Dryland Farming in Palestine

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Introduction

As a developing country with little industry or services, agriculture is the backbone of the Palestinian economy, contributing nearly 33 and 24% to the Gross National Product in the West Bank and Gaza Strip respectively. Topographic, political, and socio-economic constraints have maintained one third of the labor force in the agriculture sector, particularly given the severe lack of employment opportunities elsewhere and the difficulties in introducing widespread mechanization.

Clearly, rainfed farming plays an essential role in the economic growth of the West Bank and the livelihood of its people. Furthermore, it merits greater scrutiny, assistance, and investment which will enable it to play a principal role in the development process.

The total area of the West Bank including Jerusalem is about six million dunums of which the third is cultivated while the total area of the Gaza Strip is 365,000 dunums of which close to half is cultivated. While irrigated farming is predominant in Gaza Strip and the Jericho area, farmers throughout the West Bank cultivate almost 2 million dunums employing rainfed farming methods. In the West Bank, only 104,000 dunums are under irrigation, representing 5.5% of the cultivated area, while in Gaza there are 108,500 dunums under irrigation, representing 66% of the cultivated areas. In Israel, 49.1% of the cultivated land is under irrigation.

Throughout history, agriculture has traditionally provided a basis for human development and growth. Nomads settled to devote more energy to farming and food production where soon they found time to create other goods and, eventually, to trade. In the development process, agriculture, the primary economic activity, serves as a mechanism and a basis for the growth of other sectors. A viable agricultural sector re-invests profits in other areas and frees human capital to find more efficient roles in expanding the industry and service sectors.

The Applied Research Institute of Jerusalem (ARIJ), in cooperation with other Palestinian agricultural institutions, has identified rainfed farming as one of its four priority research programs for promoting authentic development in the West Bank and Gaza Strip. After extensive discussions with local agriculturalists regarding potentials as well as agricultural development constraints in rainfall areas in the O.P.T., the project proposal was submitted to the FORD FOUNDATION.

Since rainfed agriculture is the most predominant pattern governing farm systems in the West Bank and Gaza Strip, it is imperative then to have more understanding and insight of the agro-ecological characteristics and the socio- economic

relationships that have evolved within the Palestinian farm communities in their continuous attempts to cope with the environment and maintain their livelihood.

Development of the rainfed sector through technology transfer may have an impact on productivity only if introduction of such technologies is economically feasible, socially acceptable, and manageable by local communities. It should also be adaptable to environmental conditions, including such variables as rainfall, chemical and physical soil structure, and topography. It is towards a comprehensive understanding of the interrelated factors governing farming systems that this study is directed.

This is probably the first local attempt to use a problem solving approach in dealing with the agricultural sector. From an economic point of view, the need for such a study may be traced to the prevailing characteristics in the agricultural rainfed sector, such as low yields and poor quality produce, and a consequent waste of resources. The rainfed agricultural sector in general has been experiencing a gradual but consistent rise in product prices. At the same time, production and marketing costs are increasing rapidly. As a result, net profits are decreasing, and families find it more difficult to manage. Household economy strategies in farming communities should thus consider the effects of rising costs and marginalized profits on those who earn their living from rainfed farming.

Hence, agricultural patterns in rainfed farming are, to a certain extent, witnessing a shift that is seemingly being an impulse reactive change responding to different factors not necessarily related to coping with the environment and the natural resource base.

As an additional benefit, it is hoped that this project will gather basic information essential to any in-depth evaluation of this sector. Such seminal data will be of significant value to subsequent agricultural development work.

The project involved:

1. Reviewing the available literature on rainfed farming in the Middle East.
2. Identifying the information that has to be collected or compiled for assessing the status of dryland farming.
3. Defining the problems facing the sector.
4. Presenting applied research projects that could assist in solving some of these problems.
5. Outlining the structures, facilities and other mechanisms that are needed for actual implementation of applied research and technology transfer.

Objectives of this project:

1. To critically evaluate the status of rainfed farming in the Occupied Territories and identify the problems facing this sector.
2. To identify specific applied research and technology transfer projects that could solve the problems facing this sector.
3. To improve the utilization of the increasingly scarce physical resources namely soils, water, nutrients, plants, and animals in ways that optimize sustainable outputs.
4. To contribute to creating food security in the area.
5. To assist in increasing the income of farmers in rainfed areas, considered to be the poorest agricultural community.
6. To look at the potential of diversifying plant production in the Occupied Territories.
7. To take steps towards retarding desertification.
8. To contribute to the re-greening of the Occupied Palestinian Territories.
9. To assist in conserving water and preventing soil erosion.

SECTION 1

Physical Features

Palestine, in general, has a Mediterranean climate characterized by long, hot, dry summers and short, cool, rainy winters, which are modified locally by altitude and latitude. Geographically, Palestine is located between the subtropical aridity of Egypt and the subtropical humidity of the Eastern Mediterranean.

Also, climatic variation occurs in the different topographical regions. The watershed of the mountain range that divides the northern from the southern West Bank represents a natural division between rainy western slopes and semi-arid eastern slopes. Though relatively small in area, the West Bank enjoys diverse topography, soil structure, and climate conditions. Such characteristics offer a tremendous opportunity for agricultural variation and, to some extent, regional specialization. Olive groves cover most hilly mountains; field crops are mainly cultivated in the plains and plateaus. The Jordan Valley has its own uniqueness with a semi-tropical climate characterized by hot summers and warm winters. However, this region would be desert-like without access to water. **(Maps 1 and 2)**

The O.P.T. comprises the West Bank including East Jerusalem and Gaza Strip.

1. West Bank:

Four distinctive regions, are mainly chracterized in the West Bank based on topography and climatic variation.

1.1. The Jordan Valley Region

The Jordan Valley extends along the Western Bank of the Jordan River from the Israeli border in the north to the northern tip of the Dead Sea in the south. It is approximately 70km long with a total area of about 400,000 dunums. Elevation ranges from 200-300m below sea level, and the climate is semi-tropical, characterized by hot summers and warm winters. Annual rainfall ranges from 200 millimeters in the northern parts of the valley to 100 millimeters in the south.

1.2. The Eastern Slopes Region

The Eastern Slopes extend along the eastern side of the West Bank, east of Jenin in the north to the eastern hills of the Hebron district in the south. Total area is approximately 1.5 million dunums. Elevation ranges from 800m above sea level to approximately 150m below sea level. The climate is semi-dry with a very low annual rainfall varying between 200-400 millimeters.

1.3. The Central Highlands Region

This is the largest region in the West Bank with an approximate area of 3.5 million dunums. 120km long, it includes the hilly area that extends from Jenin in the north to Hebron in the south. This region is predominantly mountainous with some areas exceeding an elevation of 1000 meters above sea level. The Central Highlands region has a good average annual rainfall ranging from 400 millimeters in the southern foot hills to about 700 millimeters in the mountainous areas.

1.4. The Semi-Coastal Region

The Semi-Coastal region is an extension of the Palestinian Mediterranean coastal region. It is limited to the northwestern part of the West Bank and comprises parts of Jenin and Tulkarem districts. This region is about 3-12km wide and about 60km long, with an area of about 400,000 dunums. Elevation varies between 100 to 300 meters above sea level. Relatively high, average annual rainfall is about 600 millimeters.

2. Gaza Strip

Although the area of Gaza Strip is small, only 365 square kilometers, there are many different types of soil. Sandy dunes are concentrated in the coastal belt in the western part of the territory. A considerable area of such soil has been reclaimed for cultivation of citrus and vegetables. Loessial sandy to loess soil is mostly present in the eastern part. This soil is deep and used for fruit and vegetable cultivation. Alluvial soil of the wadis form a limited area in the north-eastern part. This is a productive area used mainly for fruit, field crops and the cultivation of vegetables. **(Map 3)**

The average annual rainfall in Gaza is estimated at 300mm, the lowest amount falling in the southern region where it averages 150mm/year. The total amount of rainwater in Gaza is estimated at about 125 million cubic meters. **(Map 4)**

It is also important to note that for the entire West Bank and Gaza approximately 75% of rainfall is lost to evapotranspiration, with the remaining water infiltrating into the soil, recharging the groundwater reservoir or appearing as runnoff in rivers and streams, most of them emphemeral.

SECTION 2

Socioeconomics Of Dryland Farming In Palestine

Introduction

ARIJ has initiated compilation and collection of the most essential information regarding village conditions in the West Bank. This has been done in order to build and establish a resource center and agricultural database to identify obstacles and supply the technical information essential for agricultural production and planning.

More than 70% of the total population of the O.P.T. live in rural areas. About 400 villages comprise the rural population, concentrated in the middle area of the West Bank around the districts of Ramallah and Nablus. As agricultural production is the backbone of the local economic base, the rural sector will have to remain an important area of focus for the foreseeable future.

Despite the importance of the rural population, it is still relatively undeveloped and faces many difficulties in improving the situation. The status of water, electricity, schools, roads, and markets is often poor. Furthermore, Israeli authorities have imposed certain obstacles. Land confiscation, and land closure, in addition to fragmentation of land holdings by inheritance laws, have lead to smaller scales of land ownership. The area under cultivation in the West Bank has declined continuously since 1967 because of expropriation of land, lack of access to water resources and other Israeli constraints.

