Agricultural Drought: Changing Perception of Planning and Management

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I. INTRODUCTION

The agricultural sector derives its importance on account of providing the main or secondary source of income for a large segment of the population. Palestinian agriculture is unique as it depends to a great extent on family labor, mainly for rainfed farming and sheep breeding. The agricultural sector plays a key role in the national economy through its contribution to GDP (8%) and to employment (16%), (MoA 2008). In addition to social and monetary terms, agriculture is a major contributor to food security, exports, environmental protection, private sector involvement in this sector, agro-industry, and protection of land against confiscation and settlement through encouraging interventions related to land reclamation, water harvesting and tree planting. Agriculture is also considered as a safe and last resort for Palestinian rural communities during crises.

Scarcity of water resources and limited accessibility to land are the main constraints for the sustainable management and development processes in Palestine. Currently, available resources do not allow the satisfaction of existing water demand and competition among economic sectors; this has been enforced by the planners to modify their perspective in managing the resources. For water resources, postponing the resolution of water issues to the final negotiation stage and the freezing of peace process are making water one of the most important limiting factors in the development of economic sectors and in the establishment the viable future state in Palestine.

II. IMPORTANCE OF AGRICULTURE TO THE ECONOMY & LIVELIHOOD

Agriculture is a way of life for the Palestinians, part of the Palestinian heritage, and a symbol of challenge and steadfastness. Despite its moderate contribution to GNP, it is still three times more contributory than in Jordan and Israel (Horizon 2008).

The total area of West Bank (WB) and Gaza Strip (GS) is around 6.020 km^2; 94% of it is in WB and the 6% is in GS. The total cultivated area is around 1.825 million dunum (du*), distributed as shown in Table (1).

Table 1: Agricultural areas in West Bank and Gaza (2005/2006) (1000 dunum)

	Fruit trees		Vegetables		Field crops		Total
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	
West Bank	22	1,058	100	36	15	416	1,647
Gaza Strip	47	10	53	4	23	41	178
Total	69	1,068	153	40	38	457	1,825

Source: PCBS 2008 * 1 dunum.=0.1 ha=1000m2

Over the period 1996-2006, there were no major changes in areas planted; fruit trees increased by 1.7% and vegetables by 1%, while the area of field crops decreased by 1% (Horizon 2008). However, other resources found that the area of land had been changed from 1994 to 2004 (Khalaf and Hithnawi 2007), as it shown in table 2

Table 2 : ***Changes in the Area of Agricultural Land (1994-2004)***

Category	1994 (km^2)	2004 (km^2)	Percent
Agricultural Area	2340	2025	-13%
Cultivated Area	1900	1823	-4%
Area of Vegetables	198	179	-10%
Area of Field crops	563	491	-13%
Area of Fruit Trees	1143	1152	0.80%

Source: Khalaf and Hithnawi (2007)

Despite the contradictory information, the total value of agricultural production hit the one billion US$ in 2006 and for the first time in history jumped from 754 million in 1996 (Table 3). Over the same ten-year period the costs of agricultural inputs have increased from 296 million US$ to 508 million US$.

Table 3: Production value, inputs cost and value added during 1996 and 2006

	1996 US $ million	2006 US $ million	%
Production Value	754	1,064	41
Inputs cost	296	508	72
Value added	458	557	22

PCBS/ Agric. Stat. 1996/2006

As has been stated earlier, the importance of agriculture goes beyond monetary and social terms, as there are several intangibles and indirect functions that cannot easily be quantified or valued, yet agriculture is a major contributor to the following (Horizon 2008):

1. Food security: local agricultural production achieves self sufficiency in most vegetables, fruits, olives, poultry and eggs. By contrast, the self sufficiency of red meat does not exceed 75%, whilst 85% to 90% of the wheat requirement is imported, depending on actual rainfall each year.
2. Jobs and income provision: historically, agriculture has been the main employer, as most Palestinians depended on agriculture as a major or secondary source of income. The proportion of employment within the agriculture sector increased from 11.5% in 1996 to 16.1% in 2006, and its contribution to GNP increased from 6.4% to 8% in 1997 and 2006 respectively.
3. Contribution to exports: sizeable quantities of vegetables, flowers, and fruits are exported, mainly to Israel, Europe and some Arab Countries. Agricultural exports amounted to 23% of total Palestinian exports in 2006.
4. Environmental protection: this is afforded mainly through soil and water conservation measures, rehabilitation of rangelands, afforestation, protection of agro-biodiversity and curbing desertification.

