7	448	14.6	299	12.9	1540
Jarash	60	1.7	208	6.8	138	6.0	406
Ajlune	48	1.4	189	6.2	180	7.8	417
Karak	665	19.08	353	11.6	411	17.8	1429
Tafila	172	4.9	403	13.2	430	18.6	1005
Ma'an	143	4.1	144	4.7	133	5.8	420
Aqaba	140	4.0	61	2.0	94	4.1	295
Total	3499	100.0	3055	100.00	2311	100.0	8865*

* 8865000 is the total land of Jordan. Area in Km2,
Source: Awni Taimeh, Land Use in Jordan, 2011

Available data indicates that 37.4% of the land potentially (Table 4.1) suitable for FC and FT can be found in Irbid governorate, followed by Amman (28.7%), Karak (17.3%), and Tafila Governorate (17.1%). Land potentially suitable for FC is concentrated in Irbid, Amman, Madaba, and Karak, while land potentially suitable for FT is concentrated in Irbid, Tafila, Karak, Amman, and Zarqa. This conclusion is based on the assumption of presence of favorable slope, and climate. Although Ma'an is the largest governorate, potential LR available for FC and FT are about 8.8%. The implication of such resource distribution is discussed later in other section.

4.3 Land allocation in Jordan

Available LR in Jordan is very limited. Censuses carried out since 1975 indicates that total land available was 3,904,031d in 1975 (Table 4.2), which was reduced to 3,606,000 d in 1997, and was further reduced by 14.5% after 1997. The total reduction in LR from 1975 to 2007 was 1,288,955 d (33.0%) of the total area. The main reduction was in areas cultivated with FC which were reduced by 35% of the total area since 1997, while areas cultivated with FT increased by 2.4% for the same period. A clear increase in areas cultivated with vegetables, reduction of unused land, and temporary land was observed until 1997. These types of land utilizations did not show any significant changes afterwards.

Table 4.2: Different land utilization for Jordan, by type of use, 1975 - 2007

Land use	1975	1997	2007	1975-1997	1975-2007
	Area			%	
FC	1962795	1580442	714841	-16.5	-63.6
Total FT	39700	831437	812815	160.0	154.2
Total vegetables	201704	284030	278971	40.8	38.3
Open vegetables		249959	243041		-2.8
Covered vegetables		34071	35930		5.5
P. meadow	17126	9981	10849		
T. meadow	714		2653		
Fallow	771630	233488	413413	-69.7	-46.4
Forest		4 040	12410		
Flowers open		646	297		
Flowers covered		2841	355		
T. flowers		3487			
Nursery		2740	1763		
Unused	264154	162795	190553	-38.4	-27.9
Unclassified	146140	95758	27776	-34.5	-81.0.
Other temporary.	136058		113009		-16.9
Others	38690		14384		-62.8
Total	3,904,031	3,060,000	2,615,076	-21.6	-33.0

Sources: Awni Taimeh, Land Use in Jordan, DOS different censuses, 2011
Area is in d = 0.1hectare,

Significant development in rainfed and irrigated land took place in the main production regions in Jordan. Changes between the different censuses since 1975 suggested the following (Table 4.3):

- ***Rainfed Areas****:* Rainfed agriculture is continuously changing since 1997. The increase of rainfed farming between 1975 and 1997, within the UL region, is attributed to increasing cultivation of Steppe region with barely, because farmers want to compensate for the loss of subsidized animal feed, which was lifted during the nineties of the last century. Reduction of cultivated rainfed areas continued after that period**.**

Table 4.3: Distribution of area cultivated with vegetables, 1975 - 2007

Year	1975			1997			2007		
Farm system	**JV****	**UL**	**Total**	**JV**	**UL**	**Total**	**JV**	**UL**	**Total**
					Area				
Rainfed	65375	1810400	1875775	13613	1989281	2002894	5060	1055826	1060886
Irrigated	146524	30409	176933	314958	394479	709437	312611	498387	810998
Grand total	211899	1840809	2052709	328571	2383760	2712331	317671	1554213	1871884

** Area of irrigated vegetables in Safi and Aqaba is 22,358 +520 =22878 d
Sources: Awni Taimeh, Land Use in Jordan, 2011

Total arable land had decreased about 32.5% (755,815 d) for the period from 1975 to 2007 (Table 4.4), while cultivated land was reduced by 28.9%. Two reasons can be cited for this change: First, the land without cultivation left every year, was about 19.2% of the total arable land in 2007. This was associated with substantial reduction in areas cultivated with FC, which was reduced by 64% between 1975 and 2007, and 54.8% for the period between 1997 and 2007(Table4.4). This equals to 1,280,909 d or 50% of the cultivated land. Second, area of FT increased between 1975 and 2007 by 154%. However, the increase in FT occurred after 1975, and slightly (2.4%) after 1997. The overall increase in areas cultivated with FT between 1975 and 2007 was 510,147 d (or 20%). Areas cultivated with irrigated vegetables increased by 14.3% during the period from 1975 - 1997.

Table 4.4: Land utilization, by type, 1975 - 2007

Crop type	Year				Change		
	1975	1983	1997	2007	75- 97	97-2007	75-2007
	Area				%		
FC	1995750	1661277	1580443	714841	-64.2	-54.8	-64.0
Fruit trees	319700	425224	794138	812815	148.7	2.4	154.2
Vegetables	244025	1107398	284031	278971	14.3	-1.8	14.3.
Abandoned	771627	747542	233488	431413	-51.7	84.8	-44.0
Total	3331102	3941441	2892100	2238041	-13.2	-22.6	-32.8

Source: DOS census: 1975, 1983, 1997, and 2007
Sources: Awni Taimeh, Land Use in Jordan, 2011

- ***Irrigated Area***: Irrigated areas witnessed substantial increase since 1975. The expansion was concentrated in the UL region. The increase in irrigated areas continued even after 1997, while in JV, irrigated area was relatively constant, although it was reduced, by 0.7% between 1975 and 1997**.**

- ***Overall Cultivated Irrigated and Rainfed Areas*:** Overall irrigated and rainfed areas increased by 32.1% between 1975 and 2007. The increase was due the substantial increase in the irrigated areas between 1975 and 1997, which compensated the sever losses of rainfed area which occurred in both the UL and JV. The increase in rained areas within the UL between 1975 and 1997 was due to cultivation in Steppe region with barely (Table 4.5)

Table 4.5: Changes in irrigated and rainfed cultivated land, by regions, 1975 - 2007

	JV			UL			Total		
Farming sys.	**75-97**	**97-07**	**75-07**	**75-97**	**97-07**	**75-07**	**75-97**	**97-07**	**75-07**
	Change %								
Rainfed	-79.2	-62.8	-92.2	9.9	-46.9	-41.7	6.8	-47.0	-43.4
Irrigated	115.0	-0.7	113.4	1197.2	26.3	1538.9	301.0	14.3	358.4
Grand total	55.1	-0.03	49.9	29.5	-34.8	-15.6	32.1	-31.0	-8.8

Sources: Awni Taimeh, Land Use in Jordan, 2011

Total areas cultivated with the three major crops decreased by 31.7% between 1997 and 2007 (Table 4.6). The reduction is attributed to the reduction of FC within the UL and JV (55.0%), although the area planted with FC in JV is relatively small. The overall growth of FT seemed to be negative after 1997. However, slight increase was noticed in JV. The only sector that showed steady growth within the two main regions was irrigated vegetable crops. However, the increase of vegetable area was higher in JV than in the UL region. This could be explained partially y the rapid reduction in areas of rainfed vegetables in the UL region.

Table 4.6: Changes in cultivated area of field crop, vegetables, and FT in Jordan, 1997 - 2007

Year	1997			2007			1997-2007		
	J.V	**UL**	**Total**	**JV**	**UL**	**Total**	**JV**	**UL**	**Total**
Crop type	Area						%		
FC	66479	1512590	1608070	29195	694862	724064	-56.1	-54.1	-55.0
Vegetables	162147	140677	302824	187967	146801	334768	16	4.4	10.6
FT	99944	731493	831437	100510	712545	813054	0.6	-2.6	-2.2
Total	**328570**	**2384760**	**2742331**	**317672**	**1260606**	**1871886**	**-3.3**	**-47.1**	**-31.7**

Sources: Awni Taimeh, Land Use in Jordan, 2011

Available information showed that the over all total areas cultivated with the three types of crops were reduced by 31.7 %. The reduction was due to the sever reduction of the rainfed areas (reduced by

47%). However, irrigated areas showed a modest increase of 10% from 1997 to 2007. Irrigated vegetables increased by 9.7%, but the rainfed vegetables were reduced by 65.4% in the UL region**.** Both irrigated vegetable (17.4%) and FT (31.0%) increased over the same period. These figures should be of great concerns for future planning , taking into consideration that irrigated areas in the UL rely totally on ground water, while those in JV is totally dependable on runoff water increasingly mixed with higher proportion of TWW (Table 4.7).

Table 4.7: Changes in main type crops, by type of crops 1997 - 2007

Year	1997			2007			1997-2007*		
Farm.syst.	**Total**	**Irrigated**	**Rainfed**	**Total**	**Irrigated**	**Rainfed**	**Irrigated**	**Rainfed**	Total
Crop type			**Area**					%	
Fruit tree	831437	330068	501369	813054	433265	379787	31.0	-24.3	**-2.2**
FC	1608070	131679	1476391	724064	51563	672400	-60.8	-54.5	**-55.0**
Vegetable	302824	277691	25133	334765	326068	8697	17.4	-65.4	**10.6**
Total	2742331	739438	2002893	1871883	810896	1060987	9.7	-47.0	-31.7

* of the total area
Sources: Awni Taimeh, Land Use in Jordan, 2011

The production base for main crops in Jordan experienced very important changes between 1997 and 2007 (Tables 4.8, 4.9, 4.10). Overall cultivated areas with different types of crops declined by almost 32% from 1997 to 2007. Caution should be exercised when interpreting these figures, because area of rainfed field crop, which occupied more than double the areas cultivated with other crops, varies substantially from one year to another according the amount of seasonal rainfall. However, the total areas cultivated with FC, showed a constant and significant reduction trend, regardless of the climate variation, due to other factors, such as LF and low return.

Table 4.8: Distribution of different crops within main regions 1997

Region	UL		J V		Jordan		
Farm system	**Irrigated**	**Rainfed.**	**Irrigated**	**Rainfed**	**Rainfed**	**Irrigated**	Total
Crop type				Area			
Fruit tree	231669	499824	98399	1546	501369	330068	**831437**
FC	47195	1465396	55484	10995	1476391	131679	**1608070**
Vegetables	116615	24061	161075	1072	25133	277691	**302824**
Total	**394479**	**1989281**	**314958**	**13613**	**2002893**	**739438**	**2742331**

Sources: Awni Taimeh, Land Use in Jordan, 2011

Table 4.9: Distribution of different crops, by regions, 2007

Region	UL		JV		Jordan		
Farm system	**Irrigated**	**Rainfed**	**Irrigated**	**Rainfed.**	**Rainfed**	**Irrigated**	Total
Crop type				Area			
Fruit tree	334137	378408	99130	1380	379787	433266	**813054**
Field crop	25920	668949	25743	3452	672400	51663	**724064**
Vegetables	138330	8469	187738	228	8696	326068	**334765**
Total	**498387**	**1055826**	**312611**	**5060**	**106883**	**810997**	**1871883**

Sources: Awni Taimeh, Land Use in Jordan, 2011

Table 4.10: Changes in area used for different crops, 1997 - 2007

Region	Jordan		UL		JV		Total
Farm system	**Irrigated**	**Rainfed**	**Irrigated**	**Rainfed.**	**Irrigated**	**Rainfed**	
				1997-2007			
Crop type				%			
FT	-31.3	-24.3	44.2	-24.3	.74	-10.7	**-2.2**
Field crop	-60.8	-54.5	-45.1	-54.4	-53.6	-68.6	**-55.0**
Vegetables	17.4	-65.4	18.6	-64.8	16.6	-78.8	**10.5**
Total	**-9.7**	**-47.0**	**26.3**	**-46.9**	**-0.75**	**62.8**	**-31.7**

Sources: Awni Taimeh, Land Use in Jordan, 2011

Examination of area cultivated with FT indicated 2.2% reduction between 1997- 2007(Table 4.10). However, the important change lied in the area of irrigated FT which was reduced by 31.3%. This was accompanied by an increase of 44.2% in the UL. This suggests great reliance on non-sustainable ground water resources (WR) within the UL. Irrigated FT increased by less than 1% within JV. Rainfed FT decreased by 24.3%, of which, 24.3%, was in the UL region, and 10.7% in JV. The reduction of rainfed FT is very alarming changes, which could be due to LF of ownership, lower productivity or increasing drought.

The significant shift away from rainfed agriculture is strongly reflected by the high reduction of rainfed field crop (a reduction of 54.5%), which occurred primarily in the UL, and with same magnitude in the JV, although the area is comparably much smaller than the UL areas. The shift towards irrigated agriculture was also accompanied by the extinction of rainfed-vegetable, while total vegetable area increased by 10.5% between 1997 and 2007. Total irrigated vegetable area increased by 17.4%. The increase in the irrigated vegetable was equal for UL, and JV (Table 4.10).

4.4 Distribution of major crops in cultivated areas

The following remarks can be made regarding the impact of observed changes in the crop composition:

Fruit tree:
The increase in the area of fruit tree was observed mainly in UL. The main increase was due to increasing in areas planted with olive trees on highly fragmented land, especially in Irbid and Madaba, which were planted in soil unsuitable for FT.
Irrigated FT is concentrated in the UL. Area of olive tree constituted majority of the land. Areas of stone FT increased slightly few years ago. The sustainability of this sector in the UL is under great risk due to diminishing fresh WR increasingly reallocated for domestic use. This is further exacerbated by the increasing cost of electricity for pumping and the limit on pumping allowed by the license. Therefore, it is expected that some framers will be forced to reduce planted area, if efficient water saving technologies were not introduced.
Field crops:
Areas used for field crop is concentrated in the UL and is variably, but constantly declining with time. LF, urbanization, variable seasonal rain, and low return are among reasons for variation and continuous reduction of cultivated areas. It could be stated that rainfed FC in JV will eventually disappears, which will deprive soils form benefits of crop rotations. Furthermore, irrigated FC is also decreasing in JV, due to better return vegetables.
***Vegetables*:**
Areas used for vegetable production increased slightly over the last decade. Rainfed vegetable is on the brink of extinction, although it used to be the main production sector in the UL during the sixties and the seventies of the twentieth century. The irrigated vegetable is concentrated in JV followed by the UL. Vegetable production in both areas is expected to face important future challenges.
In the JV, deteriorating water quality due to increasing use of TWW will accelerate the rate of soil salinization, thus reducing productivity and quality of produces. The irrigated vegetable in the UL faces different challenge, steaming from the expected reduction of fresh ground WR increasingly reallocated to domestic uses, unless modern production practices were introduced.

4.5 Distribution and changes in cultivated rainfed and irrigated areas

Distribution of irrigated and rainfed areas varies form one governorates to another (Table 4.11). The proportion of irrigated and rainfed areas depends on the rainfall zones. Almost all governorates suffered from reduction of cultivated areas, except of Balqa, which gained some areas due to the expansion of irrigated areas in JV.