The West Bank is roughly 5,572 square kilometers. The agricultural potential of the West Bank is dictated, in large part, by its topography. For example, the soil is thin in the hilly areas, confining farming there to terraced land and tree cultivation. Land is irrigated in the narrow valley along the Jordan River, but the small plains are used for dry farming. Dry farming depends heavily on a widely variable annual precipitation up to 600-700mm in good years. Therefore, although the cultivated acreage in the West Bank varies according to rainfall, cultivable land accounted for almost one half of the total area. Where livestock production and rain-fed farming have been the main activities, there has been a decline in field crop production and a significant increase in the area devoted to orchards. There have been no radical changes in the type of crops grown.

The rural population in the West Bank represents more than 70% of the total population. Palestinian villages and cities are concentrated in the western part of the West Bank where rainfall is plentiful and land is fertile (Map 5). Moreover, large numbers of Palestinians who were driven out of their homeland in 1948

were settled in the Western part of the West Bank awaiting their return. Because in the areas of low rainfall human settlements in the West Bank tend to be more concentrated, the village population and the average family size increases, as rainfall decreases. From the traditional land use patterns, we can expect many small human settlements in fertile areas, due to the high rainfall and the respective high productivity.

Methodology

This study focused on descriptive statistical analysis of the socio-economic characteristics of the villages, especially of the labor force, agricultural field crops, land ownership, animals, machines and related aspects.

Farmers were selected randomly from villages in the Central Highland Region, primarily in the districts of Ramallah and Bethlehem, as well as in Nablus and Hebron. Villages were selected randomly within these areas on the basis of rainfall contours dividing areas receiving between 200 and 700mm of rainfall annually.

The analysis was done using the Statistical Packages for the Social Sciences (SPSS) and Lotus 123 programs. The analysis includes calculating frequencies and descriptive statistics in addition to generating correlation matrix and multiple regression equations in order to estimate the fitting formula of recorded data and to interpret the results.

Analysis was carried out for demographic and services information, and for the agricultural role in the economic status of the rural population in the West Bank. Villages surveyed were divided, for purposes of analysis, according to rainfall zones: regions with 700mm, 600mm, 500mm and less than 400mm of rainfall annually.

Village And Farmers' Questionnaire Analysis

The questionnaire was analyzed in two stages. The cases were first examined as one unit. Secondly, the data was analyzed according to rainfall zones, variables were identified, and descriptive statistics were calculated for each indicator corresponding to the rainfall level.

Table (1): Village and Farmers Distribution by Rainfall Zones

Rainfall Zones	Villages No. %	Average Population	Farmers No. %	Average Family Size
200-300mm	2 2.9	12000	10 3.6	14.8
300-400mm	7 10.1	6688	28 10.0	9.2
400-500mm	16 23.2	5187	63 22.5	10.1
500-600mm	23 33.3	3639	88 31.4	9.6
600-700mm	21 30.4	2788	91 32.5	8.6
Total	69 100.0		280 100.0	
Average		4290		9.5

Table (1) shows that the average family size is 10 members. In general, an inverse relationship exists between family size and rainfall level. The lower the rainfall, the larger the family. The above table also indicates that a village's average population declines with the corresponding increase in the precipitation level. Low precipitation areas have more population than high rainfall areas. Large family size may be related to general trends in poverty levels and fertility, and to proximity of the villages to each other.

Table (2) Age Distribution by Rainfall Zone (mm/Year)

Age Year	whole%	700%	600%	500%	400%
less 30	7	10	8	6	5
30 - 40	14	10	12	19	16
40 - 50	19	9	25	11	18
50 - 60	26	17	21	29	32
More 60	34	34	35	35	29
Average farmer age	53.4	53.9	53.1	53.3	53.4

Although the mean age throughout the rainfall zones is the same, and farmer's age are concentrated in the range of 50-60 years, there is a negative correlation between age and level of rainfall. In the age range of less than 30 years, the percentage in the upper rainfall areas is higher than in the lower areas.

Table (3) Education Level Distribution by Rainfall Zone

Education Level	Whole	700mm%	600mm%	500mm%	400mm%
Illiterate (1)	24	21	11	33	45
Elementary (2)	42	47	49	37	26
Secondary (3)	20	18	28	18	16
More than (4)	13	14	13	13	13
Secondary Mean for (1-4)	2.2	2.24	2.4	2.1	1.9

The percentage of the population which is illiterate increases relative to lower rainfall with the exception of the 600mm zone. The number of farmers with elementary or secondary education levels increases along with rainfall increases. There is no significant difference in high school education between various rainfall regions.

Speculation about the reasons for the inconsistency in the data on illiteracy is that in this zone, higher levels of basic education are generally found. The northern region corresponds to the 600mm zone, has more irrigated farming and a higher production return than in southern zones, in which field crops and livestock are the main source of agricultural production. With greater incomes, families tend to value education more than in regions with more limited potential for agricultural earnings.

Table (4) Correlation Matrix Between Age, Education, Family Size and Rainfall Zone

	Rainfall	Age	Education	Family Size
Rainfall	1.0			
Age	-0.02	1.0		
Education	0.09	-0.46*	1.0	
Family size	-0.12	0.13	- 0.2*	1.0

*** significant at 0.01 level**

There is a significant negative correlation between age and education levels of the farmers: with increasing age of the farmers, the level of education decreases. On the contrary, the family size also has a negative correlation with the education level of the farmer.

In areas of higher rainfall, there are more farmers below the age of 30, who have higher education levels than their seniors. These lands also have greater agricultural production. Therefore focusing the introduction of technology or better agricultural practices may be most advantageous for production efficiency, when taking these things into account.

Labor Force

Table (5) : Concentration of Labor Force

	1988		1992	
	No. of Laborers	**Percentage**	**No. of Laborers**	**Percentage**
Village	177	46.8	540	54.0
Israel	161	42.6	331	33.0
West Bank	40	10.6	128	13.0
Total	378	100.0	1000	100.0

The above table shows that the average population of all the villages was about 4290. About half of the labor force are working inside their villages, 33% in Israel, and 20% elsewhere in the West Bank.

The percentage of laborers working in villages has shifted from 46.4% to 54.0% and in the West Bank from 10.1% to 20.0% during the 1988-1992 period. Because of the Intifada, boycotts of Israeli work, closed borders and work restrictions the percentage of workers in Israel dropped from 43.5 to 33%.

Table (6) Average Village's Labor Force Distribution by Rainfall Zone

Rainfall Zone	Workers in Israel No.	%	Agriculture in Village No.	%	Livestock Rearing No.	%	Other Job in Village No.	%	Avg.Labor Force
200-	2000	68	400	14	175	6	350	12	2925

300mm									
300-400mm	1121	43	600	23	107	4	770	30	2598
400-500mm	729	32	473	21	18	1	1000	45	2220
500-600mm	250	30	300	35	28	3	263	31	841
600-700mm	220	28	290	37	21	3	250	32	781

Table (6) illustrates three specific village phenomena. Firstly, the number of laborers working in Israel declines corresponding to the increase in rainfall, because of the lack of job opportunities inside the lower rainfall zones. Secondly, the number of farmers has a positive relationship with the level of precipitation, due to the availability of high rainfall and soil fertility. Thirdly, the number of herdsmen decreases as rainfall increases such as in areas of marginal productivity.

The percentages show that there is a great dependence of the rural labor force on Israeli jobs, particularly in the 200-300mm rainfall zone. Israeli employment accounts for 68% of its total labor force, in contrast to 28% in the 600-700mm zone. Taken together with the results of labor shifts illustrated in table (5), rural workers will have been more heavily affected by the border closures.

In rain-fed areas, women play a vital role in farming, particularly in field crop production. The average contribution of women to total household production somewhat exceeds that of men. Women provide more labor than men for cereal and legume crops, although men provide more labor in tree and summer crops.

A multiple regression equation was used, estimating village labor force (dependent variable) as influenced by changes of rural workers inside the West Bank, number of families, and rural population (independent variables). This is summarized in the following formula:

Y^ = -85 - 0.24 x1 + 0.25 x2 + 0.16 x3 R^2 = 77

t-test 3.4 2.2 4.4 F = 50.9

Where: Y^ : Represent estimated rural labor in Israel.

x1 : Rural workers inside West Bank.

x2 : Number of families.

x3 : Rural population.

From the above formula, we may conclude that if each of the independent variables, x1, x2, and x3, increased by one percent, the Y^ will change by -24, 25 and 16% respectively. This means that growth in the number of families affects the rural labor force working in Israel more than the general population growth affects the Palestinian labor force in Israel.

Holding Size

The size of individual property holdings has an important effect on agricultural production. Larger holding size can play a role in minimizing operation cost and improving farmer's income through allowing the introduction of mechanization. Agricultural studies indicate that about 50% of the holdings in the West Bank are less than 10 dunums. Land fragmentation as a result of confiscation, land closures and inheritance make it difficult for farmers to use land efficiently. Consequently, income generated from these holdings is low, sometimes forcing farmers to seek alternative employment opportunities. Additionally, about two-thirds of West Bank land has been appropriated by Israel since 1967.