5. Agricultural input markets and private sector: production inputs such as fertilizers, seeds, and chemicals, irrigation systems, machines, and other industries depend mainly on agriculture for their markets. In addition, various livelihoods such as transportation, wholesalers, retailers, restaurants and the food processing industry, depend on agricultural production as a major input.
6. Protection of land against confiscation and settlement: land reclamation, tree planting and water harvesting measures have contributed to undermine the Israeli settlers.

Despite the fact that only 6% of total cultivated land area in WB is irrigated; the contribution of this ratio to total agricultural production in WB is 52 %. Irrigated agriculture is practiced primarily in the Jordan Valley and the semi-coastal region around the towns of Jenin, Qaliqilya and Tulkarm in the north and northwest of WB. In fact, great potential for increasing irrigated land is reported and the limiting factor is the shortage in water resources (MoA 2004).

Restriction to movement and accessibility imposed by the Israeli occupation forces to the land and water and declining availability of irrigation water carry significant opportunity losses in terms of output and employment in agricultural sector. Potential exists to expand the irrigated area if water resources are available, and agriculture can play a key economic, social and political role in rebuilding the Palestinian economy. However, the economic downturn, restrictions on movement and export of goods, and dwindling water availability, with almost no new or replacement water sources receiving permits, are sapping the sector. The cost of foregone opportunity in irrigated agriculture to the economy is significant, and it is estimated that it could be as high as 10% of GDP and 110,000 jobs (World Bank, 2009).

The cultivated land in GS is likely to decline in the future because of the ever-mounting population pressure and urbanization. Moreover, the water quality is considered as a limiting factor in the expansion of irrigated agriculture; It is reported that 50 % of water in GS is consider saline due to overuse of chemical fertilizers and pesticides, polluting the groundwater with wastewater, overexploitation of water pumpage from wells, and the intrusion of sea water to the coastal aquifer (PWA 1999).

III. DROUGHT IN PALESTINE

Among recurrent drought episodes, drought that afflicted the WB & GS in 1998/99 has caused losses with a value of 400 million US$ (MoPIC 1999). With rainfall in the WB 40% below normal in most regions and as low as 25% in Jericho, Palestinian farmers and livestock producers have faced a long and hungry summer (Sovich 1999). Barley prices have increased from $120 to $132 per ton in anticipation of shortages. Palestinian breeders had to spend $11 million to feed their animals that summer and also paid extra money to buy water. Without government support, many had to sell their animals or look for employment elsewhere (Sovich 1999). Agricultural sector has been severely hit and rain-fed farming in the WB has totally collapsed (Isaac 1999). Irrigated agriculture has also been affected since spring flows and discharges from wells have been reduced by decreased precipitation. The Palestinian Authority, which has declared a state of emergency, has tried to prevent the total collapse of the agricultural sector. Palestinians were forced into the black market to purchase water, consuming up to 20 percent of their income on this item. The Philadelphia Inquirer (26 July 1999) describes Palestinians paying $4 per cubic meter (including delivery costs) for water costing Israelis $0.50-$1.00 per cubic meter (Isaac 1999). The same newspaper reports Israeli settlers selling water—taken from Palestinian sources—to desperate Palestinians at a 40 percent profit.

During a drought episode which afflicted WB in 2007-2008 season where rainfall reached 67% of the annual average, the estimated direct losses in plant production of rainfed agriculture was more than 113.5 M US$ based on farm gate prices (MoA 2008). The indirect losses were estimated by more than 250 M US$ and more than 200,000 small ruminants were affected. Table 4 shows the percentages of yield reduction and the losses for the main cultivated crops in WB (MoA 2008).

Table 4: Impact of drought on crop production in percentage and value (2007-2008)

Crop	Yield Reduction %	Losses Value M US$
Wheat	40	6.9
Fodder Crops	35	4.5
Fruits	35	10.6
Olive	40	60.7
Grape	35	14.1

Source : MoA 2008

IV. CONCEPT OF DROUGHT

Drought is a normal, recurring feature of climate; it occurs in virtually all climatic regimes. This temporary aberration has a slow initiation and it is usually recognized when the drought is already established. Drought is the consequence of a natural reduction in the amount of precipitation received over an extended period of time, usually a season or more in length. Although other climatic factors (such as high temperatures, low relative humidity, and high winds,) are often associated with it and can significantly aggravate the severity of the event. Drought is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (i.e., rainfall intensity, number of rainfall events). Thus, each drought year is unique in its climatic characteristics and impacts, (Wilhite and Svoboda 2006).