Table 4.11: Distribution and changes of rainfed and irrigated area by governorates 1975 - 2007

Govrner.	1975		1997		2007		75-97	97-07	75-07
	Area	%	Area	%	Area	%		%*	
Amman	604644	16.22	481709	17.29	*393362*	15.19	-20.3	-18.34	-34.94
Balqa	228948	6.14	104202	3.74	*242272*	9.39	-54.5	132.50	5.81
Zarqa	124067	3.33	128538	4.61	*273568*	10.61	3.60	112.8-	120.50
Madaba	252530	6.78	147247	5.28	*70872*	2.74	-41.7	-51.87	-71.94
Mafraq	830565	22.29	507656	18.22	*458736*	17.78	-38.9	-9.64	-38.89
Irbid	730439	19.60	477629	17.13	*425179*	16.48	-34.6	-10.98	-41.79
Jarash	154521	4.15	131619	4.72	*107730*	4.18	-14.8	-18.15	-30.28
Ajlun	108577	2.91	83813	3.00	*77576*	3.00	-22.8	-7.44-	-28.55
Karak	340181	9.13	310638	11.15	*235075*	9.11	-8.78	-24.33	-30.90
Tafila	184969	4.96	89859	3.23	*47108*	1.83	-51.4	-47.58	-75.53
Ma'an	143567	3.85	254505	9.14	*262965*	10.19	77.3	3.32	83.17
Aqaba	23619	0.63	68476	2.46	*86699*	10.19	189.9	26.61	****
Total*	3726627	100.0	2785891	100.0	*2579586*	100.0	-25.2	-7.40	-30.78

* % of the total
Sources: Awni Taimeh, Land Use in Jordan, 2011

Overall total rainfed and irrigated areas were continuously (30.78%) reduced since 1975. The largest reduction occurred between the period of 1975 - 1997 (-25.2%), while after 1975, the reduction was 7.4% of the total area. The low reduction after 1997 was due to the increase in areas such as Zarqa and Balqa governorate due to expansion of irrigated areas.
The largest reduction in cultivated areas occurred in Irbid (-41.79%, 97 - 2007), followed by Amman (-34.94%), Mafraq (-38.89%). The increase in Aqaba was due to the irrigated project in Disi area.
Examination of holdings of irrigated and rainfed land revealed that cultivated area decreased by 38.8% since 1975(Table 4.12). Rainfed cultivated area was substantially reduced by almost 61%, but irrigated areas increased (280%) (Table 4.12). However, examining the data for the period form 1997 to 2007, suggested that rainfed is continuously reduced .almost with the same rate (-34%), while irrigated area had increased by 76.9% during the same period. The increase in irrigated areas was concentrated manly within governorates located with dry region, or governorates that include parts of JV.

Table 4.12: Area of agricultural land holding by type of farming system, by governorates, 1975

Year	1975					1975-2007	
Farm sys.	Total	Irrigated		Rainfed		Rainfed.	Total
Govern.	area	Area	%	Area	%*	%	
Amman	604644	5271	0.14	599373	16.08	**-74.2**	**-51.5**
Balqa	228948	96624	2.59	132324	3.55	**-61.5**	**5.8**
Zarqa	124067	31283	0.84	92784	2.49	**-57.1**	**120.3**
Madaba	252530	2256	0.06	250274	6.72	**-75.0**	**-72.0**
Mafraq	830565	4738	0.13	825827	22.16	**-69.22**	**-44.8**
Irbid	730439	75922	2.04	654517	17.56	**-57.6**	**-41.8**
Jarash	154521	12817	0.34	141704	3.80	**-37.6**	**-30.3**
Ajlun	108577	4738	0.13	103839	2.79	**-29.9**	**-28.6**
Karak	340181	41205	1.11	298976	8.02	**-43.6**	**-31.2**
Tafila	184969	4622	0.12	180347	4.84	**-78.8**	**-74.5**
Ma'an	143567	7371	0.20	136196	3.65	**-20.2**	**83.1**
Aqaba	23619	6495	0.18	17124	0.46	**-74.9**	**267.1**
Total*	3726627	331130	8.89	3395497	91.11	-61.1	-30.8

* % of total area,
Sources: Awni Taimeh, Land Use in Jordan , 2011

4.6 Changes in land use allocation for different crops by governorates 1975 - 2007

Vegetables:
Vegetables in Jordan is a highly dynamic. It grew substantially between 1975 (38.7%) and 2007, but since 1997, it increased only by 13.4%. Although such increase is very encouraging interims of total areas, however, the following were noticed (Table 4.13):

Table 4.13: Changes in cultivated areas with different crops, 1975 - 2007

Govrn..	1997-2007						1975-2007/Total		
	Vegetable			FC			F. Crop.	Fruit	Vegetable
	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total			
					%*				
Amman	8.0	5.3	4.7	14.2	-2.5	-0.2	-14.8	24.7	5.7
Zarqa	-1.5	-1.6	-1.5	15.4	-0.2	6.1	-0.7	30.6	-1.8
Madaba	0.6	-13.2	-3.5	-2.3	00.1	-1.0	-5.6	4.1	-4.6
Mafraq	20.0	-3.3	12.8	15.1	-2.7	4.4	-13.5	39.3	15.5
Irbid	-19.2	-4.6	-27.8	-1.1	-7.6	-5.0	-12.7	51.4	-12.6
Jarash	-2.7	-6.0	-3.7	0.2	-3.8	-2.3	-1.7	5.8	-4.5
Ajlune	-0.9	-4.2	-1.9	-0.6	-1.8	-1.3	-1.2	1.8	-2.3
Balqa	25.2	-8.7	-14.5	0.9	-2.4	-1.1	-4.0	13.1	17.5
Karak	7.8	-2.4	-4.5	-2.9	-1.1	-1.8	-5.6	3.9	5.5
Tafila	00	00	00	-0.4	-2.2	-1.5	-3.6	0.7	00
Ma'an	14.6	-0.9	9.7	1.6	-0.2	1.6	-0.4	9.8	11.8
Aqaba	9.5	00	6.4	1.2	00	0.5	-0.3	3.4	8.3
G. total	61.5	-89.2	13.9	31.2	-13.6	-2.3	-64.0	188.7	38.7

*% of total for each system
Sources: Awni Taimeh, Land Use in Jordan, 2011

- The increase in irrigated vegetable was associated with significant reduction of rainfed vegetable. As a matter of fact, products of rainfed vegetable are not part of the regular market anymore, since it is farmed in highly fragmented land where the products are sold along roads, especially around Amman, where LF is progressing at very high rates.
- The increase in irrigated areas by 61.5% was noticed in the UL governorates such as Mafraq, which depends on ground WR, Balqa, which includes part of JV, and Ma'an which includes Disi area, which will be phased out very soon, and Karak, which include Ghor Safi.
- This sector faces expected reduction of available resources within the UL regions and water quality for areas within JV

Field crops:
Areas used for FC were reduced by 64% for the period between 1975 and 2007. However, the reduction between 1997 and 2007 was as low as 2.3%. Areas cultivated with irrigated FC were reduced in all governorates.
The following remarks can be made regarding the development of FC:

- Negative reduction trend in areas planted with FC was noticed. Maximum reduction of area used for FC is within areas such as Amman, Irbid and Karak governorates, where LF is high, and in Mafraq, where good land is used for irrigated agriculture.
- Reasons behind reduction of areas cultivated with FC included increasing risk of drought, LF, low return, high production cost, problem of marketing, since the government imports most of FC, which makes the local production non-competitive.

***Fruit trees*:**
The increase in the areas cultivated with FT since 1975 was remarkable (188.7%). The growth of areas planted with FT was highest in Irbid governorate, which, at the same time, it showed reduction in areas used for FC. An increase in area cultivated with FT in Amman, Zarqa, and Mafraq governorates was observed. FT in Zarqa, Mafraq, and Ma'an depend on irrigation, while Irbid and Balqa are grown under rainfed conditions.

This sector faces the following challenges:

- Except for vary small area planted with citrus in JV, all irrigated FT are found in the UL region and depends on unsustainable ground WR for irrigation.
- Large areas of irrigated FT are dominated by olive trees, especially in Mafraq and Zarqa. These orchards face increasing production cost. In addition, they are planted in environment not optimum for such trees, and face the risk of soil salinization. The use of TWW to substitute losses of ground WR is not yet carefully examined.
- FT under rainfed conditions faces increasing drought reoccurrence and deteriorating productivity caused by poor soil properties of large areas planted with olive trees, especially at Irbid and Madaba. Furthermore, large FT orchards are found within areas close to urban area and suffer from LF and increasing land prices, which encourage people to sell their land, and might increase the loss of such orchards.

4.7 Fragmentation of land holdings

Table 4.14 provides information on the distribution of land cultivated with FC and the distribution of different land sizes used for FC and its changes between 1983 and 2007. The data showed that almost 58.6% of the data available for FC fell between 50 and 500 d in 1983, but the same land categories occupied only 45% in 2007. Similarly, areas with land size less than 30 d in 1983 occupied about 6% of the total area, while, in 2007, similar land sizes occupied about 19.93% of the total areas cultivated with FC. Such data clearly indicated LF form larger to small land holding. The increase in land size > 500 d could be due to cultivation within the Steppe region indicated in other section (DOS, 1983, 2007)

Table 4.14: Number and area of agricultural for FC by area size, 1983

	1983			2007		
Land size	**Holding area**	**F Crop**	**%***	**T holding**	**F. Crop**	**%***
<5	2807	2458	0.13	82036	3520	0.49
5 – 10	9515	7631	0.44	105260	10489	1.47
10 – 20	50274	37810	2.18	197945	30991	4.33
20 – 30	50274	59370	3.47	156791	32672	4.56
30 – 40	105345	72503	4.11	247337	35654	4.98
40 – 50	100791	71964	4.19	105891	25632	3.58
50 – 100	445001	504927	18.00	223873	86492	12.08
100 – 200	513710	336284	20.01	208654	100693	14.07
200 – 500	608839	376817	22.61	322657	134804	18.83
500 – 1000	311096	177901	10.55	293704	94905	13.26
1000 – 2000	213727	102872	6.15	245133	90199	12.60
>2000	353623	135220	8.02	425756	69925	9.77
Total	**2795489**	**1685780**	**100.0**	**2615076**	**715876**	**100.0**

* % of total area cultivated rainfed area.
Sources: Awni Taimeh, Land Use in Jordan , 2011

Distribution of open vegetables showed some LF between 1983 and 2007 (Table 4.15). The main land size which showed clear fragmentation was the 40 - 50 d and the 100 - 1000 d, which occupied 45.25% of the total area in 1983, but it occupied about 27% of the total area in 2007. Open vegetables decreased by 11.4% after 1983, while covered vegetables increased by 152.2%over the same period. Moreover, 30 - 40 d holdings were increased by almost 19% in comparison with 1983. Slight land consolidation could be traced for land size of 5 - 10 d between the same periods. The analyses indicated the area increased only for land holdings of 30 - 50 d and those of large project. All other land size showed relative reduction with various degrees since 1983.

Table 4.15: Distribution of vegetables holdings, size, 1983 - 2007

Area size	Holdings			Land utilization2007			
Size of holding	1983			2007			1993-2007
	Open	Protected	%	Open	Protected	%	Open (%)
<5	3369	140	1.22	1387	66	0.57	-58.83
5 – 10	6540	350	1.22	3604	264	1.48	-44.89
10 – 20	27408	1268	2.38	11647	998	4.79	-57.51
20 – 30	23516	1398	9.99	17093	3098	7.03	-27.31
30 – 40	38946	2496	8.57	65708	13221	27.03	68.71
40 – 50	18205	1168	14.19	20727	3436	8.53	13.85
50 – 100	48708	3242	6.63	17154	2891	7.06	-64.78
100 – 200	37022	2950	17.75	19416	2231	7.99	-47.56
200 – 500	38443	3952	13.49	30064	3541	12.40	-21.80
500 – 1000	17609	1974	14.01	15247	3136	6.27	-13.41
1000 – 2000	8705	871	3.17	13835	2369	5.69	-58.93
> 2000	5955	2334	2.17	27158	680	11.17	356.05
Total	274428	22146	100	243041	35930	100	-11.44

Sources: Awni Taimeh, Land Use in Jordan , 2011

4.8 Other land utilization

***Productive, but unused land*:**
Other land utilization includes areas of potentially productive land but unused for agricultural production. This area covered 264,154 d in 1975, but decreased to 162,795 d (101,359 d or 38%) by 1997, and to 190,553 in 2007 (a reduction of 45.8% since 1975 - Table 4.2). The reduction in unused land could be due to increasing land reclamation carried by many farmers to establish FT orchards. Other types of utilization include unclassified land, which covered 146,140 d in 1975 and decreased to 95,758 d in 1997, and 27,776 d in 2007 (-80.1%). Most of the land change occurred within the UL region.

***Fallow Land*:**
Fallow land represents land which is either left for resting, generally used to be practiced by farmers, but not anymore for agricultural production, or abandoned by holders who do not practice agriculture, or due to unsuitability because of LF. Fallow land estimated at 771,630d in 1975, or 19.8% of the total area, while in 1997 the fallow land was 233,488d, or 7.6%., and it increased again to 432036d or 16.5% of the total area in 2007. Temporary land use changed from 136,058d in 1975 (3.5%) of total holding to 113,009d (4.3%) in 2007.
Such figures indicate that large LR 396,283d) in a country poor in LR (are not used annually). Many reasons are cited for such behavior including LF, drought, and increasing land prices. It is believed that, although this is an important resource to be used, its use would be highly unfeasible, unless new farming approach were introduced.

4.9 Main trends regarding major crops since 1975

Main trends in vegetable cultivated land:

- Overall, area planted with vegetables had shown steady increase. Considering the availability of WR, sustaining the production within the UL faces the following challenges:
  - Expected increase in the reallocation of fresh water to domestic use. Withdrawal of water will be on the expense of areas used for production of vegetables.
  - Increasing availability of TWW requires new production technology, and might face marketing problems.
- Land used for production of vegetables irrigated with TWW will be subjected to degradation unless special management was practiced in production.
- Deterioration of water quality will also impose new challenges on export of vegetables and the ability of producers to meet the specifications of international market standards.
- Area planted with tomato, a major crop, seemed to vary from one year to another. This seemed to reflect farmers' reaction to price fluctuation in local markets, obstacles facing exporters to

surrounding countries, and competition from other vegetables producers due to increasing productivity of protected vegetables in these countries.

- Strong trends of production diversification were noticed over the period of 1975- 2000 within the UL and JV. The diversification, considered very positive trends that reflect reaction to external and internal drivers affecting production cost, local markets, changing needs of export markets, and increasing number of investors in the production for export purposes.

Trends of field crops land use:

The preceding discussion indicates a very alarming trend regarding area cultivated with FC. The changes have a profound impact in Jordan, due to its significant contribution to food self sufficiency, and security.

The following are some of the observed trends:

- Area cultivated with field crop had generally been substantially reduced. The reduction in the FC was mainly in areas used for wheat and legumes, primarily within the UL region, and to a far less degree in JV.
- Area planted with barley was the only area, which did not suffer from reduction until 1997. The relative significance of area planted with barley had increased in comparison with other FC. The increase in area planted with barley was observed within the UL region. However, the increase in barley is thought to be due to cultivation of barley in the marginal area with low productivity. After the 1997, areas planted with barely seemed to be continuously reduced, although the relative areas had increased.
- Other important crops such as lentil, and check peas grown under rainfed conditions in the UL were continuously reduced.
- Areas of irrigated field crop occupied relatively small area and that the primarily reduction was within rainfed areas, which are subjected to sever competition from urban utilization.