Table (7) Average Farm Size and Land Use

Rainfall Zone	Avg. Farm Size(dun)	Avg. Olive Area dun %	Avg. Field Crop Area dun %	Other Area %	Total %
200-300mm	77.1	9.2 12.0	62.5 81.0	7.0	100
300-400mm	27.0	6.7 25.0	13.4 50.0	25.0	100
400-500mm	55.0	10.3 19.0	19.7 36.0	45.0	100
500-600mm	38.0	21.6 57.0	13.0 34.0	9.0	100
600-700mm	39.0	21.6 55.0	11.4 29.0	16.0	100
Mean	42.5	17.0 40.0	16.0 38.0	22.0	100

Holding size is a significant indicator of farm production and return. A family's average holding ranges between 77 dunums in the 200-300mm zone and 27 dunums in 300- 400mm zone. General holding size decreases as rainfall increases. Consequently, land use decisions are closely related to seasonal rainfall. The average holding planted in the area surveyed was 42 dunums. About 40% of the total planted area was under olive tree cultivation, and around 38% field crops. Table (7) also indicates that the 400mm zone represents the largest area planted by field crops, which has an average area of about 62 dunums. In contrast, about 11 dunums are planted in the 600mm zone on average. For olive trees, the area under cultivation in the 700mm and 600mm zones averages 21 dunums, in contrast to about 9 dunums in 400mm zone.

Table (8) Correlation Matrix of Cultivated Crop Area by Rainfall Zone.

	1	2	3	4	5	6	7
Rainfall	1.0						
Olive Area	0.2*	1.0					
Citrus			1.0				
Stone Fruit		0.2*	0.5*	1.0			
Field Crops	-0.2*	0.2 *	0.2*	0.4*	1.0		
Vegetables					0.2*	1.0	
Pasture					0.5*		1.0

***: significant at 0.01 level**

The correlation matrix indicates that on the one hand there is a significant positive correlation between rainfall and the area under olive cultivation, as in the central highlands and the northern areas, while on the other hand, there is a negative correlation between rainfall and the area cultivated with field crops, field crops being intensively cultivated in low rainfall areas. Generally, citrus, olives and stone fruit are grown under similar conditions, and field crops, vegetables, and pastures are found under similar conditions.

Table (9) Farm Size Distribution by Rainfall Zone

Farm size(dun)	Overall %	Rainfall Zones				
		700mm%	600mm%	500mm%	400mm%	300mm%
5	33.7	37.0	33.0	43.0	22.0	---
5-20	41.4	41.0	43.0	37.0	52.0	34.0
20-50	16.1	16.4	14.0	10.0	17.0	44.0
50-100	5.7	---	5.0	5.0	9.0	---
100	3.1	3.6	5.0	5.0	---	22.0

Table (9) shows that about 90% of the land holding size in the West Bank ranges between 5 and 50 dunums. Holding sizes in different rainfall zones vary widely. The highest concentration is in the range of 5-20 dunums, except in the region of 200-300mm of rainfall, in which holding size ranges between 20-50 dunums. When holding sizes are greater than 100 dunums there is an inverse relationship between the level of rainfall and holding size.

Agricultural Practices

Overall, animal ploughs are the most commonly used in the West Bank for tilling land. Where field crops are concerned, however, mechanized ploughs are more predominant, especially in the north. For topographical reasons, ploughs in olive groves and orchards are usually animal-driven.

The application of soil fertilizers depends on location, crop variety, farmers' practices, and the level of precipitation. However, farmers in the northern regions use fertilizers more frequently than those in southern districts. In the mountain regions, farmers are known to use less fertilizers on field crops. Manual weeding is practiced by most farmers in field crops. Chemical weeding is a newly-introduced technology, especially in wheat production.

Since land tenure is relatively small, the introduction of combine harvesting machines may not be feasible except in a few areas of extensive field crops. Local topography, especially in the central highland region, is often un- suitable for the use of harvesting machines. As a result, fruit trees and, to some extent, field crops are harvested manually.

Table (10) Plough Animals and Machines by Rainfall Zone

Type	Average	700mm	600mm	500mm	400mm
Plough Animals	116	71	74	75	245
Tractors	19	20	21	10	25
Harvesters	0.6	0.2	0.4	0.6	1.2
Threshers	2.0	1.5	2.4	1.6	2.3
Olive press	1.0	1.3	1.9	0.6	0.0

Table (10) illustrates the applied technology used in cultivation practices in different rainfall zones. More machines are used in the 400mm zone due to type of crops produced, particularly field crops. In high rainfall regions, more trees and orchards are planted so more plough animals are used.

Table (11) Correlation Matrix of Plough Animals and Machinery Used by Rainfall zone.

	Rainfall	Pl. animals	Harves.	Thresh.	Tractor
Rainfall	1.0				
Plough animal	-0.3*	1.0			
Harvesters	-0.1	0.3*	1.0		
Threshers	0.2	0.24	0.75*	1.0	
tractors	0.03	0.05	0.16	0.22	1.0

*** significant at 0.01 level.**

There is a negative correlation matrix between the level of rainfall and number of plough animals and harvesting machines, because field crops are the dominant crop in these areas. Farmers of the low rainfall zone are based mainly on plough animals for transportation and for the planting process.

Range Land Management And Livestock

Livestock production, particularly of sheep and goat, is considered a primary source of income in some villages in the less than 400mm precipitation zones.

Table (12) Average Number of Livestock

	Dairy Cattle No Avg		Milk l/day No Avg.		Broilers 1000 No Avg.		Layers 1000 No Avg.		Hives No Avg.	
Whole Sample	38	24	38	526	47	12	39	3.4	69	31
700mm	12	38	12	929	13	10	10	3	21	58
600mm	15	16	15	283	17	14	16	2.3	23	16
500mm	6	21	6	412	9	5	7	2.3	16	9
400mm	5	21	5	428	8	22	6	8	9	44

There are approximately 24 heads of cattle as an average per village, ranging from 38 head in 700mm zones to 16 head in 600mm zone. Average milk production per day reached 22 liters. Layer and broiler chicken production is concentrated in the less than 400mm zones. About 31 bee hives per village are concentrated in the 700mm zones where beekeepin conditions are good.

Table (13) Correlation Matrix for Rainfall and Other Livestock Variables:

	Rainfall	Dary Cattle	Broiler	Layers	Hives
1-Rainfall	1.0				
2-Dairy Cattle	0.1	1.0			
3-Broilers	- 0.18	0.007	1.0		
4-Layers	- 0.17	0.01	0.4	1.0	
5-Hives	0.1	0.05	0.08	- 0.01	1.0

There is an inverse relationship between the level of rainfall and the number of broilers and layers. Farmers in the less than 400mm zones are based mainly on marginal land for grazing their animals. On the contrary, there is a positive relation between level of rainfall, and dairy cattle and bee hives.

Table (14) Distribution of Farmers by Type of Livestock

Livestock	(1)	(2)	(3)%
Sheep	88	64	0.73
Cattle	22	18	0.82
Goats	79	63	0.80
Donkeys	99	96	0.97

Note:
(1) Total number of farmers who raise livestock
(2) Total number of farmers who raise livestock and plant field crops; and,
(3) Farmers who raise livestock and plant field crops as a percentage of those who raise livestock.

Services

About 90% of the villages are administered either by village councils or mukhtars, appointed by the Israeli authorities or by the Jordanian authorities before 1967 and still holding power. They are limited in their responsibility for development in their villages by Israeli restrictions. In contrast, about 10% of the villages are governed by municipalities, elected locally. Services in these areas are more widely available, especially electricity and water.

61.1% of the villages have running water used for drinking, 30.6% use cisterns and 8.3% use springs. About 35% of the villages use springs to irrigate their crops and about 14% of villages use cisterns. About 52% of the villages do not have any system or method for irrigation, which is an important service for areas which depend on agriculture, as much of the Palestinian economy does.

Out of the 69 villages surveyed, only 10 villages are connected to the National Electrical Grid, while 18 villages depend on small electric generators which operate only a few hours a day. About 61% of the villages have no sources of electricity.

The percentage of post offices which are available in the villages is 34% of the sample surveyed. About 10% of the villages have public libraries. With such limited public information and service access, the interaction and communication between inside and outside is also limited.

The majority of villages, 83.3 %, have access to health services through small clinics at the village level. These services are administered either by the governmental Public Health Department, by voluntary organizations, or by private practitioners.

Conclusion

In the past two decades, village life has experienced many changes, including many political, economic, and social transformations. In some cases change has been a gradual process and in others very sudden. However, improvements in the quality of life are still greatly in need. Housing, education, greater job opportunities and job security are important issues confronting rural men and women.

While most village inhabitants still find part or full time employment in the agricultural sector, net profits are decreasing, and many are forced to find employment outside the village. Many men have found work in the Israeli sector where, in fact, 65% of all West Bank workers come from rural areas. Long term research objectives must focus on the potential for increasing the viability of the dryland farming sector, identifying job opportunities for the rural population, possibly in the underdeveloped agro-industry sector. Lack of extension services, financial and credit institutions, and marketing expertise are significant obstacles which must be overcome.

One step towards increased profitability of the dryland farming sector is the creation of collective units to combat land fragmentation. A decision among owners of adjacent fields to cultivate the same crop will facilitate the use of mechanization and reduce input costs such as fertilizers and pesticides. Efforts to increase the income of rural families who traditionally work in dryland farming should focus on, firstly, the creation of job opportunities for farmers who have only seasonal work on the farm, and secondly, greater participation from women who may be able to sell traditional handicrafts, canned produce, or even initiate a local day care to permit other women the time for these projects.