Drought severity is dependent not only on the duration, intensity, and spatial extent of specific drought episodes, but also on the demands made by human activities and vegetation on a region's water supplies. The characteristics of drought, along with its far- reaching impacts, make its effects on society, economy, and environment difficult to identify and quantify (Wilhite and Svoboda 2006). This continues to represent a challenge to those scientists involved in operational climate assessments.

Frequently the term drought is confused with other related concepts like aridity (permanent water deficiency due to climatic characteristics and is restricted to low rainfall areas) or temporary water shortage (temporary insufficiency of water resources to satisfy normal requirement in a region, in a given time, due to imbalance generated by human activity) because of the lack in understanding of the characteristic aspects of drought (SME 2006). The misunderstanding of drought, as a temporary event or desertification is misleading to planners and policy makers in conceptualizing, analyzing, and proposing appropriate plans and interventions.

IV.1. Conceptual Definition of Drought

In literature two kinds of drought are cited, conceptual and operational. Conceptual definitions, formulated in general terms, help people to understand the concept of drought; conceptual definitions may also be important in establishing drought policy (NDMC, 2006).

IV.2. Operational Definitions of Drought

Operational definitions of drought, that help people to identify the beginning, end, and degree of severity, specify the degree of departure from the average of precipitation or climatic variable over some time period. This is usually done by comparing the current situation to the historical average, often based on a 30-year period of record. The threshold identified as the beginning of a drought (e.g., 75% of average precipitation over a specified time period) is usually established (NDMC 2006). Developing climatology of drought for a region provides a greater understanding of its characteristics and the probability of recurrence at various levels of severity. Information of this type is extremely beneficial in the development of response and mitigation strategies and preparedness plans.

IV.3. Disciplinary Perspectives on Drought

The drought is identified by many ways according to its effects (impacts):

IV.3.a Meteorological Drought

Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period (CSRE, 2006).

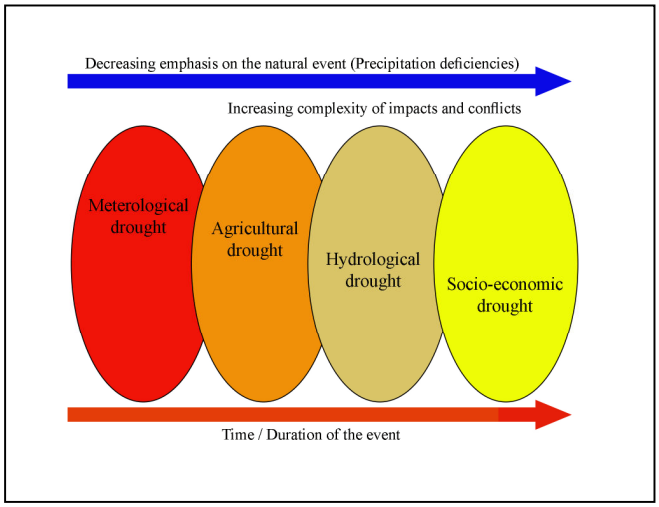


Figure 1 Dimension of Drought Impact (CSRE 2006)

IV.3.b Agricultural Drought

Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced ground water or reservoir levels, and so forth (CRSE, 2006)

IV.3.c Hydrological Drought

Hydrological drought is associated with the effects of periods of precipitation shortfalls on surface or subsurface water supply (CSRE, 2006).

IV.3.d Socioeconomic Drought

Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought.

V. DROUGHT PLAN AND MANAGEMENT APPROACHES

Greater attention has been directed to reduce the risk associated with the occurrence of drought through the introduction of a proactive or preventive approach planning to improve operational capabilities (climate and water supply monitoring and building institutional capacities) and to formulate mitigation measures. A proactive approach includes all the measures designed in advance, with appropriate planning tools and stakeholder participation, and it is based both on short term and long term measures which include monitoring systems for a timely warning of drought conditions. Nevertheless, if it is not possible to avoid a water crisis that appears as a natural public calamity (after a government declaration), the drought contingency plan is implemented until the establishment of normal conditions. It is evident that a proactive approach, even if more complex, is more efficient than the traditional approach, since it allows drought mitigation measures (both long term and short term) to be defined in advance, improving the quality of the interventions (Knutson et al. 1998).

As in many of the developing countries, the Palestinian planners and decision makers have followed a reactive approach when a natural hazard event and resultant disaster has occurred. Following any climatic uncertainty, all efforts are being directed toward conducting the impact assessment, proposing response and recovery plans, and implementing reconstruction activities to return the region or locality to its pre- disaster state. In fact, many response measures instituted by governments, international organizations, and donors have actually increased vulnerability by increasing dependency on internal or external assistance. This scenario is being repeated with every drought or disaster episode without the consideration of risk reduction.