Trends of fruit trees land allocation:

The following trends characterized the land use:

- ✓ Areas planted with FT had almost doubled during the period from 1975 to 2000. The increase was attributed to the rapid expansion of olive tree for the following reasons:
    - Implementation of many reclamation projects, at different governorates, supported by government priority of financial incentives.
    - Planting of reclaimed rocky and steep land within high rainfall zones.
    - Introduction of olive trees under irrigation, especially in dry UL areas.
    - Fragmentation of rainfed land holdings and the rapid conversion of small holdings from field crop production to olive trees.
    - The relatively simple management requirements of olive trees, and suitability of climate especially within the UL rainfed areas.
    - Good return from olive trees, considering the low cost of production under rainfed conditions.
    - Olive production is part of the local heritage, where olive products are used widely as daily food by different people.
    - Establishment of olive orchards was a suitable response by many absentee land owners.
- ✓ Area planted with citrus had also increased, although its relative significance was slight.
- ✓ Area planted with grapes had substantially decreased, due to insects, disease, and export problems.
- ✓ Areas of other FT had increased slightly. This reflects low level of crop diversification, although very advanced production techniques have been introduced, in newly irrigated farms in Mafraq. These farms were established by investors mainly for export purposes.
- ✓ Another area of new farming practices emerged very recently in JV, which focused on date palm as an alternative crop for vegetables production facing price and export problems.

4.10 Rangelands resources

RL covers areas that receive < 200 mm of rainfall. It occupies an area estimated at 80 million d; or 90% of the Kingdom's land area. This area is designated as RL only because without reclamation and irrigation, it is open for use for various unchecked activities. The RL is distributed among three different environments as follows:

The Badiah (Dry land):
The area of this region is 70 million d, and receives less than 100 mm annual rainfall. Most of this area is state land. .

The Steppe region:
The Steppe RL covers 10 million d. It occupies areas with an annual rainfall that varies between 100 - 200mm. About 90% of this region is privately owned. The average ownership size at the northern part is 236 d and 198 d at the Northern central part, and 91d at the southern parts. The remaining 10% of the Steppe RL is a state land, which is characterized by steep slopes that prevent its development.

Mountain region:
This type covers about 450,000 d, and is scattered within areas, which receive an average annual rainfall higher than 200 mm, as isolated pieces of land around villages.

5 Role of institutions in management of land resources

5.1 Public institutions

This section discuses the role of public and civil societies in the management of LR in Jordan. Public institutions operate according to laws which specify mandates given to each of these institutions, while NGOs operates according to special legislations, sometimes delegated by public institutions. For example, the Royal Society for Conservation of Nature operates according to an article in Agricultural Law, delegated by the MoA.
The role of different institutions in the management and utilization of LR will be assessed according to:

- Activities undertaken by each of these institutions based on their legal mandate and the impact of implementing their mandates.
- Coordination and collaboration between public institutions.
- Over all frame of LR management and the role of each of these institutions.
- Role of Non-governmental organizations and private sector.
- Legislations with direct or indirect impacts.
- Polices and strategies implemented by different institutions.

The following section will focus on the first four items. Special sections will be devoted to legislations and policies and strategies implemented by different institutions.
The following public institutions were identified to have significant role with clear impacts on the development of LR in Jordan. The contribution of each of these institutions varies and their role is either direct or indirect.

Ministry of Agriculture (MoA):

MoA is mandated with the development, regulation of AS in Jordan. The role is stipulated in Law No.20, 1973. The ministry was restructured in 1998, as required by a Structural Adjustment Program, which was implemented in 1994. According to this program a new role for the Ministry was redefined, and law No.20 was updated and replaced by a new law stating the new role of the MoA.

Two entities are linked to MoA and have different degree of autonomy. These are the National Center for Agricultural Research and Transfer of Technology (NCARTT), and Agricultural Marketing Corporation Organization (AMCO). NCARTT conduct its activities through a special bylaw, and is governed by a special council representing different pubic agencies, and representatives from public universities and selected citizen with wide experience in agricultural research and transfer of technology. The center's council is chaired by MoA. The center is considered the arm of the MoA for conducting research and technology transfer. Lately, extension was added to the duties of the center. The center is now called NCARE. AMCO operated according to an independent law and operates through special council chaired by the Minister of Agriculture. AMCO was converted to a directorate within MoA after the MoA was restructured in 1998.

- National Center for Agricultural Research and Extension (NCARE):

Mandate: NCARE is mandated to conduct and/or coordinate applied agricultural research and transfer of technology activities at the national level in collaboration with public and private agricultural

institutions. NCARE's mandate also provides for the identification, testing, transfer and adoption of improved technologies.

General goals of NCARE:

- ✓ Employ the results of agriculture research developed locally or adopted from other sources to increase agricultural production in both plant and livestock sectors.
- ✓ Improve and enhance agricultural production.
- ✓ Conserve the agricultural national resources and optimize their utilization.
- ✓ Support agricultural development activities.
- ✓ Promote farming systems on environmentally sound basis.

- Agricultural Credit Corporation (ACC):

The ACC is an independent organization founded in 1960, and is governed by a council chaired by the Minister of Agriculture. ACC (MoA, 2009) had contributed significantly in the area of conservation of LR in Jordan. The ACC had been providing credits for farmers with very low interest for implementing agricultural projects, reclamations of land for the purpose of establishing orchards. Recently, ACC started to provide small loans (3,000 - 5,000 JD) without the needs to provide collateral credits. This had been very effective approach for inclusion of poor framers, especially rural women households. Since 1960 the ACC provided loans (with very low interest rate) amounting 449 million JD. Number of farmers who benefited from the ACC activities is 205,000 farmers. Loans provided by the ACC are revolving. Reports of the ACC indicate a high rate of loan payments by farmers, which clearly indicates the success of this approach in meeting its goals in developing and conservation of new LR, above all improving integration between plant and livestock, and improvement of livelihood of rural people (ACC annual reports).

Ministry of Water and Irrigation (MWI):

The MWI was established in1988. The ministry is responsible for overall monitoring of the water sector, water supply and wastewater treatment system and the related projects, planning and management, the formulation of national water strategies and policies, research and development. The Ministry embraces two entities dealing with water in Jordan: The Water Authority of Jordan (WAJ), which is in charge of water and sewage systems, and The Jordan Valley Authority (JVA), which is responsible for the development of the Jordan Rift Valley, including development and distribution of irrigation water resources. The mandate of JVA in managing irrigation WR, according to Law No.18, 1988, was restricted to JV only. Lately, this mandate was extended to cover ground WR in Up region, after law No.18 was amended and replaced by a new law (Law No.30, 2001) was adopted. The area under the mandate of JVA was also extended toward the southern parts of JV.

Ministry of Municipal Affair (MMA):

The role MMA in the management of LR is empowered by law No.79, 1966 which mandates the MMA to regulate and allocates land for different sectors within cities, villages, and village councils. Lately the mandate of the ministry was extended to cover land use planning outside cities and villages' boundaries, and outside the JVA mandated areas, as stipulated by the new bylaw No.6, 2007. The mandate of the MMA now covers all Jordan, except or JAV mandate in JV region. This activity was extended after the adoption of the new Bylaw No.6, 2007.

Ministry of Environment (MoEn):

The main duties of the MoEn includes protection of the environment in Jordan, conservation of natural resources, contribute to sustainable development through adopting policies, legislations and strategies, monitor the implementation of projects and ensures that environmental requirements are considered during the implementation of developmental activities.

These duties continued until the adoption of the environmental law in 1996 (Law No.12, 1996), which empowered the ministry with wider mandates. The MoEn became a focal point for many conventions such as Convention to Combat Desertification, Climatic Changes, Conservation of Biodiversity Convention and other activities steaming from agenda 21. Relevant action plans were prepared. The MoEn was mandated to implement action plans related to various conventions.

***Land and Survey Department (LSD)*:**

The Land and Survey Department is affiliated to the Ministry of Finance. LSD is responsible for the implementation of land laws and bylaws, land registration, division, distribution between relatives, and allocation of public land for different beneficiaries. The department is mandated to carry land surveys and registration, preparation of laws and their implementation. The department control all the state lands, issues permission of special land right such as exploration, mining, and quarries etc.

The department is mandated to implement several laws such as state property Administration Law No.17, 1974, which governs state land transitions, and two important legislations: one law and bylaws with important impacts on LR. The first one is law for divisions of the non-mobile property No.48, 1953, and bylaws issued according to provision of this law. This law allows the division of land to 10 donums parcel outside boundaries of regulated urban centers. The second is bylaw No.6, 1996, which allows the division of land between partners from 10 d unit to 4 d for areas outside the villages or municipal boundaries and West of the Hijazi Railway, for specific governorate and some selected villages. The railway relatively coincided with the 250 mm rainfall Isohyets. This means the inclusion of all land suitable for rainfed AP.

Jordan Standards and Metallurgy Organization and Standards (JSMOS):

The JSMOS mission is responsible for an important role in protecting human's health, safety, and rights as well as the environment, and enhancing confidence in services and national products put into markets through developing and implementing systems that are compatible with best international practices in the fields of standardization.

JSMOS is responsible for issuing and implementation of standards and specifications. List of standards adopted for areas related to land, water and environment, which contribute significantly to resources sustainability includes:
- *Water*: Water quality, drinking water, water for industry, sewage water, examination of water for chemical substances, physical, biological, and other standards related to water quality, and quality of treated domestic water.
- *Soil*: Soil quality (Pedology), soil quality and pedology in general, chemical, physical, biological, and hydrological properties of soils, and other standards related to soil quality
- *Environment*: Environment and environmental protection in general, management, economics, impact assessment, pollution, environmental projects, and other standards related to environmental protection.

JSMOS is also mandated to prepare legislations, and regulations that control the specification of inputs or commodities used in many sectors including agricultural activities. The specification of inputs such as fertilizers, TWW is of specific significance for degradation and pollutions.

***Ministry of Trade and Industry (MTI)*:**

The role of MTI is rather new after the Ministry of Supply was dissolved (MoS). The MoS used to control export and import of agricultural commodities. The MTI implements government policy related to provision of subsidies for animal feeds. Subsidies of animal feed contributed to rapid growth of the number of small ruminants, because subsidies were not provided according to accurate number of herds. This helped in increasing the rate of stocking on the rangeland, which subsequently, contributed to overgrazing of the range resources and caused further intensification of degradation in the dry areas.

The MoS also used to intervene with the shelf prices of agricultural products. Consumers used to pay high prices with small portion going back to farmers. Moreover, substantial subsidy was allocated to bread, which was supposed to be channeled to producers rather than consumers. This had significantly reduced farmers' interest to cultivate their land with field crops, which was reflected by the reduction of areas cultivated with FC.

***Ministry of Social Development (MSD)*:**

The MSD plays a critical and important role in the fields of social services, and social development. The Ministry undertakes a number of activities, programs and services in areas such as the family, childhood, social defense, and special education. Activities related to resources use and development of rural resources is responsibility of: Directorate of Poverty Monitoring and Social Security: The tasks of this Directorate are to conduct field surveys and collect information about poverty, and propose

programs to deal with poverty at the individual and group levels. Activities of MSD are of clear significance to resource's use and protection land degradation. The role of AD in rural areas and fighting poverty is nationally and internationally emphasized.

***Department of Statistics (DOS)*:**

Department of Statistics is affiliated to Ministry of Planning and International Cooperation and is the only official governmental department responsible for generating statistical data and undertaking different surveys. The DOS produces annual reports on production of AS, and conducts special census for AS every ten years. The first census was carried 1965, and the last one was in 2007. Censuses cover wide spectrum of raw data that can be re-tabulated and interpreted. The kind of collected information was subjected to continuous evaluation, as needed by developmental needs. The data are currently presented according to governorates, which provide spatial dimension to the distribution of resources.

The DOS also prepares report about the environment, and hazardous material. Also prepares analytical reports about some special issues and topics. More important the department started to prepare reports and conduct systematic assessment of poverty in Jordan, which is a good indicator about effectiveness of development in rural areas. This type of data can be used to asses the needs and effectiveness of AD in rural areas.

5.2 Civil society organizations

NGOs involved in management of land resources:

AD witnessed, since the eighties of the last century, the emergence of role played by NGOs, which were involved with grass roots and development of local communities in specific areas. These organizations carried out several activities since their establishment in their mandated areas. Fund for their activities comes from international donation, but with approval of Ministry of Planning and International Cooperation, or part of from governmental projects.

Jordan has a number of well-organized NGOs, which are actively involved in environment, conservation of nature, and combating of desertification. They are recognized as effective entities. Their activities are well appreciated at both government and public levels. These NGOs collaborate with different governmental institutions in implementing programs, participate in various committees, and play a major role in education and awareness raising efforts.

Three well recognized NGOs were mandated with specific issues relevant to resource protection such as; combating degradation, control of environmental pollution, and conservation of nature as priority areas in their mandate. The following NGOs are leading organizations with important contribution in Jordan:

- **The Royal Society for the Conservation of Nature (RSCN):** Established in 1966 with a mission to protect and manage the natural resources of Jordan. Responsibilities include establishment of protected areas to safeguard wildlife and sceneric areas, breeding endangered species to save them from extinction, enforcing government laws for the protection of wildlife, controlling of illegal hunting, raising awareness of environmental issues through education programs, and promoting the sustainable use of natural resources.
- **Jordan Badiah Research and Development Program**: This program was initiated in 1993 with the objective to achieve sustainable development of the desertified land in the Badiah region, and the improvement of the standards of living of the inhabitants through integrated approach. The program covers about 12.5% of the total area of Jordan and focuses, among other activities, on livestock production, plant production, and rehabilitation of vegetation cover, wildlife, and related subjects.
- **Jordanian Hashemite Fund for Human Development (JOHUD):** JOHUD was established in 1977 as a non-governmental and non-profit organization. Today, it is recognized as one of Jordan's leading national advocates in the field of integrated social development. Community based outreach approach is implemented through its network of 48 community development centers located in remote and rural areas. The main mission of JOHUD is to play a leading role in advancing comprehensive and sustainable human development through the enhanced participation of Jordanians. JOHUD's centers provide different programs, projects and services in areas that target mainly low income and poor families; agricultural projects such as dairy and food processing, sheep razing and home gardens.

- **The Jordanian Society for the Desertification Control and Badiah Development (JSDCBD, 1998):** This society was established in 1990. The aim of the society is to study the mechanism and extent of desertification, and formulate solutions to halt desertification in Jordan. The Society focuses, in participation with other organizations, raising the public awareness against impacts of desertification, and improvement of Badiah environment through different activities.
- **Faculty of Agriculture, University of Jordan:** The faculty had been restructured to accommodate issues of national interests, such as environment and management of resources. Among other research activities implemented during the last two decades, the faculty implemented a very important project with clear impacts on the resources of the Steppe region. The project was implemented in collaboration between the University of Jordan, Faculty of Agriculture and European Union during the period from 1985 - 2002 under the title (Improvement of Agricultural Productivity in Arid and Semi-arid Zones of Jordan by Hatten, Taimeh, 2001). The main objective of the project was to protect and improve land productivity and plant cover, establish framework for monitoring land degradation, formulate practical packages for the management of degraded land, optimize the use of scarce WR, and to increase production while protecting land from degradation. The project was implemented through three phases from research to farm implementation.