Within the dryland farming sector, specific objectives must address the needs of low rainfall areas. Although socio- economic characteristics do not vary greatly among villages or districts, it is clear that planting patterns, total annual crop yields and consequently annual revenues are affected by total annual rainfall. As a result, in areas of high annual rainfall rural families are generally smaller and farmers younger and better educated. If this relationship remain constant over the next decade or two, greater variation in socio-economic characteristics will become visible between areas of high and low rainfall. However, obstacles preventing the development of low rainfall areas can be better addressed now. For example, the introduction of drought resistant field crops in low rainfall areas

merits greater emphasis in order to achieve higher yields. Field crops, although more profitable in areas of higher rainfall, are essential to provide feed for livestock which are predominantly raised in areas of low rainfall.

Attempts to boost the agricultural sector will not singularly assist the development process in rural areas. Education is a significant factor as well as the advent of better services and infrastructure. At present most villages have only elementary schools after which children travel to larger villages or towns to continue their education. Girls do not always continue their education at the secondary level, which they might more easily do if secondary schools were available locally. Improved roads, and comprehensive electrical, telephone, water, and waste disposal networks will contribute notably to rural development, specifically promoting small business and agro-industry.

SECTION 3

Palestinian Women And Dryland Farming

Introduction

Palestinian women rural play an important role in the survival of the family.

As a result of sharp increases in the cost of living and the failure of development to meet the challenges of a changing economic environment, the Occupied Palestinian Territories have been witnessing a decline in agricultural and economic development. Continuous expropriation of Palestinian land and seizure of control of water resources by the Israeli authorities have resulted in a number of changes in the labour market, including the economic status of women and their pattern of employment. Repressive economic conditions, political oppression such as deportation and imprisonment, migration and Palestinian men taking up employment in Israel have obliged many rural Palestinian women to work on their land.

During a recent research study on rainfed farming in the West Bank, the role of women in agriculture was raised as an issue of importance to development. Interested groups and organizations - international, regional, and local, both governmental and non-governmental - are increasingly creatin

programs that aim at developing this role of rural Palestinian women. A wealth of information about how these organizations perceive developmental programs for rural women now exists. However, it is difficult to say accurately how many of these programs meet the real needs of rural Palestinian women, or how rural women themselves perceive their role in agriculture.

The absence of adequate information on women's productive activities is not new. National and per capita gross national product (GNP) figures fail to include much, if not most, of the productivity and wealth of women in non- industrialized societies; and the informal exchange of goods and services, which is dominated by female activities in most societies, does not appear in the record keeping that serves as the basis for developmental planning. However, rural women in Palestine are concerned only with daily survival and what's happening beyond one's village is not a high priority.

Women constitute one of the main sectors of the farming labour force that has been unaccounted for and neglected in agricultural economies. The changing economic agricultural environment has forced many farmers to abandon farming work and seek more reliable sources of income outside the farm, thereby leaving

the land in the hands of women. Inevitably, women are then the major contributors to farm work and perhaps the main providers in the farming communities. Helping rural women to enhance traditional needlework or better prepare homemade jams and pickles may be successful programs for furnishing rural households with supplemental income, yet it is recognized that the role of women in practical terms also includes agricultural work in family farm practices as weeding, planting, sowing, fruit picking, marketing family produce and often decision making.

Rural women in general work with energy and considerable courage. Small babies are carried along, young girls come along to help. Women's responsibilities lie in picking fruit such as olives. Collection of animal fodder is also usually the responsibility of women. They gather grass, branches, leaves and fruit to feed small domestic animals such as goats, rabbits and poultry which are kept for their milk and meat

Research Objectives

This project has five major objectives:

1. To understand fully the nature of women's contribution to rainfed farming in the West Bank.

2. To conduct an economic analysis at the micro level of women's contribution to rainfed farming.

3. To identify common constraints and the problems of rural women in dealing with diverse agricultural practices, and to discover their methods of coping with such constraints and problems.

4. To assess their impact on and share in decision-making in various aspects of farming.

5. To make available, through publications, the findings of the project for interested institutions, groups, organizations and individuals, in order to facilitate the planning and implementation of their developmental programs and maximize their impact on agricultural development.

Methodology

The underlying issues concerning the position of Palestinian women in rural areas are not clear. There are few data about rural Palestinian women as so far very little has been published about them. The reasons for this extreme dearth of information are, no doubt, complex, but they probably include a general reticence, based on history and motivation for learning about rural women and the lack of a conceptual framework for looking at women as a separate culture or sub-culture.

In order to overcome these difficulties, questionnaires were designed by ARIJ researchers for the pilot research. It was planned to administer them to women in five villages in the Bethlehem and Hebron districts of the West Bank: Taffuh, Al-Bourj, Dar Salah, Wad Foukin and Um Salamoneh. Women from Um Salamoneh village were approached but declined to participate in the survey, believing that it might subject them and their families to political problems. Thus the sample was limited to 200 women of varying ages and economic conditions from four villages.

A combination of questionnaires and supplementary interviews allowed researchers to gain an insight into the general social background of the subjects, the role they play as producers and sellers, and the problems and constraints facing their development.

Access to rural women was generally made possible by the contacts and mobility of ARIJ researchers, and by the fact that they had established rapport with the women. It is from this project- oriented research and long-term contact with rural women that the framework for details emerged.

For many women participants, the interviews were the first opportunity that they had been given to discuss their situation in any formal context. The questionnaire and interview served to clarify their own beliefs, problems and future expectations.

This project was carried out by female researchers because in a sexually segregated society male researchers are not encouraged and often not permitted to meet with women in the absence of male family members. Moreover, previous ARIJ research in many villages in the OPT revealed that detailed or subjective information may be distorted to reflect the male view of the female world, specifically when men answer for women or when women answer questions in the

presence of men. Female ARIJ researchers are themselves subject to the custom of segregation and often cannot stay in a village long enough to gain the confidence of rural women or fully understand their situation.

The interviews show that women, when listened to, articulate attitudes, beliefs, and aspirations that could constructively influence the developmental process. The recommendations below include Palestinian women's suggestions that researchers should consider.

The success of the project depended on the ability of ARIJ researchers both to administer the project and to provide accurate feedback about the responses of rural women to questionnaire guidelines.

ARIJ concentrated on encouraging sensitivity and change in their researchers' attitudes toward rural life and rural women and emphasizing the knowledge to be learned rather than taught and the significance and contribution of the rural experience to Palestinian culture.

Results

Analysis of the data was undertaken in order to determine female input in the household and input on the farm. The questionnaires were statistically analyzed to determine the relationships between women's involvement in farming and certain socio-economic variables. These included the amount of land owned, farmed, rented, and planted and characteristics of the women interviewed, including age, marital status, number of children; experience in farm management; sources of income; membership in agricultural cooperatives; problems and prospective developments.

Location of the Sample

A sample of 200 women was chosen from the following villages:

Al-Bourj, Dar Salah, Taffuh and Wad Foukin, each with different annual rainfall and cultivated areas as shown in Table I.

Table I: Location Of The Sample

VILLAGE	ANNUAL RAINFALL mm	AVERAGE PER CAPITA CULTIVATED AREA Dunums
Al-Bourj	200 - 300	3.61
Dar Salah	300 - 400	2.70
Taffuh	400 - 500	7.82
Wad Foukin	500 - 600	4.51

Average cultivated area per person is relatively low in Dar Salah (2.7 dunums), principally due to mountainous landscape which makes cultivation difficult, a lack of springs, and poor accessibility to primary transportation routes.

Al-Bourj, which has less annual rainfall than Dar Salah, has 3.61 dunums of cultivated area per person. This figure used to be higher, but land confiscations by Israelies authorities have reduced total cultivated dunums somewhat.

Taffuh village has both a high average rainfall (400- 500mm) and access to spring water. As a result, each person can farm an average of 7.82 cultivated dunums. Wadi Foukin, on the other hand, receives between 500-600mm of rainfall each year, but the average number of cultivated dunums per person is only 4.51. Geography and fewer total dunums are the primary factors for reduced cultivated area. Moreover, farmers in Wad Foukin cultivate irrigated vegetables which require considerable labor while stone fruits, which are the main crops in Taffuh, do not.

Age,MATERIAL Status,and Number of Children

Most women interviewed were married and between the ages of 27 and 50, as shown in Tables 2 and III, respectively. While these characteristics do not appear to significantly effect the degree of a woman's involvement in agriculture, the number of children a woman has does effect her involvement in the field

Table 2: Marital Status Of Women

Status	Taffuh		Wad Fukin		Dar Salah		Al-Bourj		Total	Total
	#	%	#	%	#	%	#	%	#	%
Married	47	94.0	50	79.4	39	78.0	33	89.2	169	84.4
Widowed	1	2.0	8	12.7	7	14.0	3	8.1	19	9.5
Divorced	1	2.0	0	0.0	2	4.0	0	0.0	3	1.5
Single	1	2.0	3	4.8	2	4.0	1	2.7	7	3.5
No Response	0	0.0	2	3.2	0	0.0	0	0.0	2	1.0
Total	50	100.0	63	100.0	50	100.0	37	100.0	200	100.0

Table 2 indicates that almost 85% of the women surveyed were married, 9.5% widowed, and 3.5% single.