The risk associated with the occurrence of drought is a product of both regional exposure to this event and the vulnerability of society to the event. Vulnerability is determined by social factors such as population, demographic characteristics, technology, policy, social behavior, land use patterns, water use, economic development, diversity of economic base, and cultural composition. These factors are changing with time, and vulnerability will change in response to these changes. Subsequent droughts in the same region will have different effects, even if they are identical in duration, intensity, and spatial characteristics, because societal characteristics will have changed. Despite the fact that much can be done to lessen societal vulnerability to drought, the improvement of understanding the region's drought climatology will provide critical information on the frequency and intensity of historical events. Identifying the factors that explain potential risks and how they can be evaluated qualitatively and quantitatively can lead to the development and implementation of a wide variety of mitigation actions and programs to reduce the impact of future drought events (Wilhite and Svoboda 2006).

All components of the cycle of disaster management should be addressed in a comprehensive hazard mitigation plan, but greater attention needs to be placed on pre- disaster activities than has occurred in the past (Knutson et al. 1998).

Tackling water scarcity problems requires the alignment of water management measures and policies with the concept of sustainable development. Despite the enormous progress obtained in the development of technology and management tools, there are still many questions related to drought management that need to be answered. To properly adjust the concept of sustainability to drought management, water management should be based on knowledge, include the water demand of non-productive uses like natural ecosystems, give priority to uses that lessen environmental degradation, establish socially acceptable measures, and incorporate economic aspects in the decision making process (MWDF 2006).

VI. THE GLOBAL EFFORTS TO DEVELOP DROUGHT GUIDELINES AND PLANS

Many methods for designing drought plans have been developed around the world to assist countries in developing drought plans, and the variations among these methods are due to the complexity of drought impacts. The National Drought Mitigation Center in USA has created the "10-Step Drought Planning Process" and the "How to Reduce Drought Risk Guide" that governments in both developed and developing countries have utilized to develop drought plans (Wilhite, 2005). This approach and process has been implemented in USA and Canada (Knutson et al., 1998).

In addition, the Mediterranean Agronomic Institute of Zaragoza and University of polytechnics in Madrid, Spain, coordinated (in collaboration with scientists and stakeholders from Cyprus, Greece, Italy, Morocco, Spain, and Tunisia) the creation of the MEDROPLAN drought management guidelines to assist Mediterranean basin countries in developing drought plans (Medroplan 2007).

Similarly, the United Nations secretariat of the International Strategy for Disaster Reduction (UN/ISDR) and the National Drought Mitigation Center (NDMC) partnered to develop "Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action" (UN/ISDR 2007). The document provides information to assist countries in reducing their drought risk and meeting the terms of the "Hyogo Framework for Action 2005- 2015".

The Food and Agriculture Organization (FAO) has developed a planning process (six steps methods) drawn from the previous resources but is tailored for the Near East Region. It included specific case studies of drought-related projects in the region (Syria, Jordan, and Iran), and presented a practical planning methodology relevant for the needs of Near East drought planners (FAO/NDMC 2008).

The efficiencies and effectiveness of these methods depends on the applicability of the systematic approach in developing drought management plans, methodology, linkage between science and policy and consideration of legislations, management, and technologies and methods for evaluating risk. All of the above mentioned methods highlighten and focus on the following issues:

1. The importance of defining the planning purpose and process, establishing a common language among stakeholders, and highlighting the importance of using a common set of terms and concepts for developing a comprehensive drought management plan.
2. The understanding of legal and institutional framework within which the drought plan will be designed and implemented.
3. The understanding of drought hazard, the risks to different systems qualitatively and quantitatively, the causes of risk, and the operational aspects to decrease risk.
4. The development of indicators and indices of risk in water resources, agricultural systems, and other economic sectors.
5. The establishment of a monitoring system to warn about a possible incoming drought provides adequate information for an objective drought declaration and to avoid severe water shortages.
6. The conduction of vulnerability assessment to identify the characteristics of the systems that modify the level of risk derived from inadequate structures, management

and technology, taking into consideration the economic, environmental, and social factors.

7. The Identification of both the long and short term activities and actions that can be implemented to mitigate and prevent drought impacts. Operationally, these aspects have to be included:

- Preparedness, monitoring and early warning, systems
- Establishing priorities of water use
- Defining the conditions and the thresholds to declare drought levels
- Establishing the management objectives in each drought level
- Defining the actions.
- Implementing actions.