Private sector (PS):

The role of PS in resources management varies from one agriculture sub-sector to another.
The contribution of PS in RA in terms of investment is really poor, and is restricted to providing some inputs such as importing FT seedlings, fertilizers, insecticides, building and operating oil presses. PS investment in production of cereal crops is absent. The PS investment activities are more evident in IA. In this subsector, the participation of PS is very old in JV. Activities includes import of inputs, introduction of new vegetable varieties, investment in plastic houses and tunnels for production of vegetables and carnation, introduction of modern irrigation systems for vegetables and FT. Among the most important example of recent form of PS investment in the Valley, which will have profound impact on resource management is the investment in the establishment of Date Palm orchards. In export sector, participation of PS was restricted to export of vegetables to surrounding countries such as Syria, Lebanon, and Gulf states. The export of vegetables to these countries are not carried according to best specifications. Hover, few investors who started to implement the European Good Agriculture Practice had penetrated some European countries with vegetables.

PS involvement in the IA in the UL region is different, beside its role in providing irrigated farms' inputs; lately the involvement of PS concentrated on the establishment of FT orchards with export quality products. More active role of PS also involves importing modern olive oil press and packing olive oil for export to many countries as far as USA. The PS has no contribution in development or management of range LR in Jordan.

Setting priority for private sector's role in agricultural development: Currently; the National Strategy for Agriculture Development (NSAD,2002) had defined areas, which should be left for the PS. Among these areas are poultry production, post harvest, and food processing. Among areas that could provide opportunities for the PS involvement, according to the new role of MoA, might include the production of hybrid vegetable seeds, production of virus-free seedling using tissue culture, technology transfer in the areas of equipments for irrigation, testing of new crops for protected agriculture, and some new emerging research areas in biotechnology.

Research institutions:

- Role of research institutions:
The growing concerns about the environment and the protection of natural resources from further degradation while protecting the environment presents profound challenges to national research institutions. Such demands cannot be achieved without inflecting (Taimeh, 1998) more pressure on these resources. Although Jordan is not unique regarding this issues, alternatives for the development of additional land resources is highly constraints by shortage of WR needed for irrigating dry land as a sole resources for cultivating this land.

- Main research institutions:
NCARE: A national institution for research and extension carries its activities according to the National Strategy for Agricultural Research and Transfer of Technology, which explicitly expresses high priority to the

balance between improving productivity while protecting the environment. Realizing the significance of this balance was translated through the implementation of several projects, which addressed the issue of environmental protections. etc..

Colleges of agriculture at public universities: Faculties of agriculture, at public universities provided undisputable contribution through knowledge generation, data, and solutions of resources problems. It would be very hard to give even a short summary for wide range of research issues covered by these colleges during the last thirty years.

Participatory approach in resource management:

The government of Jordan realized the role of local communities in controlling environmental degradation which negatively affects the health of LR. In order to invigorate and empower the participation of local communities, the government used several means, which include participation of local community leaders in committees responsible for planning and implementation of various programs, increasing public awareness and developed better means for disseminating information among the public.

Cooperatives in Jordan operate under the umbrella of Jordan Cooperative Corporation, a viable example of people participation in resource management. There are about 238 agricultural cooperatives in Jordan. Twenty of these cooperatives are range cooperatives with grazing reserves where management and improvement of the dry land (Badiah region) lands is carried through planting fodder shrubs and protection of the natural vegetation cover. The agricultural cooperatives are involved in conservation and development of their LR.

Among other successful example of involvement of local community participation in managing local resources, is the approach adopted by the second Phases of Resource Management Project, implemented by MoA and IFAD in Karak-Tafila Governorates (2005-2013). Local community participation is carried though the preparation of a Community Action Plan. According to this approach, local community selects their representatives and identifies their local developmental needs and prioritizes their implementation. The project implements its designed activities according to the community action plan prepared through full consultation of the representative of the local communities.

Environmental issues also occupy a good space within the local media as reflected by the various programs broadcasted on the public radio and television stations. Documentaries, interviews, and coverage of local events and workshops undertaken by various parties are given proper participation of local communities.

6 Issues threatening land resources

6.1 Factors affecting sustainability of land resources

Institutional Coordination:
Coordination with MoA regarding the implementation of agricultural policy or water policy does not exist. Although the AP and monitoring the quality of produce is responsibility of MoA, The MoA has no role in controlling the distribution or quality of water being allocated to for AP. This will have a strong impact on the degradation of the land in the valley.

Implementation of Policies:
As indicated, only in 1997 MWI had prepared and implemented a water policy with regards to utilization of water allocated for irrigation. Nevertheless, the formulated policy was not comprehensive, and was not implemented in the field. For example, the policy called for providing enough water to maintain low salinity level in the soil by adding leaching requirement. In practice, water is provided to farm unit is rarely enough to meet crop requirements.

Mandate for Allocation of LR:
Coordination, Management, and Allocation : The absence of clear mandate with regard to resource management had created poor resource management and sometimes some confusion. The poor enforcement of pumping regulations lead to intensive investments in irrigated farming in the UL and

illegal pumping, or illegal well drilling. Any attempt now to correct such problems will lead to great economic losses to farmers who invested tremendously, if MWI strategy to implement pumping regulations were carried. JVA was very much involved in expanding irrigated areas without proper attention to deterioration of the water quality and its impact on quality of products. The complementary role of JVA, which was expected to compliment the role of MoA was never institutionalized or implemented at any level. This situation is translated by a lack of clear trend of proper management, which could be affecting the LR, and the absence of any regulations regarding the management of these resources.

Land Use Allocation:

Although MoA is charged with developing the AS, land use planning or land allocation were not among duties empowered by Agricultural law No.20. Empowering such duties to other ministries had severe negative consequences on the protection of the AP base. Determining the land use and allocation of land within urban boundaries was, instead charged to MMA. Not only this, but MoA was not even represented at any planning level, required by the Law for organization of Cities, Villages and Building No.79, 1966, which was mandated to MMA. Land use allocation was not carried according to the actual potential of the land, whether this potential is based on economical return or yield. The allocation of land within municipal or village boundaries was never carried using any criteria and with no attention paid to protection of good AL.

The lack of adopting a national policy, which gives priority to allocation of land for agricultural use over any other use, lead to the losses of good AL to other uses, namely urban use.

Such misuse also generated several trends which further aggravated the situation. Among these were:

- Conversion of AL to other uses raised the price of land, which attracted many holders of AL to fragment the land to facilitate the sale of part of their land.
- The inclusion of many areas suitable for cultivation within the village or municipalities boundary not only contributed to the losses of AL within the boundaries, but also put the AL around them under future threat of inclusion and conversion for other non-agricultural uses. Thus, land outside the urban areas is continuously threatened since there is no law yet to control the expansion of the boundaries of urban centers.

6.2 Land use allocation the Jordan Valley

Jordan Valley Authority was mandated with special law, which governs the allocation of LR in the JV (Law No.18, 1988). The size of the land ownership, as well as the use, was controlled by special provision of the law. According to this law, if a farmer wanted to sell his land he can sell it only to JVA, who, in turn, can sell it without changing the size to another farmer. Accordingly, the AP base is very well protected within the valley.

The JVA law No.18, 1988 was revised. The new law, (JVA Law No.30, 2001) permitted land consolidation of farm units up to 250 donums.

6.3 Land use allocation in rainfed areas

Land suitable for rainfed cultivation, generally found in areas, which receive rainfall > 250 mm had suffered from strong competition from urban activities. Land that had been used for AP and falling within the urban boundaries had been subjected to fragmentation, or is not used. Land occurring outside the border of urban centers is also subjected to fragmentation to 4 donums in comparison with original law, which restricted division to 10 donums. The late law was implemented in 1996, and is expected to inflect strong negative impact on the production base. Among the expected impact would be that additional land will be abandoned, and as a result, land degradation will intensify.

6.4 Management of the agriculture sector

The management of the AS was carried since the establishment of the country as a part of the country. Developmental plans started since the late sixties of the 20th century. The developmental plans were implemented over 3-5 years. Although the various plans targeted economic growth and social improvement, reviewing the various plans revealed that protection of the LR from fragmentation or degradation were not reflected as clear national policy, which gives priority to protect these resources. Very scattered effort, however, can be sited regarding soil conservation projects within the highland, which helped farmers to build stonewalls and plant FT. Among projects, which clearly signaled clear national policy with regard to conservation of resources was the protection of forest, and the forestation

effort, which started, at least thirty years, prior to declaration of independence. The clear national intention to protect the national forest was strongly expressed in the Agricultural law No.20, 1973.
Recently, in 1996, the government adopted an Agricultural Policy Charter (APC), which, if implemented, it would have provided some assurance to sustain the resource of the country. Among the specific objective relevant to resource sustainability were to manage and utilize the available AP resources, in particular water, land, capital, and labor, in an economically efficient manner, while preserving the environment and ensuring the sustainability of agricultural production in the long term.
Among the specific adopted policies relevant to the rainfed farming system: protection of AL from fragmentation and urban encroachment was recognized. Unfortunately, the APC was adopted as result of adjustment of the AS, and the implementation of the policies was very selective.
The role of MoA with regard to the management of resource of the irrigated-farming sector has been restricted to conducting research and providing extension. While with regard to developmental efforts, MoA has no mandate.

Irrigation water resources:
The 1985 marked the use of TWW produced at El-Samara wastewater treatment plant. Before that date, irrigation in the JV depended on fresh water with good quality. After the construction of the El-Sammra plant, the middle part of JV, south of Deir Alla started to receive increasing amount of TWW mixed with runoff water stored behind King Talal Reservoir (KTR In the upland areas, the number of wells increased to more than about 3,000, of which about 800 wells are illegal causing substantial over pumping estimated at 200 MCM annually. License for pumping from wells permits withdrawal of only 50,00 CM per year. This limit is never respected, especially for illegal well, or those who expand their farms and over pump ground water.
The increasing availability of TWW and over-pumping are crucial for sustaining the land productivity. Strict standard quality should be enforced. Although there is a there is strict pumping regulation, which should be implemented, and specification for the quality of TWW use in agriculture, the specification were not established taking into consideration conditions prevailing in the irrigated land. No efforts had been exerted to examine the impact of used specifications on the degradation of the land resource. Moreover, no comprehensive study had been carried to monitor any suspected degradation of irrigated and resources. It is true that the quality of irrigation water is monitored. Nevertheless, significant changes in the water quality had occurred, as a result, of using the TWW and over-pumping. The impacts on the LR or their quality are not yet assessed.

Framework of resources developmental activities:
The various developmental activities carried out by MoA relevant to resource development and management was mostly carried through implementation of projects, were not according to a national broad base planning. The reliance on individual projects that are not part of a strategic plans, did not play a catalytic role to help in the formulation of a long term strategy for the conservation of the LR from degradation and to protect the production base form misuse or negligence. Moreover, many of the short- term projects were generally neglected after their termination. Thus, environmental benefits targeted from the execution of such project were not maintained.
The lack of long term strategy is reflected by the budget allocated to MOA, which in most years it barely covers running cost.

Management of land resources:
Sustainable management of LR requires integrated holistic approach. Such integration should take into consideration linking WR and their availability and quality with AS, as an integral part of a national strategy, which optimizes the output without damaging the environment. Linkages between resources such as land use and water utilization should constitute an integral national policy executed by one agency empowered with proper technical and trained human resources. Unfortunately, neither land use allocation, nor strategy for water utilization even at the farm level, is not under the supervision of the MoA. Water resource is managed by MWI, while land use allocation is under the mandate of MMA with no institutional linkage to coordinate the management of the two resources. Environmental degradation, as well as losses of the production base is attributed to improper mandate allocation and poor institutional linkage between relevant authorities.

6.5 Future threats to sustainability of resources

***Globalization**:*
Among issues with immediate threat to the sustainability of resources is related to globalization. Although all forums steaming from the recent global conventions emerging after the adoption of agenda 21, which raised attention to the protection and preservation of the plant resource in a sustainable manner to be passed for future generation. Globalization will also impose great danger on the sustainability of the national resource. The economical impact of the globalization on agricultural product will be very severe. Agricultural production has to be carried in manner, which ensures maximum efficiency and can guarantee competitive price to agricultural produce. If good earning from agricultural produce was not attained, farming will be deserted. Moreover, if proper farming technologies were not adopted, higher production, and better quality of products can not be attained. Furthermore, reducing degradation cannot be achieved.

Research and technology transfer:
Agricultural research activities in Jordan started since 1953 when the first research station was established in JV. Until 1985, research activities were not carried according to a declared policy or a strategy. Research agenda was determined by individual researchers. Although some good results were achieved, findings were not adequate to ensure proper management of LR.
Among resource requirements, which could help in ensuring the sustainability of resources productivity can be achieved through providing farmers with different crop choices. This was not achieved in rainfed farming or irrigated farming.
The results of inadequate research outputs is a sever reduction in the areas cultivated with legumes, which are considered vital for soil fertility, reduction of area cultivated with cereal and conversion of land towards olive trees, which are planted at many locations in soils not suitable for tree. Establishing many of the olive orchards on unsuitable land is felt by many farmers who already started to notice sever yield reduction after seven-ten years of tree life. Unfortunately, this trend had emerged since farms were not provided by farming alternative packages to economically cultivate small farms size.
In 1996, MoA adopted a strategy for research a technology transfer. The strategy was expected to serve as an umbrella for conducting research at the national level.
Extension efforts were at best characterized as scattered or inadequate. This forced farmers to seek information form different sources, which had commercial objectives.
Research activities carried at universities was not also carried according to any agenda and was not linked to national developmental plans. The absence of any national mechanisms to coordinate research activities between different national agricultural institutions related to AS had resulted in poor research impact on the sustainability of LR in Jordan.

Marketing:
Export market in Jordan is hindered by the absence of proper post harvest infrastructure, large-scale production of produce for the purpose of export. Number of farmers who are trained to produce products that meet standards of international market are few. As a result of poor investment for export marketing, farmers do not produce mainly for export. Price obtained from such production is either form regional markets, which offer low prices, or local markets, which provide even lower return. Moreover, due to constraints imposed by water quantity and quality, some crops with high return per unit cannot be grown.
The impact of such marketing problems on degradation of land resource should be clear as a result of poor resource management, and the inability of farmers to efficiently use the available resources.

Regional land use planning:
Land use planning for urban purposes, takes into consideration the protection of land resource, and is based on sound resource allocations. Such planning is strategic, meet long-term and short-term objectives and target the protection of LR from competitions and potential degradation. Unfortunately, the lack of such strategic planning had contributed to the loss of production base to sporadically establish urban centers, and conversion of AL to non-agricultural uses. The rest of the land suffers from sever fragmentation and is highly vulnerable to degradation. The demographic distribution also had resulted form the improper regional land use allocation, and lead to the concentration of cities on best AL. The future needs to meet the demand of increasing population, is also expected to aggravate the losses of AL.