Table 3: Age Of Women Surveyed

AGE	Taffuh		Wad Fukin		Dar Salah		Al-Bourj		Total	total
	#	%	#	%	#	%	#	%	#	%
15-20	4	8.0	1	1.6	0	0.0	0	0.0	5	2.5
21-26	10	20.0	3	4.8	3	6.0	3	8.1	19	9.5
27- 32	8	16.0	14	22.3	12	24.0	3	8.1	37	18.5
33-38	13	26.0	13	20.6	11	22.0	7	18.9	44	22.0
39-44	4	8.0	11	17.5	7	14.0	9	24.3	31	15.5
45-50	7	14.0	14	22.3	11	22.0	5	13.5	37	18.5
51-56	1	2.0	3	4.8	3	6.0	3	8.1	10	5.0
57-63	2	4.0	3	4.8	0	0.0	4	10.8	9	4.5
64-70	1	2.0	1	1.6	2	4.0	3	8.1	7	3.5
71-80	0	0.0	0	0	1	2.0	0	0.0	1	0.5
TOTAL	50	100.0	63	100.0	50	100.0	37	100.0	200	100.0

Table 4: Number Of Children & Role In Agriculture

Role in Agriculture	Number of Children					
					Total	
	1-4	5-8	9-12	>13	#	%
All Aspects of Farming	3	7	1	0	11	5.9
Major	20	39	16	2	77	41.4
Minor	25	40	19	1	85	45.7
None	6	2	1	2	11	5.9
N/A (No Land)	2	0	0	0	2	1.1
Total	56	88	37	5	186	100.0

From Table III above, it is apparent that most women working in agriculture are between the ages of 27 and 50. Often, women between these ages have children who are in school or do not need constant care. Women who are between the ages of 21 and 26 often have younger children and cannot leave them home alone to work on the farm. Table IV above demonstrates the relationship between a woman's involvement in agriculture and the number of children she has. Women with 1 to 4 children often have small children whom they must constantly watch and thus have little or no time to help in the fields. When women have more than four children, the older children may care for the younger while the women take on greater responsibility for the farm. However, women with 9 to 12 children usually have older sons or daughters who begin to work on the farm. Finally, those with 13 or more children frequently have elder sons and daughters-in-law who play important roles in the farm work and housework.

Education

Typical of women in most villages, the women interviewed received little educational training. Many were illiterate. A variety of explanations for lack of schooling was provided. Many explained that it was not customary to educate girls when they were young. Others claim little need to educate girls as they soon move on to their husbands' houses.

Although few women were formally educated, many have sent their daughters to school or would if they could afford it. Education for girls appears to be more valued today as the primary obstacle is a lack of resources and not lack of social sanction. Elementary schools now exist in each village, but secondary schools are often located only in larger towns. Al-Bourj, for example, has one elementary

school for boys and another for girls. Dar Salah has a co- educational elementary school, and Wad Fukin and Taffuh have no schools at all. Once a child finishes the elementary level, transportation costs become a limiting factor for poorer families. As a result, boys often continue through the secondary level while girls may or may not.

Place of Interview

ARIJ researchers used contacts from previous visits to the villages to guide them and encourage other women to meet at a specific place on appointed days. This greatly facilitated the work of the researchers and also convinced more village women to participate. While 6.5% of all interviews were held at the village health clinic, the majority (53%) were held inside the woman's house and 35.5% held at a neighbor's.

Table 5: Place Of Interview

Place	Total #	Total %
Own House	106	53.0
Neighbour's	71	35.5
Health Clinic	13	6.5
Street	5	2.5
Field	2	1.0
Son's	1	1.0
Father-in-Law's	1	1.0
Family Diwan	1	0.5

Head of Household, Status & Occupation

It is significant to note that most heads of households were working in the Israeli sector, specifically in construction. When respondents were asked why land was neglected for work in Israel, many commented on the high salary and relative stability offered in the Israeli sector compared to the turbulent agricultural sector which is characterized by uncertainty due to irregular and often inadequate rainfall and seasonal concentration.

Table 6: Status Of Head Of Household

STATUS	Taffuh		Wad Fukin		Dar Salah		Al-Bourj		Total	Total
	#	%	#	%	#	%	#	%	#	%
Present	43	86	51	81	43	86.0	25	67.6	162	81.0
Out-of-Town	0	0	0	0	0	0.0	1	2.7	1	0.5
Deceased	2	4	8	12.6	6	12.0	2	5.4	18	9.0
Handicapped	5	10	2	3.2	1	2.0	8	21.6	16	8.0
Missing Variable	0	0	2	3.2	0	0.0	1	2.7	3	1.5
TOTAL	50	100	63	100.0	50	100.0	37	100.0	200	100.0

Table 7 : Occupation Of Head Of Household

Occupation	Taffuh		Wad Fukin		Dar Salah		Al-Bourj		Total	Total
	#	%	#	%	#	%	#	%	#	%
Handicapped/Deceased	8	16.0	12	19.0	7	14.0	12	32.5	39	19.5
Laborer	36	72.0	40	63.5	33	66.0	17	45.9	126	63.0
Farmer	5	10.0	4	6.3	1	2.0	4	10.8	14	7.0
Stone Quarrier	0	0.0	0	0.0	1	2.0	0	0.0	1	0.5
Mechanic	0	0.0	0	0.0	2	4.0	1	2.7	3	1.5
Driver	0	0.0	3	4.8	3	6.0	0	0.0	6	3.0
Olive Wood Manufacturer	0	0.0	0	0.0	1	2.0	0	0.0	1	0.5
Mukhtar	0	0.0	0	0.0	0	0.0	1	2.7	1	0.5
Storekeeper	0	0.0	1	1.6	1	2.0	1	2.7	4	2.0
Company Employee	1	2.0	3	4.8	1	2.0	1	2.7	5	2.5
Total	50	100.0	63	100.0;	50	100.0	37	100.0	200	100.0

Table 8: Place Of Employment

PLACE	Taffuh		Wad Fukin		Dar Salah		Al-Bourj		Total	Total
	#	%	#	%	#	%	#	%	#	%
Unemployed	8	16.0	11	17.4	7	14.0	13	35.2	39	19.5
Israel	35	70.0	40	63.5	33	66.0	18	48.6	126	63.0
Home Village	7	14.0	3	4.8	6	12.0	5	13.5	21	10.5
Bethlehem	0	0.0	8	12.7	3	6.0	0	0.0	11	5.5
Beit Sahour	0	0.0	0	0.0	1	2.0	0	0.0	1	0.5
Jerusalem	0	0.0	1	1.6	0	0.0	0	0.0	1	0.5
No Response	0	0.0	0	0.0	0	0.0	1	2.7	1	0.5
TOTAL	50	100.0	63	100.0	50	100.0	37	100.0	200	100.0

Table 9: Additional Employment

		# OF SAMPLE	% OF SAMPLE
SPOUSE HAS SECOND JOB	**Yes**	15	7.5
	No	184	92.0
	No response	1	0.5
	TOTAL	200	100.0
SECOND JOB, as	**Laborer**	2	13.3
	Farmer	13	86.7
	TOTAL	15	100.0

When subjects were asked if their husbands had part-time work on the side (Table VIII), 92% responded negatively and 7.5% positively. Almost 87% of those who hold a second job work in the agricultural sector part-time.

Predominant Cultivation Patterns

Olive trees are the primary crop cultivated in all four villages, followed by vegetables and stone fruits. Fruit trees are concentrated in Taffuh and vegetables in Wad Fukin village.

Table 10: Predominant Cultivation Patterns

DUNUMS	OLIVE TREES		VINEYARDS		STONE FRUIT		FIELD CROPS		VEGETABLES	
	#	%	#	%	#	%	#	%	#	%
0.00	93	46.5	171	85.5	149	74.5	161	80.5	137	68.5
0.05	1	0.5	-	-	-	-	-	-	-	-
0.20	-	-	-	-	-	-	-	-	1	0.5
0.50	9	4.5	5	2.5	-	-	-	-	3	1.5
1.00	25	12.5	5	2.5	14	7.0	14	7.0	23	11.5
1.50	3	1.5	-	-	-	-	-	-	1	0.5
2.00	22	11.0	4	2.0	17	8.5	9	4.5	22	11.0
2.50	1	0.5	-	-	-	-	-	-	-	-
3.00	14	7.0	3	1.5	4	-	-	-	8	4.0
3.50	1	0.5	-	-	-	-	-	-	-	-
4.00	4	2.0	3	1.5	-	-	5	2.5	1	0.5
4.50	-	-	-	-	-	-	-	-	-	-
5.00	8	4.0	6	3.0	9	4.5	1	0.5	1	0.5
5.50	1	0.5	-	-	-	-	-	-	-	-
6.00	2	1.0	-	-	-	-	3	1.5	-	-
6.50	-	-	-	-	-	-	-	-	-	-
7.00	3	1.5	1	0.5	1	0.5	-	-	1	0.5
8.00	5	2.5	-	-	1	0.5	1	0.5	-	-
9.00	1	0.5	-	-	-	-	-	-	-	-
10.00	4	2.0	1	0.5	3	1.5	4	2.0	1	0.5

12.00	-	-	-	-	-	-	1	0.5	-	-
15.00	-	-	-	-	2	1.0	-	-	-	-
20.00	2	1.0	1	0.5	-	-	1	0.5	-	-
25.00	-	-	-	-	-	-	-	-	1	0.5
30.00	1	0.5	-	-	-	-	-	-	-	-

 # = Numberin sample.
% = percentage of sample

Rented Land

Very few women in any of the four villages surveyed rent land. Table (XI) shows that only 14% of the women replied that they do rent land. Primary crops planted on rented plots are vegetables and field crops; trees are rarely planted as they take a long time to mature. In general, the research team observed that families cannot cultivate enough to feed themselves if they farm less than one dunum. They must find other sources of income. Families who farm more than two dunums, depending on farming intensity, may be able to feed themselves off the land and in some situations have a surplus. However, they must also depend on additional sources of income for other needs. The number of landless families (who do not have land other than their homestead) is not precisely known. The women interviewed who do not have land to farm generally depend on their husbands' salaries from work in Israel.