8. The definition of methodology to revise periodically and update the development and application of the drought plan through conducting a public multi-stakeholder dialogue, workshops, guided interviews, questionnaires, effective dissemination of information.

VII. POLICIES, STRATGIES & MITIGATION MEASURES:

The region is currently experiencing increased numbers of severe drought episodes due to climate change (ESCWA 2009). There is therefore an urgent need to design and implement comprehensive long-term drought risk management strategies that incorporate policies to improve the response to drought events. This will require the application of effective approaches and tools (e.g. models and decision support systems) and the implementation of the appropriate policies and measures. The United Nations Economic and Social Commission for Western Asia (ESCWA) has proposed comprehensive policies, strategies and mitigation measures for the Arab Region on the Thematic Area of Sustainable Development and Productivity Division (CSD-17), (ESCWA 2009).

Drought and other climatic uncertainties continue to threaten the livelihoods of Palestinian urban and rural communities. Combating drought is necessary to achieve sustainable development goals and improve the livelihoods of people living in drought-prone regions. The effects of climate change heighten the risk of droughts and increase the need for effective drought management. Drought must be addressed in an integrated fashion with other themes of sustainable development, considering socio-economic and environmental aspects. Strategies for drought management and prevention should be incorporated into sustainable agricultural practices, soil conservation, crop diversification and integrated water basin management.

VII.1 Policies: The following policies should be agreed upon through multi-stakeholder consultation and dialogue to improve the capabilities to response to drought episode (ESCWA 2009):

- Organizing and preparing risk and vulnerability profiles and maps, as well as stimulating efforts to combat the negative effects of drought and climate change (Mitigating and managing drought);
- Supporting and developing technical, human and institutional capabilities at the national level in order to combat drought and the effects of drought in rural areas;

- Enhancing coordination and cooperation in planning and implementing drought mitigation programs at the national and regional level;
- Developing a compressive database on activities related to drought monitoring, assessment, mitigation and management.

VII.2 Strategies: The following Strategies are needed to achieve the policies (ESCWA 2009):

i. Create enabling environment for drought preparedness and mitigation

- Prepare national drought risk reduction strategies;
- Support more pro-active drought risk management approaches;
- Promote and implement effective national and regional drought information, forecasting and early warning systems which disseminate reliable information for all stakeholders including the communities living in drought-prone regions to take appropriate measures with adequate support from their respective governments and the international community;
- Implement afforestation and reforestation to prevent drought and desertification and the negative impacts of climate change;
- Promote monitoring and sustainable management of soil carbon stocks, to take full advantage of soil's potential as a carbon sink;
- Promote regional cooperation and partnering for capacity building and improving effectiveness in planning, monitoring and implementation of drought plans.

ii. Strengthen the knowledge base and information sharing on drought

- Invest in research, robust data collection and standardized information to quantify risk, predict, plan for and manage droughts;
- Promote the exchange of information and experiences and lessons learnt in relation to drought risk management and reduction and increase public awareness on innovative, traditional and adaptable practices;
- Establish drought national indicators and benchmarks and related web-based information systems;
- Establish a unified standard drought index for use around the world and in the full range of drought conditions and ecosystems to facilitate the compilation and reporting of drought conditions;
- Increase knowledge sharing and information on weather forecasts and climatic conditions at the local, regional and global levels;
- Increase funding and support for research and development on the underlying causes and effects of drought, including social and environmental perspectives.

iii. Enhance communities' resilience to drought

- Enhance social and economic resilience and reduce vulnerability in drought-prone communities by encouraging community-based land tenure based on good governance principles, mixed livestock production and cropping, the implementation of water management schemes and the expansion of index-based weather insurance schemes;
- Support research to develop and introduce drought-tolerant seed varieties and widespread access to such varieties;

- Promote sustainable land-use practices aimed at combating and adapting to drought such as replanting logged areas with high-temperature-tolerant trees and thinning drought-stressed forests;
- Promote innovative technical solutions and practices, combining them with traditional knowledge, for sustainable integrated water management such as efficient irrigation systems, rainwater harvesting, and reusing of non-conventional water.

iv. Enhance capacity-building, technology transfer and financing

- Promote access to affordable, appropriate and needed technology and provide corresponding capacity-building to enable sustainable and efficient use of scarce resources and arable land;
- Provide technical and financial means and support to implement national and regional early warning systems, allowing for rapid mitigation and adaptation to drought and improved drought management plans;

VII.3 Measures: Support should be provided to the implementation of the following measures (ESCWA 2009):

- Establishing and activating drought early-warning systems in order to manage and mitigate any adverse future impacts;
- Conducting regular field monitoring of drought cycles and identifying reliable tools to predict the correct timing of drought episodes;
- Conducting risk, vulnerability and impact assessments on the effects of drought and the ecological, agricultural and socio-economic dimensions of this problem at the district and the national level;
- Engaging in a continuous review and assessment of the relevance and effectiveness of current practices, plan of actions and policies related to drought preparedness;
- Limiting the effects of drought episodes through the optimal use of rainwater harvesting techniques and storage facilities, such as dams on small and medium scale and reservoirs;
- Developing capabilities, strengthening cooperation and implementing programs to alleviate the effects of drought on vulnerable communities.