Legislations also provide window for increasing the loss of more land, by allowing the building to three floors only in most areas, Such law had forced urban areas to expand horizontally very rapidly, which facilitate the expansion of the boundaries of various urban centers.
Furthermore, no strategy concerning the national allocation of LR was implemented during past decades. No strategy yet is in place to be used as a guideline for allocation of land resource at the national level and the protection of the production base or to protect it from degradation.
The poor resource management could be attributed to several reasons. Among these reasons are: lack of any strategy or policy for protection of LR, lack of establishing any priority to allocate land resource according to its potential with emphases on protection of AL, conversion of land use from one type to another without any restriction or any criteria, and finally, no mandate was given to MoA to intervene with land use allocation. As a result, LF within urban centers, conversion the land to other uses and abandoning land are among the features, which characterize the land management in Jordan.

Urbanization:
Most of the urban activities in Jordan occur within AL, which have heavy soil texture. Such soil will suffer from poor drainage problems, if irrigated. Projection suggests that about 550 MCM of TWW will be generated in Jordan within the next 50 years (Baker and Harza, 1998). Currently, most of the generated TWW is used to irrigate land in JV. When such huge amount of water is available, its use for irrigation in the UL will not be avoided. Most practical projections indicate that the use of water would be around the urban areas, where it was generated. The use of such water to irrigate soil with heavy texture implies high risk of environmental degradation. The erratic distribution of these urban areas does not provide ways to use the water in a manner, which could minimize the environmental impact.
The shortage of suitable soil map also contributed to the inability of the concerned departments to establish multifunctional database for proper interpretation and decision-making regarding the protection of LR from abuse and from degradation.

Cropping pattern:
It needs no emphases that appropriate cropping pattern constitute one of the sound management principles. No defined cropping pattern based on potential land suitability or match poor water quality and aiming to protect of land from degradation was formulated or implemented. Such chaotic conditions had lead to poor production efficiency, dominance of few crop with poor return and inability to compete in international markets. Farmers are totally not aware of the danger of degradation. No plans are yet formulated to deal with future, probably more intensive degradation. The threats steam from the continuous increasing use of TWW in agricultural without clear land use plans. Such threats will negatively affect new areas in the UL, which are characterized by high salinization risk due to dominance of soils with heavy texture. Moreover, fresh WR needed to dilute TWW is not expected to be available. Furthermore, areas irrigated with ground water are scattered at locations far from sites where TWW are produced. No attempts yet are made not examine what is the appropriate cropping pattern that could be introduced to sustain the use of LR, if irrigated with TWW.

7 Policies and strategies relevant to land resources utilizations

7.1 Introduction

Many strategies were prepared to improve and protect LR in Jordan. These strategies were changed or updated more than once. Water sector was given first priority because of its critical and sensitive role, and increasing deficit, and its direct impact on various sectors. Priorities adopted by the government for dealing with land resources inflected positive impacts, in some cases, and negative impact on land utilization in some other cases. The future capability of LR in Jordan to perform its expected role in providing adequate food depends totally on available WR and its quality.
LR in Jordan is managed through the implementation of important strategies developed during the last two decades.
These strategies covered:

- Water Resources
- Agricultural resources
- Agriculture policy
- Environment

Laws and bylaws played vital role in management of LR. Many laws and by laws were prepared and enforced with various impacts on the sustainability of WR.
Among most import laws, which had significant impacts on sustainability of LR, the following laws had clear impacts.

- JV Law No.19, 1988 and it amendment
- Law No.78, 1966
- Bylaw No.6 prepared according to Law No.79
- Land use Bylaw No.6,1996
- Agriculture law No.20, 1972 and amended law

7.2 Water resources

The first well coordinated strategy was prepared in 1997. The strategy divided the water sector to four sub-sectors. Separate strategy and action plans were prepared for each sub-sector. These sub-sectors were:

Water strategy and policy:
The National Water Strategy was adopted in 1997. The strategy stressed the need for improved WR management with particular emphasis on the sustainability of present and future uses. Special attention was given to protect Jordan's WR against pollution, quality degradation, and depletion.
Policies for the following water sub-sectors were prepared:

- Groundwater management
- Irrigation policy
- Wastewater management policy
- water utility policy

Strategic plan for Jordan Valley:
The Strategic Plan for JV (JVA, 2003) was prepared by JVA for the period 2003 - 2008. The strategy covered the following goals:

- Goal One: Water Resources Management
  Meet the needs of current and a future water user by managing, developing, protecting and sustaining both existing and new WR, in a way, which takes into account both economic and environmental dimension, and involves the private sector where appropriate.
- Goal Two: Water Supply and Distribution
  Ensure that JVA's existing water delivery and distribution infrastructure, systems and facilities are managed in an efficient, transparent and equitable manner, and involve the private sector where appropriate.
- Goal Three: Land Development and Management: Develop, manage, regulate and protect land and related resources in the JV in order to maximize their economic usefulness while taking into account environmental considerations, and involve the private sector where appropriate.
- Goal Four: Organizational Performance, Improvement and Development: Develop and reorganize JVA to enable it to better achieve its new mission and improve its performance and effectiveness in providing quality service to its stakeholders.

Water Strategy 2007 "Water for Life":
A comprehensive water strategy was prepared in 2007. The strategy followed a new approach different from previous strategies, which dealt with different water sub-sectors separately.

- *Irrigation water:*
  Goals for irrigation water by 2022:
- Reduce annual water allocation to 661MCM in 2022 (293 MCM in 2007) and in the Highlands reduced to 191MCM in 2022 (304 MCM in 2007).
- Establish efficient bulk water distribution and on-farm irrigation systems.
- Use TWW for activities that demonstrate the highest financial and social return including irrigation and other non-potable uses.
- Establish one service provider for irrigation water for the whole country, and while retail function for irrigation water will be privatized.
- Promote water use efficiency by introducing water tariffs and incentives.

- Promote the use of alternative technologies such as rainwater harvesting for enhancing irrigation water supply.

➢ *Wastewater:*

Goals for wastewater by 2022:

- Provide all the major cities and small towns with wastewater collection and treatment facilities.
- All major industries and mines have wastewater treatment plants.
- New high-rise buildings use grey water for internal non drinking purposes.
- Public health and the environment, in particular groundwater aquifers, are protected from contaminated wastewater in the areas surrounding wastewater treatment plants.
- TWW is used for activities that provide the highest return to the economy. For irrigation use in the JV and in the UL, a comprehensive risk management system is in place.
- The quality of TWW from all municipal and industrial wastewater treatment plants meets national standards and is monitored regularly.
- Tariffs for wastewater collection are rationalized.
- All treatment plants are operated according to international standards and our manpower is trained accordingly.

➢ *Water demands:*

Goals for water demand by 2022:

- Cap and regulate irrigated agriculture in the highlands by laws.
- Introduce water tariffs and incentives to promote water efficiency and higher economic returns for irrigated agricultural products.
- Increase awareness of Jordanians about water scarcity and the need to conserving limited WR.
- Reduce water demand within each sector in a viable manner.
- Water tariffs within and outside the water sector should support water demand management.
- Non-revenue water to be 25% by 2022.

➢ *Water supply:*

Goals for water supply by 2022:

- Uninterrupted safe and secure drinking water supply achieved including continuous flow in Amman, Zarqa, Irbid, and Aqaba.
- Water supply from desalination is a major source.
- Drinking WR is protected from pollution.
- Surface water is efficiently stored and utilized.
- TWW effluent is efficiently and cost-effectively used.
- Groundwater management plans to ensure safe yield are operational.
- The concept of utilizing grey water and rainwater is fully embedded in the codes and requirements of buildings.
- Our shared water rights are protected.

7.3 Agriculture strategies, policies, and action plans

Agriculture Policy Charter (MoA, 1996):

The government adopted the APC in 1996. The Charter aims to cope with local, regional and international changes. The charter is considered as a contribution toward achieving integrated socio-economic development that is efficient, sustainable, and equitable. The role of AS in rural development towards the welfare of population, and the preservation of the natural resources and environmental protection, was emphasized. The APC underlines the vital role of rural areas in AD.

The specific objectives of the APC were presented according to the AP sub-sectors as follows:

- Rainfed Agriculture.
- Low Rainfall Areas.
- Livestock.
- Forest.
- Irrigated Agriculture.

According to the APC, the role of MoA was defined n providing services, monitoring and regulation.

National Strategy for Agricultural Development (NSAD):
The NSAD was prepared in 2002 (MoA, 2002). The main objectives of NSAD were to improve productivity rehabilitation, conserve and sustain management of land and WR and to put the AS on sustainable bases. One of the most important achievements of the strategy was the clear linkage, which was achieved for the first time, with WR as well as linking the development of AS with all public institutions, and PS. More important the strategy emphasized the three pillars of sustainability by developing specific objectives and action plan that addresses the economic, social, and environmental dimension of agricultural development and emphasized the regional dimension by proposing specific policies relevant to cooperation with Arab countries.
The action plan of the strategy included many programs (economic, social and environmental), which addressed most important developmental requirement of AS.
The strategy and action plan was presented according to the following agricultural sub-sectors:

- Rainfed Agriculture Farming Sub-sector.
- Rangeland Sub-Sector Farming System.
- Irrigated Agriculture Farming System in the Jordan Valley.
- Irrigated Agriculture Farming System in the Highlands.

7.4 Gabs and shortcomings

Gabs or shortcomings regarding action plans for different strategies:
Different strategies where adopted with direct relevance to protection of LR from threats such as desertification. Some of these strategies where prepared with degradation of LR as the main targets. Among such strategies was the National Strategy for Agricultural Development, Conservation of Biodiversity. Analyses of the various strategies indicated the following:

Biodiversity Strategy*:*
The strategy seemed to have addressed all required issues needed to enhance the implementation of combat of desertification activities.

National Strategy for Agricultural Development*:*
Action plans prepared for this strategy did not deal adequately with mitigating the impacts of degradation as well as the impact of climate change. However, the strategy recommended polices needed to address the following issues highly relevant to combating desertification such as:

- Conservation of land, WR, and the vegetation resources in a manner which sustain their utilization.
- The role agricultural practice as a mean to alleviate the impact of negative environmental conditions resulting from other sector, such as the increasing availability of TWW and the need to properly use such resources.
- Policies and strategies to combat desertification were directly targeted along with policies, related water or development of LR.
- Recognized relevant issues related to climate change.

Shortcomings:
The following issues were not adequately covered by the NSAD:

- Issues related to soil pollution by pesticide and disposal of empty pesticide containers and expired pesticides.
- Possible impact of LFs on land degradation.
- Polices to deal with neglected land.

Climate Related Strategy:
Climate change strategy that deals with protection of LR is prepared yet.

National Strategy for Combating Desertification:
The strategy was prepared in 2006 by MoEn. The following is a list of issues not addressed by the national strategy for combating of desertification:

- Establishing guidelines for land use and soil management.
- Proposing methods for monitoring the status of desertification in Jordan including: causes, possibility of spreading, control strategy, and efforts made by Jordan to combat desertification,

- Development of model for combating of desertification in Jordan.
- Resolving conflict between major sectors resulting from water allocation.
- Resolving conflict on use and allocation of groundwater between MWI and MoA.
- Institutional arrangements for coordination among different involved agencies.
- Legislative measures, such as decentralizing authority, improving land tenure systems,
- Involvement of stakeholders, and supporting women, farmers and pastoralists to participate in the efforts to combat desertification.
- Involvement of non-governmental organizations to play a strong role in preparing and implementing the action programs.
- Development of scenarios for land use change at various scales focusing on the consequences of land use changes and how they affect, land degradation and promote desertification.

8 Land degradation

8.1 Processes of degradation

Land degradation processes affect the three main farming systems in different regions of Jordan. These farming systems are: irrigated agriculture, rainfed agriculture, and rangelands.
Generally, the following types of degradation processes affect LR in Jordan:

- Soil Salinization.
- Physical degradation: including soil structure and compaction.
- Biological degradation: degradation of organic matter, vegetation cover.
- Water erosion
- Wind erosion

Specific type of degradation can dominate specific farming system, and more than one type of degradation could be active at the same location. Generally, many of the degradation processes are interrelated. For example, degradation of vegetation cover causes organic matter degradation, can cause degradation of soil physical, and eventually accelerates other types such as erosion by wind or water.
Four major ecosystems can be found in Jordan. Each of these ecosystems has specific characteristics, and is subjected to different drivers which results in the occurrence of one or more than one type of degradation.

8.2 Causes of degradation in Jordan

Land allocation and utilization of LR within different farming systems in Jordan played a pivotal role in subjecting these resources to different types, and risk of degradations. Currently, these resources suffer from accelerated rate of various types of degradation processes, LF, high rate of urbanization, deteriorating water quality and misuse of LR due to the absence of proper land use planning. Degradation in Jordan is caused by many factors that vary from one region to another and from one ecological system to another. It had resulted from complex interactions between physical, chemical, biological, socio-economic and political factors, both of local, national, and global nature.

Among the socio-economic factors contributing to land degradation: framework governing the land tenure system, land use, and land use policies, lack of sustained national policies, market tools affecting local farmer, taxation and trade barriers could be listed. Plans to sustains and manage available resources also plays a key role in protecting available production bases for degradation. The threat is immense and the scale of threats is also of great concerns. For example the protection of IA which covers about 740,000 donums from degradation by soil salinization, presents a special challenge. This stems from the increasing threats of potential degradation which could be accelerated due to the steady increase of withdrawal of fresh water reallocated for domestic consumption, and substitution of the fresh water by TWW of water of lower quality.

Land degradation within some regions could affect adjacent regions too. For example, degradation in the low rainfall rangeland areas has significant off-site impact on resources of RA. The fragility of ecosystem that dominates the low rainfall areas is attributed to the indigenous properties of soils, variability of the rainfall, and to topography configuration. These factors are partially responsible for high rate of degradation by wind erosion and water, which has a spill over impact in the AR located to the west of the low rainfall region (Taimeh, 2010).

8.3 General factors contributing to land degradation in Jordan

The following is a summary of factors contributing to land degradation in Jordan:

- Increased negligence of land caused by LF, which hinders farming of small ownership in agriculture production.
- Increasing pressure on LR caused by higher production demands, which is not accompanied with proper management.
- Poor allocation of land for different crops according to optimum land potential.
- Expansion of irrigated land into dry regions without consideration of suitability of soils and the use of appropriate production practices.
- Expansion of areas cultivated with barely on to highly fragile rangelands within the Steppe region.
- Increasing animal stocking, vegetation destruction, overgrazing, traffic movement, and plowing of rangelands resulted in accelerating degradation by water and wind erosion.
- High level of seasonal rainfall variation which affects fragile soils, which prone to degradation within rainfed and rangelands in dry areas.
- Presence of soil with indigenous properties susceptible to degradation processes with extensive coverage within the dry lands, which resulted form climatic changes.
- Poor enforcement of existing or lack of proper legislations, or policies needed to protect LR against land degradations.
- Lack of employing regional land use planning to guide the allocation of land based on their suitability.

8.4 Natural vs Human - Induced land degradation

There has been great debate about the role of natural and human induced land degradation. Most of the debate focused on the role of climate as one of the driver causing land degradation. Other biophysical factors such as indigenous soil properties, or topography were not given due attention. Indigenous soil properties and topography are important factors that might increase the risk of specific type of degradation. Therefore, assessing the role of either factor is very important in formulating measures to protect land from land degradation.