Table 11 : Rental Of Farm Land

DO YOU RENT LAND?	NO. in SAMPLE	% OF SAMPLE
No	184	92.0
Yes	16	8.0
TOTAL	200	100.0

Cooperation among Women

When asked if women would be interested in cooperating with each other in agricultural work and raising livestock, most responded that they prefer to work independently. Some commented that relatives would be the best partners because they share family background and therefore are more trustworthy and have similar knowledge of agriculture.

It should be noted that cooperation among village women is rare in societies where resources are scarce, division of labor based on gender is strict, and women are often isolated from each other and have little access to outside resources independent of the males in their families. Without the introduction of change, it will be difficult for women in these circumstances to develop effective group power or leadership.

Purchasing and Marketing Sixty percent of the subjects' husbands purchase agricultural products with a marginal 6.5% of the women surveyed involved in this activity (Table 12). Women do appear to be more involved in selling their produce, however, as demonstrated in Table 12. While little over 6% of the women surveyed purchase the necessary farm supplies, 13% of survey pool are responsible for selling their produce in the market. Moreover, 42% of the women surveyed don't even sell their products but perhaps keep them for home use. Those from Wad Fukin and Dar Salah who do sell their products typically market them in Bethlehem; products from Taffuh and Al-Bourj are sold to wholesalers at the local central market.

Table 12: Family Member Responsible For Purchasing Products

RELATION	NO. IN SAMPLE	% OF SAMPLE
Husband	120	60.0
Agri. Commodities	46	23.0
Son	10	5.0
Wife/Interviewee	10	5.0
Father	4	2.0
Father-in-law	3	1.5
Husband & Wife	3	1.5
Brother	2	1.0
No Response	2	1.0

Do Not Purchase	0	0.0
TOTAL	200	100.0

Table 13: Sale Of Products

ARE MOST OF YOUR PRODUCTS SOLD?	NO. IN SAMPLE	% OF SAMPLE
Yes	113	56.5
No	85	42.5
Missing Variable	2	1

Table 14: Family Member Responsible For Selling Products

RELATION	NO. IN SAMPLE	% OF SAMPLE
Do not sell	85	42.0
Husband	58	29.0
Wife/Interviewee	27	3.5
Son	6	3.0
Husband & son	5	2.5
Father-in-law	5	2.5
Mother-in-law	3	1.5
Father	3	1.5
Mother	2	1.0
Brother	2	1.0
Husband & father-in-law	2	1.0
Missing Variable	2	1.0

Health Conditions

Researchers observed that health conditions among the rural Palestinian women remain inadequate. A local health clinic exists in every village, but severe cases

are taken to the nearest town. Researchers noted that the health of rural women is often inferior to that of men due to frequent pregnancies and prolonged nursing. Many women expressed that they prefer to have small families, but cultural and religious norms dictate otherwise. Many husbands are perhaps more traditional than their wives in still wanting many children.

The Family as an Economic Unit

Our study of rural women reveals that the family is the basic economic unit on which its members depend for economic survival and advancement. Through it, rural people seek to satisfy their basic needs, utilizing all human and material resources and deploying male and female, young and elderly for maximum socio-economic advantage. Number and status of it members, available opportunities, and the social ideology of the village all merge to determine the nature of each member's contributions. A son's contribution to the family and concurrent training or responsibilities will depend on the factors mentioned above. He may, for example, begin working as a laborer at an early age or work on the land and receive little or no education. Or if socio-economic factors permit, he may continue through the primary or secondary level to be qualified for a low-paying job in the nearest town or may even continue his education through the highest possible level in order to attain a prestigious job in an urban area. In any case, the son's course will be determined by socio-economic factors in pursuit one goal, meeting the needs of the family.

Polygamy

Polygamy was practiced by only 3.5% of the husbands whose wives were surveyed. Researchers noted that although there may be tension and rivalry between the two wives, cooperation and mutual help is equally prevalent in all spheres of activity. Household work, routine, and festivities are shared between them.

Table 15 : Polygamy

SPOUSE HAS SECOND WIFE	NO. IN SAMPLE	% OF SAMPLE
No	190	95.0
Yes	7	3.5
Not married	3	1.5
TOTAL	200	100.0

Access to Information

While men have access to information in or outside the village, or wherever they may be, women cannot easily obtain information because they often have difficulty moving outside the village without an attendant son or husband. Women ordinarily hear news from men, from each other, or from visiting relatives, and are fairly well informed on issues that are of interest to them or concern the village. Men, on the hand, have access to news wherever it is disseminated or at gathering places such as the mosque or market.

Women's Responsibilities and Duties

Women are responsible for numerous tasks, concerning both the household and the farm. They are almost singularly responsible for poultry, milking and dairy products, food storage, household chores, and food preparation. They harvest fruit, weed planted areas, cultivate homestead land, and manage the use of by-products such as manure.

Poultry management includes letting the chickens in and out of the cages and feeding them twice a day, protecting them from theft and disease, breeding them, providing safe places for the eggs to hatch, and collecting the eggs for home use or for sale. Raising chickens involves almost no expenditure. They provide protein for the family in the form of eggs or occasionally meat. They allow the woman to save a little money on a regular basis or serve as a backup in case of small emergencies. Some households have rabbits and pigeons.

Other livestock are common on rural farms, with 53% of the families surveyed owning sheep, goats, or cows. Sons or husbands are primarily responsible for grazing; women attend to milk and dairy production. Milk is generally for family consumption and any surplus may augment family income.

Table 16 : Family Member Responsible For Milking

RELATION	NO. IN SAMPLE	% OF SAMPL
Woman/Interviewee	104	52.0
Husband	3	1.5
Daughters	3	1.5
Sons	2	1.0
Woman or husband	1	0.5

Missing Variable	6	3.0
No animals	81	40.5
TOTAL	200	100.0

Table 17 : Family Member Responsible For Processing Milk

RELATION	NO. IN SAMPLE	% OF SAMPLE
Woman	106	53.0
Husband	5	2.5
Children	1	0.5
Missing Variable	6	6.0
No animals	82	41.0
TOTAL	200	100.0

While wheat and barley harvesting is mostly mechanized, women do assist when manual harvesting is required. Over 75% of the women help cultivate the land and weed and nearly 70% help pick ripe fruit from the trees. In cultivating the homestead, women must prepare the soil, sow seeds, water, and keep crops free from insects and other pests. They must also select vegetables for seed stock and preserve the seeds to be used in the next season. Little or no expenditure is required in these processes.

Husband/Wife Consultation

Women were asked if they were consulted by their husbands when the family needed to borrow money. 51% responded positively and 5% negatively. This question was not applicable to one third of the women interviewed whose husbands had never borrowed money. Moreover, subjects were asked from whom they most frequently borrow money. Relatives have lent money to 45% of those interviewed; merchants to 24%, and close neighbors to remaining 31%.

Table 18: Husband/Wife Consultation

SPOUSE CONSULTS WIFE BEFORE BORROWING MONEY	NO. IN SAMPLE	% OF Sample
Yes	102	51
No	10	5
Do not borrow	66	33
No Response	22	11

Adoption of New Technology

When asked about the adoption of new technology or new methods, 82% of the women replied that they had heard of using hormones for sheep and goats, and 70% had heard of artificial insemination. Seedless grapes were familiar to 59% of those interviewed and chemical fertilizers familiar to 53% of the survey pool. Most had learned about these methods or new varieties from farmers in their village. At present, however, only the use of hormones has been adopted in villages in the West Bank. And although the use of new technologies is accepted and even welcomed in villages, limited capital and high uncertainty and risks related to local agro-climatic conditions and the annual variability of rainfall prevent farmers from easily adopting these methods.

Perspectives on Problems Facing the Agriculture Sector

Participants in the survey expressed their opinions regarding the development constraints in the agricultural sector. They are summarized as follows:

- large distance between house and field and lack of agricultural roads to facilitate movement,
- lack of agricultural experts in villages surveyed, excluding Dar Salah,
- lack of veterinarian assistance,
- insufficient water for personal hygiene or agricultural use, numerous soil diseases and no correspondent research to provide remedies,
- Israeli land confiscation practices which usurp significant proportions of agriculture land,
- and intrusion of animals, e.g. deers, camels, and rabbits, that feed on seedlings and destroy crops.