VIII. AGRICULTURE, DROUGHT AND CLIMATE CHANGES

The relation between weather conditions and farming systems, especially in rainfed agriculture and marginal land, and social conditions is an important issue to planners and scientists. For instance in Palestine, drought has a direct relationship with farmers' income and it is relatively simple to analyze risk by evaluating simple variables, such as crop yield. In contrast, farming systems in economically developed regions, are greatly affected by policy, markets, technology and financial instruments, and it is complex to determine the effect of drought in individual farmers and in the aggregated agricultural sector.

The integration of climate (hazard) and agricultural system's characteristics (that explain vulnerability and trends of the systems) through yield functions (yield is taken as an impact variable) is an example of what is to be addressed by policy makers. The quantification of the

overall drought risk of agricultural systems is the right gate for assessing risk and vulnerability and to consider the proper mitigations to be taken.

Addressing the difficulties that farmers already face on local and regional bases is becoming more complicated when climate change is represented as an externality, rather than as a complex mixture of social construction and physical process. These difficulties are becoming more complicated when drought issue is considered in the context of water scarcity on regional bases. Distorting the ratio of water demand to supply, low and erratic rainfall and hot temperature, inadequate infrastructure, lack of accessibility to markets and credit, and other challenges are constraining the development of agriculture sector and improvement of food security. Finding solutions to these issues should go in parallel with building resilience to future climate change. More attention should be directed toward improving the skills of farmers to use climate information in making decision on farm basis and this can be accomplished if the advisory services are locally, timely, relevant, and transparent.

Climatic and agricultural scientists work should be directed toward making climate predictions match farmers' needs. Introducing more drought-resistant or heat resistant varieties, switching crop patterns, improve farming practices, adapting time and methods of harvesting are examples of how farmers can cope with future changes in climate and the occurrences of drought.

Coping with water scarcity requires the measures and policies of water management to be in line with the challenging concept of sustainable development. This usually requires new perspectives and approaches toward development of water and agricultural sectors and water resources management. This is not only a question of implementing new technologies and management approaches for allocating and controlling the water uses, rather, there is a need for also considering the driving forces governing the pressure on the resources themselves, the behavior of the users, and the diverse human and social objectives (SME 2006). Reallocating water shares among users is one of the alternatives in preparedness plan or during drought period. Shortage in water supply for domestic purposes is usually compensated by fresh or medium quality water used for irrigated agriculture. Thus, the planners will enhance the utilization of non traditional water in intensive agriculture to meet the demand for food and to replace the reallocated portions. In drought planning, more attention should be directed to promote the research in these topics because the consequences of mismanagement will affect environment, health, ground water, and sustainability of these resources.

In regard to agriculture sector, the risk of each drought period on rainfed agriculture, irrigation, and water supply, as well as environment should be evaluated and quantified, by using one or more variables. For instance, risk on rainfed or irrigated agriculture has to be quantified in terms of production losses. Secondary consequences may be, in some cases, of great importance. For example, the reduction in crop yield may result in land abandonment due to reduced crop yields and subsequent loss of farm income.

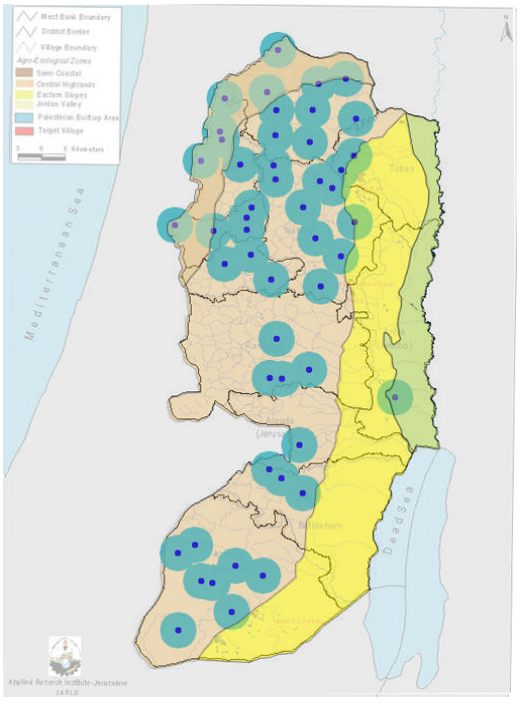
For example, given a specific farm, the vulnerability is directly related to the intensity of the drought event. In contrast, given a defined drought event, the most vulnerable farming system is the one that has less social and economic resilience; in general marginal and poor farming systems suffer the greatest consequences of drought.