- Naturally induced land degradation:

Climate had been cited as a factor responsible for land degradation. In Jordan, studies had clearly indicated that climatic changes occurred several times within different regions (Awni, 1984). As a result of these changes, especially the last climatic episode, soils and plant cover was changed substantially. The soil properties which developed during the last climatic changes had significantly contributed to the dominance of highly fragile ecosystem that prone to degradation. The increasing human activities, had variably exacerbated, various types of degradation within the different regions, depending on the system fragility. The increasing level of current short-term climatic variation also is another factor that contributes to land degradation in Jordan.

- Human induced land degradation

The role of human-induced land degradation includes activities in arid, semi-arid and sub-humid areas. These activities include: poor cultivation practices, overgrazing, forest clearing, and wood gathering for fuel consumption. Cultivation includes: land-clearing practices, cultivation of marginal lands, cultivation of poor soils, and inappropriate cultivation practices such as reduced fallow time, improper tillage, poor irrigation practices.

Rangeland excessive grazing and miss-management is considered as a leading factor causing land degradation, since grazing had exceeded the carrying capacity of the land. This was particularly noticeable in the Steppe and Dry region. Mismanagement coupled with poor or inappropriate governmental policies, the use of inappropriate technology in arid, semi-arid, and sub-humid region, increased level of traffic movements, road construction, industrial activities, mining, establishment of new urban centers, collection of wood for fuel, in combination with overgrazing or inappropriate cultivation practices are among human activities responsible for accelerating land degradation within two major areas in Jordan, namely, the Steppe and dry regions. (These two regions cover about 91% of the total areas of Jordan). These activities also are responsible for exposing land surface to either wind

or water erosion, consequently, creating conditions that are inimical to plant growth, thereby, causing further degradation of soil and vegetation cover.

The role of biophysical factors, namely soil, climate and topography play a significant factor responsible for causing high-risk of land degradation.

Climatic variation had great impacts on land degradation, because of its direct effects on vegetation cover, and eventually on other degradation processes such as erosion by water and wind.

In Jordan, various studies indicated that soils within the different regions of Jordan were subjected to different type of climate changes in the past, and are subjected to a varying degree of climatic variation, or gradual change in climate (Taimeh, 1984, 1991, 1992, and 1996). Regarding the climatic change, a sequence of climatic change that had affected the soils of Jordan in different regions is established as follows: Very humid- dry- Humid, and finally the current climate.

8.5 Regions of Jordan:

In order to facilitate the assessment of different types and causes of degradation, Jordan is divided into different regions based on ecological properties, geological, vegetation, and soils properties**.** Accordingly, areas occupied by different ecological systems were divided into sub-regions to obtain homogeneous sub-region with regards to type of dominant degradation.
These regions are (Taimeh, 2010):

Jordan Valley (Sub-tropical ecosystem) region:

This region occupies the Jordan valley. The total area of this region is bout one million ds. This region is divided into the following sub-regions:

- North sub-region: This region extends from Deir Alla to Yarmouk River.
- Middle sub-region: This region extends from Deir Alla to the Dead Sea.
- Southern sub-region: This region extends from Southern part of the Dead Sea to Ghor Fifa.

Shafa Ghor-highlands transition region:

This area includes escarpment area bordering the Jordan Rift Valley called Shafa-Ghor. The climate is transitional between sub-tropical and Mediterranean. Area close to the valley floor has sub-tropical climate, while Mediterranean climate influence prevails as the elevation increases eastwards.

Eastern highlands:

- The Highland region (Mediterranean sub-humid to semi arid ecosystem): This region occupies areas, which receive annual rainfall higher than 250 mm. This area occupies 9% of the total area of Jordan,
- The Steppe region (Mediterranean Semi-Arid Climate): Covers areas, which receive annual rainfall of 100 - 250 mm.
- Dry land region (Mediterranean arid system): Called locally: Badiah region: This region occupies areas with annual rainfall less than 100 mm. This region is divided into three sub-regions:
    - Southern region: This region extends from Ghor Fifa to Aqaba south and extents to Mudawarah to the East.
    - Middle region: This region extends from Ma'an to Azraq to the North.
    - North region: This region extends from Azraq to the Iraqi and Syrian borders.

Land degradation identified in the different regions will be presented in two parts. The fist part will list as human- induced land degradation, and the second part will list as anural causes.

8.6 Degradation within different regions:

A - Jordan Rift Valley: Degradation common to the three sub-regions JV:

- Soil salinization in JV is caused by:

Human-induced factors:

- Deterioration of irrigation water quality, the use of saline soils (Middle JV),
- Contamination of the surface water with substances originated from different sources such as agricultural and industrial activities conducted in areas surrounding wadis and channels carrying WR. Most of the wadis are contaminated with effluents of wastewater treatment plants, and cesspool leakages.
- Increasing salinity of return of irrigation water return.
- Poor irrigation scheduling causing limited salt leaching.
- Poor farm water management, and over fertilization.
- Rate of soil salinization is expected to increase due to shortage of water needed for leaching of salt.

Natural induced factors:

- Distribution of the saline lacustrine sediment with various salt contents.
- Annual climatic variability.

- Erosion by water:

- Rainfall characteristics.
- Topography of wadis discharging to the Valley floor. Erosion by water occurs during intensive storm, which accompanies over-flooding from side wadis. Although erosion by water is not continuous in this region, however, the risk becomes very high during intensive rainstorms.

- Chemical degradation of soil: This type of degradation is the dominant type in JV.

Chemical degradation refers to the increase in the concentration of specific element in soils, where the quality of the produce or the production quantity is reduced. This type of degradation is common to the three sub-regions (Taimeh, 1996). Example of such elements is chloride, which could cause plant toxicity. Increasing of the concentration of heavy element up to the level where the quality of the produced may affect human or animal health.

***B - Shafa-Ghor: Highland transition region**:*

This region occupies a strip of land occupying a transitional position between the JV, with Sub-Tropical climate adjacent to the Valley floor, and the Highland region occupied by eastern mountains and dominated by the Mediterranean Semi-Arid to Sub-humid climate.

Water erosion:

Human-induced factors:

- Fragmentation of private land and dispersion with governmental land.
- Poor agricultural practices such as plowing with the slope, plowing shallow soils, and clearing of natural forest trees without undertaking any proper measures to protect the soils from erosion.
- Inadequate soil conservation measures to protect soils from erosion.

Naturally-induced factors:

- Dominance of steep slopes.
- Poor soils properties, such as shallow soils, high coarse content and rocky steep slopes.
- Low and high rainfall intensity and variation.

C - Eastern highland (Upland region):

C.1 - Uplands regions: Mediterranean sub-humid to semi arid ecosystem region:

This region receives annual rainfall > 250 mm, and occupies 9% of the total area of Jordan.

Degradation:

Human-induced factors:

- The extensive destruction of forest lands during the last two centuries.
- The rapid establishment of urban centers.
- Improper land practices, and use of machines, cultivation of steep land without implementing any soil conservation measures.
- Erosion by water affecting this region also contributes to pollution of WR. This resulted from the concentration of waste material around urban centers. These wastes find its ways to waterways and eventually to dam collecting water for irrigation.

Degradation of vegetation: Deterioration of plant cover in the UL (Highland) region had accelerated during the few decades. The destruction of the vegetation cover caused by human and naturally -induced factors had contributed to higher rate of erosion by water.

Water erosion: Erosion by water (geological and accelerated) is very active in this region. Erosion within cultivated lands within the UL region is active on land with slope above 3%. Geologic erosion in this region is

considered the most important factor responsible for the formation of the soils of this region. All the soils of this region were formed from material transported by water from high areas and deposited at lower areas.

Slope configuration: Steep slope with extensive rock outcrops.

Rainfall variation: High level of rainfall variation.

Environmental issues with significant impacts on land degradation:

Wind erosion: Erosion by wind is negligible in this region. This region is recipient of wind sediments transported from Eastern region and deposited over the land.

Increasing use of treated wastewater:

Water is a scarce resource in Jordan. Effort to utilize all available WR is a matter of a high national priority. TWW will be an important resource in irrigated agriculture causing concer about environmental degradation.

Degradation of groundwater: Degradation of ground water quality other than depletion and salinization includes contamination with trace elements, organic compounds, bacteria, viruses, biocides and fertilizers. This form of degradation occurs (Salameh, 1993) along the Zarqa River, urban areas, and in aquifers underlying ALs.

Intensifying urban activities:

The UL region hosts most of the urban population in Jordan. Currently, the population in Jordan is approximately 6 million. It is expected to be doubled every 18 years. In the absence of regional planning to ease pressure of urban expansion in this region, municipal and village is expected to consume extensive area rich in flora, destroy environmental equilibrium. This will aggravate the deterioration of plant cover, and accelerate extinction or migration of large number of the remaining wild life.

Irrational changes in land use:

This region is the primary area for the production of rainfed crops and FT in Jordan. Economical constraints will play a major role in changing crop composition in the near future. Such economical changes already had its full impact on LF, and will be further accelerated as a result of rapid LF.

C 2 - The steppe region (Mediterranean semi-arid system):

- Soil salinization: Soil salinization in this region is caused by**:**

- Over-pumped groundwater resulting in increasing salinity in irrigation water.
- Poor irrigation management.
- High evaporation rate and lack of proper irrigation scheduling coupled with addition of leaching requirements.
- Increasing total salinity of groundwater caused by over-pumping of ground water.
- Lack of proper irrigation management.
- Irrational intensive use of fertilizers.

- Degradation of vegetation cover: Degradation of vegetation cover is caused by:

- Land management: plowing of land without any measure to reduce erosion. Field observations indicated that one single plowing could destroy plant cover very easily due to poor soil recovery which accelerates erosion by water and wind.

- Overgrazing:

- Range resources have become extremely degraded during the last three decades, due to the sharp increase in the number of livestock.
- Removal of vegetation covers though cutting of shrubs, cultivation, overgrazing, continuous deep plowing, accelerated erosion, etc.
- Poor grazing management: No guidelines for managing plant cover are available. Grazing is carried out without any restriction, no consideration to land carrying capacity.

- Inappropriate land use:

- Expanding cultivation of barley without consideration to land suitability.
- Lack of proper packages for improving vegetation cover or rehabilitation of areas with degraded vegetation cover.

- Urbanization:

- Establishment of new urban centers without any environmental precautions.
- Increasing urbanization, increasing traffic movement resulting in soil compaction and reducing plant germination.

- Land registration: Increasing registration of land ownership to private citizens, which increase land entering the market, and negligence of any conservation programs.

- **Land fragmentation:** The law allows division of land to 10 donums. This hinders land developments and facilitated the development of land market in this area. Therefore, large fragmented areas are almost deserted without any use.
- **Climate:** Natural thinning out, or removal of vegetation cover results from repeated drought reoccurrence, and rainfall variation.
- **Wind erosion:** Wind erosion is very active in this region. The wind erosion had been active in transporting calcareous silt and its re-depositing air borne material in the Steppe region. This process seems to be active during the last 5,000 - 10,000 years.
  Steppe regions have rather level topography and poor vegetation cover or poor surface structure stability.
- **Water erosion:** Erosion by water (geological and accelerated) is very active in the Steppe region caused by:
  - Destruction of vegetation cover, intensive overgrazing, poor grazing management, increasing random traffic movements on the land which destroy soil structure and vegetation cover, and expose soil already sensitive to erosion force.
  - Poor land use such as cultivation of land suitable for natural range with barley production.
  - Intensive urbanization and increasing LF.
  - Inappropriate plowing and cultivation with unsuitable crops, and plowing of land during poor rainy seasons.
  - Soils with poor structural stability and low resistance to wind and water erosion (silty soils, high carbonate and low organic content, and low infiltration rate).
  - Intensive and short rainfall storm, which is effective in causing erosion due to low infiltration rate and poor vegetation cover.
  - Poor soils that support suitable plant cover dense enough to protect soil.

C3 - Dry land region (Mediterranean arid system): The badiah region:

This region is divided into three sub-regions:

- Southern Dry Region: This region extends from Ghor Fifa to Aqaba south, and extents to Mudawarah to the East.
- Middle Dry Region: This region extends from Ma'an to Azraq to the North.
- North Dry Region: This region extends from Azraq to the Iraqi and Syrian borders.

Degradation processes common to the three sub-regions:

- Wind Erosion

Human - Induced Factors:

- Over grazing.
- Increasing traffic movement.
- Cutting of desert shrubs.
- Plowing for claiming land ownership.
- Stone clearing for claiming land ownership.
- Mining for mineral.
- Dominance of level topography.
- Poor vegetation cover.
- Poor surface structure stability soil properties.

- Water erosion: Erosion is very active in this region**.**

- Over grazing.
- Increasing traffic movement.
- Cutting of desert shrubs.
- Plowing for claiming land ownership.
- Stone clearing for claiming land ownership.
- Mining for mineral.
- Poor vegetation cover.
- Poor soil properties.
- Intensity of rain storms.
- Increasing drought.

- Degradation of vegetation: Caused by:

- Removal of vegetation cover could result from cutting of shrubs, forest tree for consumption, clearing forest for cultivation, overgrazing, continuous deep plowing, accelerated erosion, etc.
- Natural Thinning out of vegetation cover my results from repeated dry seasons reoccurrence, climatic changes or geologic erosion

- Specific causes of degradation within Sub-regions (Taimeh, 2010)**:**

i. Southern region:

1. Dominance of dry climate, high level of rainfall variation, high temperature, and evaporation rate.
2. Poor soil properties, dominance of coarse textured soils (Wadi Araba), or very heavy soil, which has poor drainage properties (mud flat of El-Disi Area), large saline and gypsiferous soils (Mudawarah) (Taimeh, 1991, 1992b).
3. Topography configuration in Ghor El-Safi - Wadi Araba region, which enhance high rate of erosion by water within eastern steep, bare exposed rocky surfaces, and erosion by wind within the floor due to the dominance of sandy instable surface formed by weathering under dry conditions.

ii. Middle region:

1. Dominance of dry climate, high rainfall variation, high temperature and evaporation rates.
2. Dominance of soils with poor indigenous properties such as shallow, calcareous, saline, and gypsiferous soils (Azraq, Omari, Jafer)(Taimeh,1992b).
3. High rate of wind and water erosion accentuated by flat topography and poor vegetation cover.
4. Intensive, highly random traffic movement on the land, which destroy soil structure, and vegetation.
5. Mismanagement of the rangelands, overgrazing and random purposeless random plowing.
6. Dominance of flat topography, which increases activity of wind erosion.
7. Removing stones, which protect the surface of the land as a mean for claiming ownership of the land.
8. Unattended cross border grazing which affected the rangeland for long time, before recent border crossing regulation, which substantially reduced cross border grazing.

iii. North region:

1. Degradation of vegetation cover: In recent years, the rapid expansion of irrigated land in Jordan, introduced tremendous pressure on available WR. Therefore, degradation of soil chemical properties within areas irrigated from ground water in areas outside JV.
2. Overgrazing, unattended plowing, and clearing of stones covering the land, which protect the surface.
3. Rainfall pattern: Low and highly variable rainfall, high temperature, and evaporation rate.
4. Indigenous soil properties: Poor indigenous soil properties such as high salt, silt, and calcium carbonate contents, and dominance of large areas covered with basalt stones pavement.
5. Open topography: This region suffers from wind erosion accelerated by open topography, which resulted from endurance of dry climate.
6. Presence of well developed soils: The soils of many areas were found to be well developed which is not consistent with current climate.
7. Distribution of soil types: Presence of sandy soils, gypsic soil, soils with poor properties is attributed to the impact of climate currently affecting this region.