Perspectives on Future Development

When women were asked about their hopes for future agricultural development, they mentioned the following needs:- to improve production techniques;

- To improve access to agricultural credit for small farmers;
- To develop facilities for supplying agricultural inputs,
- To establish more efficient road networks to facilitate farmers' movements to and from their land;
- To establish medical facilities for humans and livestock, and facilities for soil research; and
- To improve water supply to ameliorate living conditions.

CONCLUSIONS

The principal goal of this preliminary survey on Women in Agriculture was to identify priorities for the agricultural sector and for women's work therein as perceived by women themselves. Through the results of this first phase, a basic formula can be derived to translate objectives into action.

Persistent lack of knowledge about women's work in and contributions to the agricultural sector may undermine or retard the development process as priorities and goals are distorted. Moreover, assumptions concerning the universality

of the development process, both in industrial and underdeveloped countries and among men and women, may not only delay development but may mislead us. Thus we emphasize the significance and even uniqueness of the Palestinian women's role in agriculture in her country. Effects of various development processes on the life of the rural woman must also be weighed, and she must be a full partner in this process, not merely a factor under consideration.

As demonstrated above, rural women do not form a homogeneous group. Disparate opportunities for education and access to choice and participation result in different degrees of responsibility and involvement. Women's control over resources is notably less than men's, based on the tradition that women should not be visible and should not have to "work". Limited educational opportunities prevent rural women from having effectual control over the course of their lives.

Rural women cope and occasionally prosper. They move within the bounds of tradition and ideology, seeking to expand these rather than overstep them. Lack of mobilization multiplies the risks of questioning tradition and ideology as rural women rarely move beyond the villages in which they are born and in which they marry.

Although rural women are adept at identifying their needs and the requirements of survival and success, inadequate resources often obstruct their goals. They must carefully analyze new projects, weighing potential risks and gains. They most frequently opt to minimize risks at the expense of increased profit. Development programs must encourage the use of limited resources in a way that expands women's options and furnishes greater security and control over their lives.

Lastly, rural development programs must be designed and directed specifically towards women to permit them to make the desired changes in their lives and to chart an approved course for the future. Agendas should incorporate rural women's perceptions, perspectives, and manifest behavior and recognize that these are part of the indigenous culture, not isolated, independent variables. Programs which have been based solely on the needs of rural men cannot accomplish synchronized, projected development for the whole society, no matter how significant or insignificant the woman's role is viewed to be.

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SECTION 4

Field Crop

Part 1: Cereals

1. Introduction

Cereals are considered the main source of energy for the diets of humans and animals. Their importance also derives from the superiority of these crops in withstanding drought conditions, and from their high productivity under suitable environmental conditions. Cereals occupy the largest area of cultivated land in the world, grown on an average of 70 million hectares yearly (FAO 1990).

As the world population increases, there is a need to cultivate and produce more grains every year. Over the last four decades, world wheat production rates have increased annually by two to three percent due to the introduction of genetically improved genotypes, fertilizers and new mechanization.

2. Status of Cereal Production in The O.P.T.

The total area under cultivation ranks, cereals first among other cultivated field crops in the O.P.T. , covering about 389.9 thousand dunums. Wheat is the most important among the cereal crops. It covers an average area of 197.5 thousands dunums, representing 50.4% of total area ofcereals, while the total cultivated area of barley is around 174.2 thousand dunums, representing 44.4%, and sorghum, 20,328 dunums, representing 5.2%.

Cereals in the O.P.T. are cultivated mainly under rainfed conditions. In addition to the problems associated with poor rainfall, improper cultivation practices, inadequate pest and disease control, minimal use of fertilizers and planting of low yielding varieties inhibit proper growth of crops.

3. Agricultural Practices and Cereal Cultivation

Developing tillage practices involves several steps.

Land preparation for planting includes primary tillage, in which moldboard and disc ploughs are used to a depth of 25- 35cm. These implements are used after harvesting, in order to turn over the plant residues of the previous crop and to control summer weeds by exposing soil to sun and heat. This helps to control soil-borne diseases and to reduce water loss through evaporation by preventing capillarity.

Secondary tillage follows primary tillage to prepare the seedbed. Cultivators and harrows such as rotovators, spikes or small sweep and chisel harrows are used in order to break up large clods and to make the seedbed fine. This method can be repeated more than once to properly incorporate residues into the soil, to increase water holding capacity, and to control weeds. These harrows can loosen the soil surface to a depth of 8-10cm. Although fall-sowing is more dominant, some farmers prefer to sow after the rains begin. Some agricultural studies show that the earlier the sowing, the higher the yield produced, as illustrated below.

Cereals are commonly sown by the broadcasting or drilling method. Use of the drilling method is limited by many factors including size and topography of land holding and the costs of using machines. Drilling, however, has many advantages over the broadcasting method. Uniform distribution of the seeds, better establishment of plants, and application of nitrogen and phosphorus directly to the seeds result in higher yields and reduce the cost of adding fertilizers separately.

Sowing date is another important factor which determines the duration of the growing season and increases water use efficiency. Plant suitability to various temperatures affects planting time. Wheat and barley are the most cultivated winter cereals, sown in fall. Sorghum, however, a summer crop and the third most important cereal, must be sown in spring after the danger of frost is gone.

Due to the small size of land holdings, mechanization of cereal cultivation is limited in the O.P.T. The Applied Research Institute of Jerusalem study found that about 75.1% of the O.P.T. holdings ranged between 5 and 20 dunums. As the rate of rainfall increases, the size of land holdings decrease.

As the size of land holdings decreases, the opportunity for mechanization of cultivation decreases. About 46% of the lands are cultivated by animal ploughing, and 32% by machines. The percentage of animal ploughing increases in the south because regional topography plays a major role in limiting the use of mechanization. Animal ploughing is more dominant in mountainous lands since in steep lands, contour ploughing must be applied to prevent soil erosion (Table 1).

Table 1: Ploughing Methods for Cereals in The West Bank

Commodity Used	WB%	Jenin &Tulkarem%	Nablus%	Ramallah%	Bethlehem &Hebron %
Animal	46	15	29	55	54
Machine	32	80	37	21	25
Both	22	5	34	24	21

3.1 Most Cultivated Cereals

The most cultivated cereals in the O.P.T. are wheat, barley and sorghum. Each of these crops requires certain environmental conditions to reach optimum growth and yield.

3.1.1. Wheat Cultivation

Wheat, from which bread is made, is a vital crop which responds well to the environmental conditions of the Mediterranean region. The length of the total growing period of wheat ranges from 180-200 days according to the variety used. This crop can be grown in a wide range of soils, although medium textures are preferred, and is moderately tolerant to soil salinity.

Local farmers usually cultivate winter wheat as the growing requirements of winter wheat fit with the climatic conditions of the O.P.T. Winter varieties require a cold period or chilling during early growth for normal heading.

Wheat crops are irrigated in some parts of the O.P.T. , mainly in the Jordan Valley. Wheat is preferably cultivated in two year rotations after lentils, chickpeas or the fallow year. There has been a noticeable drop in the cultivated areas of wheat in the West Bank within the last 25 years. The cultivated area of wheat dropped from 464,900 dunums in 1967 to 156,600 dunums in 1992. In Gaza Strip there is no change in the cultivated area since 1985, where the average area of wheat is around 12.9 thousand dunums (Table 2).

Table 2: Areas of Wheat (1000 Dunums) in the O.P.T.

Year	Tulkarem	Nablus	Jenin	Hebron	Jericho	Bethlehem & Ramallah	Total	Gaza Strip	O.P.T total
1966	----	---	---	---	---	----	459.8	----	459.8
1967	----	---	---	---	---	----	464.9	----	464.9
Avg.	----	---	---	---	---	-----	462.4	----	-----
1985	29.2	28.3	33.6	60.6	0.65	37.5	189.9	7.5	197.4
1986	29.6	27.1	40.0	50.5	0.18	33.5	180.9	13.5	194.4
1987	25.4	44.8	31.6	55.0	---	38.1	194.9	11.0	205.9
1988	32.0	38.2	33.8	45.2	2.7	37.3	189.2	9.2	198.4
1989	30.9	46.9	43.2	51.1	3.8	36.7	212.6	10.7	223.3
1990	36.5	44.3	38.7	48.6	0.9	39.9	208.9	12.7	221.6
1991	20.2	30.1	36.1	30.0	2.4	25.0	143.8	18.9	162.7
1992	24.3	23.7	32.5	40.9	9.3 25.9	156.6	19.4	176.0	
Avg.	28.5	35.4	36.2	47.7	2.9	34.2	184.6	12.9	197.5

*** = Under irrigation ---- = No available data**

The average productivity of wheat in the West Bank is 163.5 kg/dunum. In Tulkarem, which gave a yield higher than in other areas, the average yield of wheat was 350kg/dunum in 1990, while it was about 200kg/dunum in 1985. The average yield of wheat in Gaza Strip and the northern areas is higher than in the southern areas. The higher average productivity of wheat in Jericho is related to planting under irrigation (Table 3).

Moreover, there is a correlation between the total average annual rainfall and the total average yield of both wheat and barley. In 1987 the average annual rainfall of the West Bank was around 641mm, resulting in higher wheat productivity (210kg/dunum) as compared to the previous two years. As rainfall began later in 1991, however, West Bank productivity reduced significantly to 96 kg/dunum. Fluctuation exists within the same area and among different areas for different years. As not all of this is due to rainfall variations, investigations into the causes would be useful in increasing production.