IX. DISCUSSION

Vulnerability of natural resources to drought in WB and GS is the highest if it is compared with regional countries and this is resulted from the interactions of many political, historic, economic, social, and other factors. The imbalance between growing demand on natural resources, because of increasing population, and limited supply is aggravating the vulnerability of water resources and increasing the expected harmful consequences of exposure to drought. In fact, water supply is diminishing because of the restrictions of Israeli Authority to rehabilitate existing water infrastructures and because of exploitation of water in the Israeli agricultural settlements in WB. The Israeli wall prevents Palestinians from using 6 to 7 Million cubic meters per year which is estimated 1/3 of what has been used from the Western aquifer.

Planning and management of drought in Palestine needs collaborative efforts from all stakeholders concerned with this issue, not on the political level only, but on the technical levels too. The policy of closing, confiscation, and creation of ghettoes have decreased the accessibility of Palestinians to manage natural resources and to build infrastructure needed to establish early drought warning system needed for monitoring and predicting the occurrence of drought in future. The current situation are characterized by, a): limited number of meteorological stations, b) inefficient distribution of low technology stations and rain gauges in the semi-coastal and central highland agro-ecological zones, c) absence of meteorological stations in the eastern slop and Jordan valley zones (Map 1), and d) lack of data and information for historic records. The need for installing a net of meteorological stations is a priority for the Palestinian Authority especially for the eastern slop and Jordan valley where condensed irrigated agriculture is practiced (MoA 2007).

The pattern of rainfall on Palestinian land is an important factor in the needs for drought planning and for identifying mitigation measures in Palestine. Variations in quantity and distribution of annual rainfall from season to season and the tending of rainfall to fall in intense storms are characterizing the precipitation pattern in WB and GS. Average annual precipitation in WB is 450 – 500 mm, decreasing from north to south, from west to east, and from high to low altitude. Number of rainy days in the north is 60-70, in the centre is 40-60, and in the south 15-20 (Geography of Palestine 1996). The precipitation pattern is characterized with a reverse relationship between distribution of rainfall on the season (Oct. to April) and the deviation coefficient of rainfall from the mean, and this means that the exposure of western north part of WB to higher rainfall and lower deviation is more than in the eastern south areas (Geography of Palestine 1996). The deviation of rainfall coefficient increases from north (20%) , centre (30%), to south (50%), and this indicates that the eastern south areas is more exposed to drought



Map 1: Distribution of rain gauges in WB

occurrence if it is compared to western north part of WB.

The vulnerability of agricultural sector to the occurrence of drought can not be neglected. Rainfed agriculture is the dominant pattern in Palestinian territories and it is known that the impact of agronomic drought is more critical in rainfed pattern if is compared to irrigated pattern especially in arid and semi arid area. In addition to rainfed crop pattern, the diminished water supply during drought period requires the farmers be capable of adopting reduced demand and efficient water use practices. Agricultural drought in Palestine is very important factor in aggravating the socio-economic drought in the rural area. Thus, the current and possible drastic reduction in farmers' incomes should be highlighted and the complement mitigation and reaction measures should include support measure and modified agricultural insurance policy.

There is no doubt that political (situation, commitment, and will) and technical contexts are the main reasons for the absence of comprehensive and proactive drought risk reduction strategies. The priorities for Palestinian Authority were directed toward the foundation of institutional, legal, and legislative framework and the formulation of policies and strategies to improve the water supply. In addition to constraints imposed by the Israeli occupation forces that distort the performance and hinder the development planning, the lack of scientific and technical knowledge bases is another constraint to achieve the comprehensive disaster risk reduction, starting with hazard and risk assessments, vulnerability analysis and ending with preparedness, response and recovery processes. Institutional reforming, adoption of good governance and participatory approaches, and technical and human building capacities need substantial financial resources which are considered one of the important difficulties in updating and formulating policies and strategies. These approaches of reforming and good governance need a clear commitments and wills from the policy makers and decision makers where political dimension interacts and hinders the implementation of such approaches. Furthermore, the public prospective is making such changes difficult to be accomplished especially with the weak participation and incorporation of civil and public sector in this process.