9 Successful sustainable land management practices

9.1 Introduction

Management practices discussed in this section represent successful story in resources management. They were outputs with positive impacts on LR. They represent either the outputs from long-term projects, which included different innervations or measures, or approach, which have been implemented with promising potential future impacts. Some of these activities had direct impacts on LR such as improving agricultural production, or protection of LR, or resources important for production such as water, or those with indirect impacts, which contribute to improvement of livelihood, which subsequently contribute to conservation of resources.

The AS passed through different phases were significant changes took place. Many of these changes had severe negative impacts on the future sustainability of this sector. Many of the implemented projects were not very successful due to implementation of improper approaches , lack of technical expertise, or termination of the project due to lack of fund. Among the rules that should be accepted when dealing with AD is that AD is a long-term development endeavors. Such endeavors require clear vision, political will, and suitable of funding. Above all, it should include measures and strict

enforcement proper legislations. The following section discusses measures, programs and some new approachs, with potential positive impacts on AL resources in Jordan.

9.2 Measures

9.2.1 Strategies and action plans

The government since the late nineties of the last century took several steps in organizing the AS. Among these measures was the ratification of the international conventions on Conservation of Biodiversity, Combat of Desertification, and Protection of the Environment, Climatic Changes, and preparation of Jordan Agenda 21.

As are result of ratifying these conventions, relevant action plans were prepared to implement different conventions. Such action plans required collection of multidisciplinary data, which were examined, classified. The outputs of such exercises were the availability of huge multipurpose data and clear road map for the development of natural resources, among which land and water, and environment were the top beneficiary. A bank of projects and related measures were prepared. Just to mention one example, the NASD, in addition to the various measures proposed about, 130 projects, which cover every aspect of resource developments, were proposed.

Other strategies also proposed different measures and projects to achieve their developmental goals. The Strategy for Combating Desertification, for example, proposed six programs which contribute to reducing the threats of degradation of LR.

It is unfortunately true that not many of these suggested measures, or proposed projects were implemented, for several reasons. However, they should be considered as a wealth of integrated information available for use, when conditions permit.

Among a long list of positive benefits obtained from the preparation of these strategies is creation of official department, or restructuring of ministries with better focused mandates, emerging role of NGOs, and civil organizations, preparation of new legislations, and increasing awareness among different communities. The indirect list of benefits is really long.

9.2.2 Legislations

Legislation is a clear expression of sustained national commitments. This, however, was not the case in JV, where LR were managed by special legislation (Law No.18, 1988). Articles of this law relevant to land distribution and land ownership prohibited fragmentation of farm units between partners for any reasons. Moreover, the distribution of land followed clear rules and sales of any farm units was also restricted to JVA. The price of the farm unit was also fixed, which prohibited the formation of land market. Establishment of new villages or the expansion of old ones was controlled, and only a small area of marginal land were consumed for urban activities. Therefore, one can claim that the implementation of this law was responsible and had effectively contributed to the preservation of AL resources in JV. The new law (Law No.30, 2001) which followed the 1988 law even went a step further by allowing consolidation of farm units through sales of farm unit between Jordanian without interference from JVA. The new law allowed the sale of farm unit form current farm unit sizes, which vary from 30 - 50 d, depending on the land class dominating the farm unit, to a new farm unit with maximum size of 250 d per owner, and restrict the sale only to Jordanians. Although the intention behind such act was to encourage investment in agricultural production, and to improve production efficiency, it is not expected that land will be a market commodity like the land the UL region, because still, the farm units can not be divided into units smaller than size of original farm size.

9.2.3 Integrated activities: Poverty alleviation

The government adopted a national strategy for poverty alleviation. The strategy aims to pool national effort in the area of poverty alleviation among most vulnerable population. Several agencies are involved in the implementation of the action plan. The strategy calls for implementing activities through financing small projects including increasing production of food using small holdings and using innovative measures.

9.2.4 Resource management programs

- The Highland Development Project: 1960-2004(MoA, 1960-2004):

This a long-term project implemented by MoA in collaboration with the World Food Organization (WFP) during the period of from 1964-2004. The main goal of this project was to control erosion by

water and farm development. The project is responsible for protecting land from degradation and had sustained production and provision of food for large areas in Jordan. This project is a good example that demonstrates the effectiveness of long-term projects in achieving solid resource development. The project was implemented all over the country, wherever the criteria were met. It was estimated that about 250,000 donums had benefited from the service of this project (Figure 9.1).

Figure 9.1: Soil conservation carried by WFP project for to control erosion by water

Source: Awni Taimeh, Land Use in Jordan, 2011

- Agricultural Resources Management Project: A National Program for Rangeland (MoA):
The first phase was implemented by the government of Jordan, with loans and technical advice from IFAD. The project is a long-term project which started since 1996 and will be closed in 2013, unless a new agreement is reached to extend it.

The project phase was implemented at five sites extending from the dry region (Badiah) to the Semi arid rainfed region.

The second phase was: (**Yarmouk Agriculture Resource Management Project)** was implemented at five districts in Irbid, Ajlun, Jarash and Mafraq governerates. The project focused on the most vulnerable households selected from 90 priority villages. The project was implemented during the period from 2000 - 2004 (Figure 9.2):

Figure 9.2: Long-term range development in Steppe Region

Source: Awni Taimeh, Land Use in Jordan, 2011

The third phase was implemented under the name of: Agricultural Resources Management of Karak-Tafila. This phase covers areas in the southern Highlands, East of the Jordan Rift Valley within governorates of Karak and Tafila, and the districts of Shoubak, Wadi Musa and Ail of the Ma'an governorate. The project duration is from 2005 to 2013.
These phases were marked by well identified objectives and the introduction of innovative approach for integrated resources development. The program was designed with the vision that integrated resource management is the proper approach for rural development.

The program design was based on the need to take action to preserve and rehabilitate the rangeland. The program employed an integrated aspect of rangelands development by addressing the various components including environmental aspects; fauna and flora; soil and water conservation; the pastoral industry activities and the economics of production; the communities living on and from the rangeland; and property rights and legislation.
The program's overall goal was to reduce environmental degradation of LR by introducing sustainable management practices. The specific objectives were to:
(1): Provide information on the current status of range LR.
(2): Develop a national pastoral resources assessment monitoring system for the rangelands.
The program introduced key innovative technologies including:
(a): Community participation in planning, priority setting and decision making of watershed management through the preparation of Community Action Plans, (b): Promotion of an integrated agro-ecosystem approach for sustainable land management practices (c): Rejuvenation of old olive plantations for the first time to improve their productivity and longevity, (d): Supplementary irrigation of rainfed olive trees to improve productivity and quality of soil, (e): Grey water reuse in agriculture.

- The Agriculture Credit Corporation (ACC):
The ACC is an agency which provides credit for rural farmers. Most of the credit ranges from 3,000 - 5,000 JD. The total annual budget fro credit varies from one year to another. One of the main clients targeted by the ACC is rural women (ACC - Annual reports). The ACC provided 449 million JD as small loans since 1960. Number of farmers who benefitted from the ACC activities is 205,000 farmers. Activities included land reclamation, animal husbandry development of farm and farm equipments (MoA, 2009).

- NGOs activities:
Non-governmental Organization had been active in various activities related to food production in rural areas and empowerment of rural house holds. Among the NGO with activities at the national scale: The Jordanian Hashemite Fund for Human Development: JOHUD has the human resource capacities to work in most fields of development to promote social, economic, cultural, environmental, and technological empowerment. JOHUD draws also on the resource of a volunteer network of some 4,000 women, youth and men, and coordinates their operations through association with some 500 local communities, local committees and other key stakeholders.
Working in rural communities JOHUD has more than thirty years' experience working in rural communities in Jordan. When its network of community development centers was expanded in the mid 1980s, JOHUD actively sought to locate them in the more remote locations, so that people living there would also have access to services such as education, health, welfare and agricultural extension. As a result, some 35 of JOHUD's 50 CDCs can be classified as rural or semi-rural.

9.3 Approaches

9.3.1 Water use efficiency: Water tariff

Jordan suffers from extreme water shortage. The shortage covers the agricultural, domestic and industrial sectors. According to national water strategy, priority for water allocation is given to domestic consumption followed by agriculture. The government undertook major steps to increase the efficiency of resources use. In this regards, water distribution in JV was completely pressurized up to the farm gates. Achieving high water use efficiencies in JV is a top priority goal to sustain the AP in JV in response to the continuous reduction in the amount of WR allocated for irrigation. The farmers' response to any government regulation is crucial in any attempt to increase such efficiency. One of the many tools available for the government was to implement water tariff.

Tariff on irrigation water was implemented since 1961. The tariff was 0.001JD /cubic meter. Since then, it was changed three times. Last amendment was implemented in 1994 (JVA, Reports).

The water tariff category was established in a way which encourages farmers to save on water by introducing more modern irrigation practices, better scheduling irrigation or to change cropping patterns. The cost paid by the farmers is considered a small portion of the total cost of the water. The revenue will help the MWI to maintain services to such vital sector. Water tariff introduced to IA in JV, aims to encourage farmers to use water wisely and to be aware of the water running cost, which is subsidized by the government. Economic impact of implementing such tariff is not yet carried out (MWI, 1994).

Table 9.1: Water tariff scheme applied in JV

Water Category	Tariff (JD/m^3)	Water Quantity ($M^{3/}$day)
W1	0.008	0 - 71.4
W2	0.015	71.4 - 100
W3	0.020	100 - 128
W4	0.035	> 128

JD=1.41US$

9.3.2 Water harvesting

Watershed runoff for irrigation:
Jordan suffers from increasing water shortage. Fresh WR are increasingly withdrawn from AS to meet the rapidly increasing domestic demands. Jordan receives, on the average about 8billion cubic meters every year. Therefore, early efforts were directed to benefit from such resource. Many dams were built along the eastern ridge of the JV. The total capacity of these dams is about 230 MCM. Stored water is the primary source for providing good quality water for irrigation. Water allocated for irrigation in 2007 was 193 MCM in JV. The largest Dam is King Talal Reservoir with a capacity of 78mcm, which also receive about 60 MCM of TWW discharged from El-Samra treatment plant.
Considering the water budget and increasing water deficit, and total withdrawal of fresh water from the valley, water stored behind these dams is the only source for irrigation. Without such efforts, JV would be deprived form irrigation water, except for the availability of TWW.

Integration of water harvesting with resource development:
- **Watershed runoff**: Realizing the increasing water deficit, and the increasing water needs, the government of Jordan, represented by MoA, started to appreciate the significance of water falling on the Badiah region, where about 85% of the runoff is lost by evaporation. Efforts started during last two decades by the government to capture as much of runoff water. Recently, the government initiated a national program in collaboration between MoA and the Jordanian arm forces to construct about 40 small earth dams as a first phase. Water will be used for animal and improving plant cover by spreading water. This technique, however, has been used by locals for longtime, to provide animal with drinking water. During the past period, MoA had already constructed several dams to provide drinking water for animals. Such practice is even adopted by private wealthy local community leaders who constructed his own dam with a capacity of about 10 MCM (Figures 9.3 and 9.4).

Figure 9.3: Small earth dams is used in integrated development in dry region of Jordan

Source: Awni Taimeh, Land Use in Jordan, 2011

Figure 9.4: Small earth dam, an indigenous practice for water harvesting in dry region

Source: Awni Taimeh, Land Use in Jordan, 2011

- On-farm water harvesting: The future prospect of WR in Jordan within next two decades, lead to the realization that development of additional land within dry region, is not possible to achieve through using traditional water. Therefore, efforts to invest in activities related to on-farm water harvesting represents the only window of opportunity for improving production using suitable land for such purposes. Two successful programs were carried out based on integrating water harvesting with agricultural farming practices.

- Private sector investment in water harvesting: A case study

An example of successful resource development and agriculture production entirely based on water harvesting is carried out in dry region within area which receives about 150 mm of annual rainfall. The area of the farm is about 5,000 d planted with olive trees. The farm is located at the mouth of low depression were natural water flow is collected during the first shower in the winter. After the first shower, the farmers pump about 3 MCM to a side dam for storage. A channel is constructed from the depression to carry the water backward to the farm by gravity. The water is used to irrigate the olive trees. The remarkable thing to notice is that only very short shower would be enough to produce runoff to obtain water with quantity enough for the entire season. The significance of this case, it demonstrates the applicability of such approach since it is tested by farmers and since such approach can be transferred and duplicated at many suitable locations in Jordan with similar conditions.

9.3.3 Integrated development

Increasing the productivity of arid-semi-arid and and suffering from desertification program:
This program was implementing by the Faculty of Agriculture (Taimeh, 1988a, 1998c, Hatten, Taimeh, 2001) in collaboration with EU and MoA. The program was implemented in three phases from 1985-2003. The program included improvement of land suffering from desertification in Jordan. The Steppe region was selected as the impact zone of the program. The first phase was a research program with multiple objectives ranging from improving plant cover, reducing erosion, improving soil fertility lost by degradation, to improving soil properties, especially infiltration rate, a property responsible for high runoff rate in this area

The second phase was marked by implementing some of the developed packages at farmers' field. The third phase was entirely a technology transfer program to farmer's field, where recommended packages were adopted by farmers. One of the most important results of this program was providing 36 trained graduate students with masters' degrees and three PhDs graduates. As a result of implementing such long-term program, it is nationally accepted that any attempt to develop LR in dry region must be integrated with water harvesting. (Figure 9.5):

Figure 9.5: On-farm water harvesting in steppe region

Source: Awni Taimeh, Land Use in Jordan, 2011

Rehabilitation of range resources in Jordan:
This is along-term program implemented by MoA to improve the productivity of the range and LR in Jordan. This program was implemented over 15 years in various parts of Jordan. Although the project consisted of various types of resources development methods and improving livelihood by different income generating activities, water harvesting is among the main pillar envisaged to be integrated with many of the proposed activities. One of the successful outputs of adopting such technique is the increasing efforts to rehabilitate old water cisterns, which have been used by local people for generations at every part in Jordan.

The previous two examples of LR development based on water harvesting has great value in Jordan since it had been implemented at large scale, and is among the most promising opportunity for Jordan to deal with the expected climatic change which predicts less rainfall and more violent rainfall pattern (figures 9.6, 9.7).