On political and security level, climate change and drought present a security threat in many distinct dimensions: (a) it may increase competition for scarce water resources, complicating peace agreements; (b) it may intensify food insecurity, thereby raising the stakes for the return or retention of occupied land. The climatic uncertainties could further decrease local agricultural productivity and make global food prices increasingly volatile, further politicizing the issue of food security. As populations and demand for food grow, this could further increase domestic pressure for the Palestinian Authority to secure the return of occupied lands and shift the strategic calculations in Israel on whether to withdraw from these areas; (c) it may hinder economic growth, thereby worsening poverty and social instability (Brown and Crawford 2009). These considerations without any doubt will complicate the implantation the appropriate strategies and measure to achieve the policy objective by the Palestinian planner and decision makers.

The motivation to initiate a drought planning process is often fostered by the occurrence of a drought event (FAO 2008). Such event can create a "policy window", a time during which the public's and policy makers' attention was directed toward a particular issue. In addition such event can also serve as a catalyst for change in the perceptive thinking and political environment in to address these climatic uncertainties. This requires awareness building and the persistent efforts of forward-thinking advocates who continuously promote the need for natural hazard

planning and seek avenues to accomplish it. These advocates of reducing the cost of crises management by integrating risk in the disaster management and improve the resilience of communities prone to these uncertainties, are essential for raising awareness, building stakeholder networks, and keeping drought planning on the political agenda. Depending on the situation and opportunities, an advocate could promote drought planning by fostering the passage of legislation requiring the development of a national drought strategy, seeking or sponsoring a drought planning technical assistance project, sponsoring activities to raise drought awareness and conducting drought-related research.

The necessity for formulating drought policy and strategy in Palestine is becoming a reality day after day. The vulnerability of natural resources and the agricultural sector, the absence of a drought preparedness plan in the Palestinian development plans, the absence of monitoring and early warning system because of weak infrastructure and lack of cooperation among the Palestinian institutes dealing with this issues, the misunderstanding of the concept of drought management and the confusion between drought and desertification are pointing the importance of tackling and prioritizing the issue of drought planning.

X. CONCLUSIONS

In Palestine as in many other countries, the decision makers react to drought episodes, mainly through a crises management approach rather than on developing comprehensive long-term drought preparedness policies and plan of action that may significantly reduce the risk and vulnerabilities to drought and other extreme weather events. Drought planning tendencies nowadays drift towards moving from crises to risk management.

In drought planning, monitoring and early warning system, assessing the potential risk, assessing the vulnerability of communities prone to climatic uncertainties, and formulating and implementing appropriate mitigation measures, actions, and response the core constituents. The monitoring and early warning component of a drought plan is essential because it provides the foundation on which timely decisions can be made by farmers at farm level and decision makers at all levels.

Preparedness leads to greater institutional capacity to cope with drought events through the creation of an organizational structure that improves information flow and coordination between and within levels of government. It is also about increasing the coping capacity of individuals, communities, and governments to handle drought events. Drought preparedness, coupled with appropriate mitigation actions, and public awareness and training programs, can reduce and, in some cases, eliminate many of the impacts associated with drought.

The necessity of formulation of drought policy and planning in Palestine is becoming a reality day after day because of the vulnerability of natural resources and agricultural sector resulted from the interactions of many political, historical, economic, social, and other factors. It can be concluded that the absence of drought preparedness plan in the Palestinian development plans, and the absence of monitoring and early warning system are resultant of the weak infrastructures, lack of cooperation among the Palestinian institutes dealing with this issues, misunderstanding of the concept of drought management and the confusion between drought and desertification.

Planners should be very careful in formulating the proper mitigation measures to minimize the impact of drought episodes because some measures may create economic and social

externalities. Reallocating water shares from one economic sector to another which is more prioritized may create social conflicts and economic complications. Changing crop pattern in agricultural can be a solution to reduce agricultural water demand but the consequences of food insecurity, unemployment, and abandonment of land (depopulation) will have substantial impacts on Palestinian livelihood.

With no doubt, this paper can't cover all aspects related to drought planning issues in Palestine and it is clear that more studies and researches are needed. It is an attempt to highlight the importance of starting a national campaign leaded by Ministry of agriculture with the coordination and cooperation of other governmental and non governmental organizations and with the help of international and regional organizations. To ensure the success of a resultant plan, the approaches of good governance, participation and commitment to prioritize the drought planning, should by adopted by politicians and decision makers.

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