Figure 9.6: Re-vegetation of water ways in steppe and dry region

Source: Awni Taimeh, Land Use in Jordan, 2011

Figure 9.7: Protection of vegetation in steppe region

Source: Awni Taimeh, Land Use in Jordan, 2011

9.3.4 Modern agriculture production: A case study

Recently the PS started investing in the production of FT in the dry region East of Mafraq using ground water for irrigation. The established orchards use modern agricultural management, good irrigation scheduling, and comprehensive fertigation programs. The farms are planted with famous and suitable varieties of FT. Most of the production is oriented for exported to various markets. This kind of farming practices, marked by increasing water use efficiency, not only saves water, but also reduces cost of pumping, which is lately increasing due to increasing fuel prices. Such farming approach would be the right answer to reduce the impact of the projected water shortage this area is expected to suffer within the next two decades, if the MWI fully implemented the strategy for ground water, which will be reallocated for domestic use (Figure 9.8):

Figure 9.8: Integrating water harvesting with improvement of rangeland plant cover in steppe region

Source: Awni Taimeh, Land Use in Jordan, 2011

10 Recommendations

Cross cutting recommendations:

1. Appropriate legislations must be adopted to stop the unjustified expansion of urban boundaries on the expense of agricultural land.
2. Legislations to protect of land resources form land degradation are still inadequate or poorly enforced and do not prevent misuse of these resources which cause further degradation and losses of productivity.
3. A new legislation must be prepared to enable the government to implement rangelands developmental activities that allow of communal benefits rather than individual benefits, and reduces deterioration of the rangelands.
4. Strict regulations about management of water resources and its uses must be implemented to ensure the delivery of quantity and quality of water allocated for irrigation during next two decades, to protect the investments in irrigated agriculture, and to help private sector to prepare their production plans according to stable policies.
5. The government should ensure stability of legislations, economic, and environment -oriented service, which ensures provision of a stable and suitable climate conducive to private sector investment in agriculture.
6. The government must develop and implement measures, legislations and instructions for adopting suitable land use planning, protection of resources, preventing continuous encroachment of cities and villages on expense of agricultural land, and fragmentation, misuse of range resources, protection of forest, and strict adherence of industry to protection of the environment from activities with negative impacts on agricultural resources.
7. Measures adopted by Ministry of Water and Irrigation, to restrict groundwater over-pumping, should be implemented to avoid further drop of water table and increase pumping cost.
8. New innovative farm management practices must be introduced in the Northern part of Jordan Valley originally irrigated with Yarmouk River water since this area is recently irrigated with water from King Talal Reservoir.
9. Agricultural production system in Jordan Valley should be reviewed in the light of irrigating with water mixed with treated wasterwater over the whole valley.
10. A national program should be initiated to assess means of optimizing runoff yield from Zarqa River catchment discharging to King Talal Reservoir to sustain the productivity and quality of produces in JV, due to the dependence of irrigation only on runoff blended with treated wastewater.
11. Increasing amount of treated wastewater will be available with time in the Upland region. A new strategy should be prepared to identify ways and measure for safe use of this water without causing increasing environmental risk. This situation will be exacerbated by the projected climatic change indicating an increase in temperature and rainfall reduction and variation.
12. National attention must focus on preparation of a master plan to avoid the reduction of irrigated land resources , or to improve their productivity in response to reducing water allocated for irrigation and increasing use of treated wastewater, which will present a new challenge to producers to produce good quality produce and protect environment from degradation.
13. An integrated plan should be prepared and implemented to protect irrigated areas in the Upland region form diminishing availability of fresh water resources and increasing availability of treated wastewater.
14. Provide appropriate mean to encourage farmers to be more involved with tools of open markets, help opening new markets, and provide incentives for farmers who adopt modern technologies which increase product competitiveness.
15. Provide proper training to help farmers to organize themselves and to improve their production skills for export, packing, reducing post- harvest losses, and to cooperate between themselves to use cooling storage facility and packing houses, which increases shelf life of their products.
16. The government must create a suitable platform to invigorate participation of farmers of different sub-sectors, in planning, implementation of activities relevant to their sector, and in particular, empowering the involvement of women households in agricultural activities in rural areas.
17. Development within rainfed and dry land areas should be based on employing integrated watershed management, which utilizes all resources available within the landscape, regulates water distribution through soil conservation measures and soil moisture conservation and maximizes integration between plant and livestock production sectors.
18. Commission national research institutions to develop new innovative, diversified, and integrated agricultural production systems to reintroduce highly fragmented land, within the rainfed areas into production

19. New national drought mitigation strategy and action plans should be prepared to help farmers to coup with drought and other natural disasters' incidents. Otherwise the government will have to face waves of farmers and livestock owners' immigration from rural to urban areas in search for jobs, which will further aggravate the problems of unemployment and poverty.
20. The government should adopt a national policy to organize agricultural production in a way that creates a balance between local and export demands.
21. Linkages and coordination between national institutions with direct and indirect impacts on the development of the agriculture sector should be reviewed and institutionalized. This review should aim at amending articles hindering the establishment of institutional relationship.
22. Improve the structure of Ministry of Agriculture, agricultural research institutions, and those of private sector. Improvement should focus on changing their investment policies, increasing their scientific, technical or administrative capabilities to help them to be able to meet the new challenges emerging at the national, regional, and international levels.
23. Special national committees should review programs and activities executed by various organizations relevant to agriculture sector including environmental protection, protection of land resources including soil, water and agro-biodiversity, and related policies to formulate integrated packages of policies which guide this sector towards the future.
24. Government must sustain the implementation of prepared strategies and action plans which could put the agriculture sector on stable and sustainable path. Development and protection of land resources required to sustain agriculture sector must top national priority, shoulder to shoulder with other national sectors.
25. A national strategy that deals with improving food security and poverty alleviation in rural areas oriented towards agricultural development should be considered as a priority issue.
26. Government must exert special efforts in developing the capability of private sector in various areas such as irrigation water management, agricultural extension, international marketing, and create conducive environment for private sector to invest in production and more important processing of products in rural areas to help fight poverty in those areas.
27. The government should beef up efforts to enhance the role of NGOs in agricultural development, by building on success stories, and encouraging them to participate in agricultural development in rural areas.

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Annexes

Annex 1 Terms of Reference

Country Study on Status of Land tenure, Land Management and Land use planning in SNO Countries

I - Background: The Sub-regional Office for the Oriental Near East (SNO) covers 6 countries: the Arab Republic of Egypt; the Islamic Republic of Iran; Jordan; Lebanon; the Syrian Arab Republic and Iraq. The Land Tenure and Land Management Position is being newly- established in this Office in view of the need for these countries to address land management and tenure issues stemming from the general limitations of agricultural lands in most of these countries and the problems resulting from the ways these lands are being managed.

The present study aims at providing a highlight of the current situation regarding land tenure, management and proposing potential solutions.

II - Objective: To take stock of land tenure, land management and land use planning situation and status in concerned SNO countries with a view to collecting information and data and subsequently identifying priorities for technical and policy support both with a sub-regional dimension and targeted to the different countries situations, priorities and needs.

III - Duties: Under the overall supervision of FAO Sub-Regional Coordinator for the Oriental Near East (SNO) and the technical supervision of relevant units/officers in NRC, NRL and RNE, the National Consultant (he/she) will prepare a country paper that will be divided into two parts because of the need for different expertise to lead the two components. The first part focuses on the state of land tenure in SNO countries, with emphasis on salient issues and the ways to address them. The second part aims at providing an overview on land management and land use planning in each of the SNO countries with a view to identifying key issues, constraints and opportunities, status and priorities and needs aiming at strengthening land management and land use planning as well as identifying opportunities for regional cooperation.

In particular the National Consultant (he/she) will perform the duties described under Terms of Reference (part 1 and 2) below.

IV - Terms of Reference

(Part 1):

1. Provide an overview on land tenure issues, land tenure policies and regulations in the country, including land governance issues (effectiveness of institutions, extent and difficulties of the implementation of relevant land tenure laws etc.). It includes inter alia the following:
    a. Overview of the regulations pertaining to Land Tenure, the extent of their enforcement and the related issues, including land governance.
    b. Proposed recommendations regarding the mechanisms to tackle issues identified under the above item.

The structure of this part should be as follows:

- Introduction
- Review of previous studies
- The land tenure question in the country
- Laws and regulations: Islamic, Customary, Civil….
- Land use systems
- Land markets: challenges and opportunities
- Issues to address
- Conclusions, policy recommendations and planning implications

(Part 2):

2. Based on available information, provide an inventory of the main land resources and ecosystems of the country, including their current uses and land use systems (Arable land (Cultivated, Irrigated), Forests, Rangelands, Wetlands, Lakes and Rivers, Protected areas, etc.), their extent and any significant changes in extent over the last 10 years. This should include an overview of the status of the resources in regard to management (Is the land under each of the main uses i) degraded - what are the main degradation types, ii) well conserved/managed or ii) undergoing restoration/rehabilitation- through specific interventions). See Annex 1.
3. Provide an overview of previous and actual work and processes on agricultural zoning land use /territorial planning at the different levels (national, district/provincial and community) and the extent of their implementation mentioning constraints and opportunities in this regard.
4. Provide an overview of the prevailing government policies and legislation, strategies, action plans regarding land management and land use planning/territorial planning. Focus should be placed on the current situation as an input for identifying areas of action.
5. Provide a general inventory of the existing sustainable land management practices (traditional/local practices and recent interventions) and identify successful land use and management practices. Special attention should be given to the approach and institutional background (Is it supported by an official policy/legislation/strategy, national plan/programme, localized project, NGO efforts and/or local/community based efforts and with what level of inputs and knowledge). See Annex 1.
6. Develop proposed recommendations regarding the ways and means to address the key land management, land use/territorial planning and land policy issues, constraints and opportunities that have been identified under items 2-5, with a view to enhancing the sustainable and integrated management and planning of land resources (soil, water, vegetation) and ecosystems in the country.

V - Schedule and Timeframe

The country study is to be completed within a period of three months following signature of the contract. The first draft of the report will be submitted two months following signature of the contract, followed by the final version within one further month, taking into consideration the comments and feedbacks made by FAO on the draft.

The National Consultant shall undertake all required tasks according to the following schedule:

	Month 1				**Month 2**				**Month 3**			
Designation Week:	1	2	3	4	5	6	7	8	9	10	11	12
Part 1: Land tenure	■	■	■									
Part 2: Land management and use				■	■	■	■	■				
First draft of the report									■			
Comments and feedbacks from FAO										■	■	
Final report												■

VI - Reporting

The report will consist of an executive summary (1000 words), a full text (maximum of 50 pages for each part) in addition to annexes (figures, photos, maps, data series, references, etc.) that will be based on factual data and information as they relate to the country. It will avoid rhetoric and be concise with arguments and justifications.

The report will be produced in English, typed in Word, and submitted as a hard copy and in a CD. The ownership rights of the report produced by the Consultant are governed by FAO rules and regulations on the subject.

VII - Duty Station: Desk Work at home

VIII – Terms of payment

The payment of honorarium will be done upon submission of the final report and its approval by FAO.

IX - Qualifications

The National Consultant shall be a qualified Land management/land use planning/land tenure expert, with a Geography, Soil Science or Agronomy background or equivalent field with at least M.Sc. degree and sound knowledge of land tenure, land management and land use planning processes in the country. Minimum of ten years of practical experience in the area of land tenure, land management, land use planning and land policy. Demonstrated skills in developing concise factual reports in the area required. Level C of English.

Appendix - ToR: Degradation Types and SLM Technologies/Practices (LADA-WOCAT extract)

Main Land Degradation Types (state indicators) could include

- **Soil erosion by water:**
  - Loss of topsoil / surface erosion;
  - Gully erosion;
  - Mass movements / landslides;
  - Riverbank and coastal erosion;
  - Offsite degradation effects **(**deposition of sediments, downstream flooding, siltation of reservoirs /waterways, pollution of water bodies with eroded sediments).
- **Soil erosion by wind:**
  - Loss of topsoil;
  - Deflation and deposition;
  - Offsite degradation effects
- **Chemical soil deterioration:**
  - Fertility decline and reduced organic matter content;
  - Acidification;
  - Soil pollution ;
  - Salinisation / alkalinisation
- **Physical soil deterioration:**
  - Compaction;
  - Sealing and crusting;
  - Waterlogging;
  - Subsidence of organic soils, settling of soil;
  - Loss of bio-productive function due to land use changes (e.g. construction, mining and effects on ecological and productive function of the soil).
- **Water degradation:**
  - Aridification;
  - Change in quantity of surface water:
  - Change in groundwater / aquifer level;
  - Decline of surface water quality;
  - Decline of groundwater quality;
  - Reduction of the buffering capacity of wetland areas
- **Biological degradation**
  - Reduction of vegetation cover;
  - Loss of habitats;
  - Quantity / biomass decline;
  - Detrimental effects of fires;
  - Quality and species composition / diversity decline;
  - Loss of soil life;
  - Increase of pests / diseases

You may be able to indicate what are the main direct and indirect causes of degradation

Direct causes of land degradation (direct pressure indicators4)

- Improper management of soil, crop and pasture/rangelands
- Deforestation and removal of natural vegetation
- Over-exploitation of vegetation for domestic use (degeneration)
- Overgrazing
- Industrial activities and mining
- Urbanisation and infrastructure development
- Discharges leading to point contamination of surface / ground water resources or excess runoff
- Contamination by airborne pollutants from industrial activities, mining and urbanisation
- Disturbance of the water cycle
- Over-abstraction / excessive withdrawal of water
- Natural causes e.g due to climate, steep or fragile terrain, avalanches, volcanic eruptions, mud flows etc.

Indirect causes of land degradation (indirect pressure indicators)

- Population pressure
- Consumption pattern and individual demand
- Land Tenure
- Poverty
- Labour shortage
- Inputs and infrastructure
- Education, awareness raising, access to knowledge / support services, loss of knowledge
- War and conflict
- Governance, institutions and politics
- Other

Main conservation/SLM groups could include inter alia

- Manuring / composting / nutrient management
- Conservation agriculture (minimum soil disturbance, improved soil cover, and crop rotation).
- Rotational system / shifting cultivation / fallow /slash and burn
- Contour farming : Vegetative strips; stone bunds; terraces -level, forward/ backward sloping
- Agroforestry
- Afforestation and forest protection
- Gully control / rehabilitation
- Grazing land management
- Water harvesting
- Groundwater / salinity regulation / water use efficiency
- Water quality improvement
- Sand dune stabilization
- Coastal bank protection
- Protection against natural hazards: flood, storm, earthquake, avalanche, landslide, mudflow
- Storm water control, road runoff
- Waste management
- Conservation of biodiversity
- Other

Institutional Approaches could include for example

- Extension, advisory services and Training
- Promoting local Innovation
- Participatory Learning and action
- Particpatory land use planning
- Farmer field schools and farmers groups
- Integrated watershed management
- Territorial development/Gestion de terroirs
- Community based natural resources management
- Community development/microfunds
- Participatory monitoring and evaluation
- Payments for environmental services
- Upscaling efforts

Annex 2: Short biography of the consultant

Awni Y. Taimeh, holds PhD degree in Agronomy/Soil from USA, Professor of soil since 1992, University of Jordan, Land, Water and Environment Department at the Faculty of Agriculture, University of Jordan, Served as Chairman of department, 1991-1992, Director General, National Center for Agricultural Research in Jordan, 1995-1998, Undersecretary, and Ministry of Agriculture, 2002-2004. Participated in the preparation of several national strategies for: Agricultural, Water, Environment, Poverty Alleviation, Health in Jordan, and the strategy for development of rainfed coastal areas in Egypt. Author of several books: on Desertification in Jordan, Land use in Jordan, Soils of Jordan and Vertisols of Jordan, Co-author of Arab flagship report on climate adaptation. Participate with international scientists in the preparation of white paper on land degradation presented in Copenhagen Climatic Changes, COP15.

Published more than 60 papers in international journals and conference proceedings in areas related to: Land degradation, integrated development of Arid and Semi-Arid land, soil classification, land use planning, land resources development, desertification, soil degradation, climate changes, soil conservation. Instructor for several courses in soil geneses and classification, advanced soil taxonomy, resource planning and development, and environment reservation. Supervised several theses for PhD and master students.

Received FAO medial of research achievement in 2003, member of the Higher Board of the Jordan National Alliance against Hunger, served on several national and international committees in different areas.