Most of the wheat varieties cultivated are Israeli. These include: Bread Wheat (Triticum aestivum) and Durum Wheat (Triticum durum) varieties, the names and growth characteristics of which are found in Table 4.

Table 3: Productivity of Wheat (kg/dunum) in the O.P.T.

Year	Tulkarem	Nablus	Jenin	Hebron	Jericho	Bethlehem & Ramallah	Avg.of W.B.	Gaza Strip
1985	200	130	170	55	---	120	135	50
1986	250	120	100	80	175	220	158	300
1987	250	155	350	135	200	170	210	300
1988	220	104	150	50	---	135	132	330
1989	220	104	150	70	250	220	169	330
1990	350	200	250	120	200	250	228	300
1991	80	66	120	55	200	55	96	350
1992	120	142	250	80	350	135	180	250
Avg.	211	128	193	81	229	163	163.5	276

*** Under irrigation.**

Table 4: Cultivated Wheat Varieties in the O.P.T.

Variety	Plant Height (cm)	Resistant to	Utilization
BREAD WHEAT			
Bethlehem	95-98	yellow rust	bread
Shaffir	90	rust, lodging	bread
Ateer	95	yellow rust, stem rust, leaf rust	bread
Lakhesh	100	yellow rust stem rust	bread
HARD WHEAT			

Breket	90-100	yellow rust, stem rust lodging	pastries
Anber	90-100	yellow rust lodging	pastries, pasta

3.1.2. Barley (Hordeum vulgare) Cultivation

Barley is mainly grown as a rainfed crop in the O.P.T. It is more resistant to drought and environmental stresses than is wheat. There has been a noticeable change in the cultivated areas of barley in the O.P.T. within the last decade as compared with the 1960s. In the West Bank the barley cultivation area dropped from 231,000 dunums in 1967 to 141.600 dunums in 1992. In the Gaza Strip the area of barley increased from 1,000 dunums in 1967 to about 21.8 thousands dunums in 1990 (Table 5).

Table 5: Barley Cultivation Area (1000 dunums) in the O.P.T.

Year	Tulkarem	Nablus	Jenin	Hebron	Jericho*	Bethlehem& Ramallah	Total W.B.	Gaza Strip	O.P.T Total
1966	----	---	-----	----	----	----	195.8	---	195.8
1967	----	---	-----	----	----	----	231.0	1.0	232.0
Avg.	----	---	-----	----	----	----	213.4	1.0	213.9
1985	14.5	13.3	29.2	79.9	0.4	17.2	154.4	13.8	168.2
1986	15.7	13.2	32.7	79.1	---	17.0	157.7	28.1	185.8
1987	14.1	19.7	26.8	88.3	---	17.2	166.1	21.0	187.1
1988	18.0	17.7	33.9	87.0	2.7	18.0	177.3	21.8	199.1
1989	17.1	17.1	24.4	66.8	1.1	17.9	144.4	21.8	166.2
1990	21.2	21.0	27.5	92.5	0.9	18.5	181.6	21.8	203.4
1991	11.0	11.5	26.1	62.8	0.2	11.6	123.2	8.3	131.5
1992	14.3	8.7	20.3	83.8	1.4	13.1	141.6	11.0	152.6
Avg.	15.7	15.3	27.6	80.0	1.1	16.3	155.8	18.5	174.2

* Under irrigation ---- = No available data

The average barley yield is more stable and is higher in Gaza and the northern parts of the O.P.T. than in Hebron. Respective values are 241, 199, and 81 kg/dunum. In Jericho, all barley crops are irrigated (Table 6). The average yield of barley dropped in 1991 due to late rains, to an average of 95kg/dunum in the West Bank. This value is higher than wheat in that year, suggesting that barley can withstand more drought conditions than can wheat.

The varieties of barley cultivated in the O.P.T. are of Israeli origin and include Naomi 531, Rout, Ma'leet and Noga. There is only available information about Rrout and Naomi 531. Some of their growth characteristics are listed in Table 7.

Table 6: Productivity of Barley (kg/dunum) in the O.P.T.

Year	Tulkarem	Nablus	Jenin	Hebron	Jericho*	Bethlehem& Ramallah	Avg. of W.B.	Gaza Strip
1985	220	165	200	65	120	240	168	30
1986	200	150	125	55	---	320	170	250
1987	200	200	350	130	150	212	207	150
1988	180	149	200	60	---	166	151	310
1989	180	150	200	90	200	270	182	310
1990	370	240	200	120	---	400	266	270
1991	120	82	150	55	100	60	95	350
1992	125	175	200	75	250	160	164	260
Avg.	199	164	203	81	164	229	175	241

* Under irrigation

Table 7: Barley Varieties in the O.P.T.

Variety	Characteristics
Rout	Two rows, ripens early, high productivity, large grains susceptible to lodging.
Naomi-531	Six rows, ripens early, high productivity, small grains.

3.1.3. Sorghum Cultivation

Two kinds of sorghum are cultivated in the O.P.T. for their grain production: white corn (Sorghum bicolor) and broom corn (Sorghum vulgare).

A minor part of the white corn seed production is used for a traditiona sorghum toasted bread called Qaradeesh. The rest is used for animal food concentrates, and the straw is used as roughage.

The broom corn grain yield is used mainly in animal concentrates, and the remainder is stored to be cultivated the following season. After threshing, the inflorescence is used in making brooms while the straw is used for animal feed.

Sorghum has several drought-resistant characteristics. It is a summer crop that is extensively grown under rainfed conditions, even in high temperature regions. Sorghum crops do well in most soils, but grow best in light, medium texture, well-aerated and well-drained soils. It is relatively tolerant to short periods of water logging, and is moderately tolerant to soil salinity.

It is also relatively more drought tolerant than many other crops. This is due to an extensive root system, giving it effective control of transpiration and an ability to recover rapidly after periods of water stress. The primary root system grows rapidly in deep soils to 1-1.5 meters. Due to its drought tolerant characteristics and its C4 structure, sorghum may be an alternative crop for areas of 300mm of annual rainfall.

Broom corn covers about 17,003 dunums representing 83.7% of sorghum production, as compared to 3,316 dunums and 16.3% for white corn. Broom corn is mainly cultivated in the northern West Bank, where an average area of 16,707 dunums is found, compared to 296 dunums in the south. It is not cultivated in the Gaza Strip (Table 8). White corn is only cultivated in Hebron and Gaza Strip with an average area of 2,688 and 628 dunums, respectively (Table 9). There is no available data about sorghum cultivation in Jericho district.

Table 8: Broom Corn Cultivation (dunums) in the O.P.T.

Year	Tulkarem	Nablus	Jenin	Hebron	Bethlehem & Ramallah	Total
1985	755	6023	4460	115	112	11465
1986	1264	13615	4600	138	165	19782
1987	1426	11955	4360	108	147	17996

1988	1507	12110	4085	81	169	17952
1989	1792	9607	4200	161	137	15897
1990	2071	11800	5200	75	197	19343
1991	1265	8550	5000	142	193	15150
1992	1300	10636	6070	165	266	18437
Avg.	1423	10537	4747	123	173	17003

Table 9: White Corn Cultivation (dunums) in the O.P.T.

Year	Hebron	Gaza Strip*
1985	3205	560
1986	1950	630
1987	795	630
1988	1631	470
1989	2094	540
1990	3850	810
1991	5764	760
1992	2215	620
Avg.	2688	628

* Under irrigation

The productivity of broom corn is higher in the southern West Bank than in the northern, as represented in Hebron with an average of 238kg/dunum, and Nablus with an average of 175kg/dunum. Large fluctuations of yield are noticed not only among different areas during different seasons, but within the same areas as well (Table 10).

The productivity of white corn, mainly cultivated in Hebron, is very low with an average of 69kg/dunum compared with that of the broom corn, even though it occupies about 22 times the area of the broom corn. The higher average productivity of white corn in Gaza Strip is related to planting under irrigation which reached 2238 kg/dunum

(Table 11).

Table 10: Broom Corn Productivity (kg/dunum) in the O.P.T.

Year	Tulkarem	Jenin	Nablus	Bethlehem & Ramallah	Hebron
1985	180	300	200	230	300
1986	140	135	300	150	300
1987	120	90	250	150	400
1988	160	100	180	170	375
1989	130	110	100	130	150
1990	250	300	200	200	200
1991	150	70	100	210	70
1992	132	80	70	110	110
Avg.	158	148	175	169	238

Table 11: White Corn Productivity (kg/dunum) in the O.P.T.

Year	Hebron	Gaza Strip
1985	55	2100
1986	50	1900
1987	60	2000
1988	65	2000
1989	50	2400
1990	90	2000
1991	100	2500
1992	85	3000
Avg.	69	2238

* Under irrigation

A great percentage of the sorghum grains is lost to birds, which feed on the grains while still in inflorescence. A possible solution to bird predation is introducing new varieties of sorghum which contain higher percentages of polyphenols (tannins, flavonoids) in the grain. These chemicals have a poisonous effect on birds and act as a repellent.

Many varieties of sorghum are cultivated. Their agronomic characteristics are listed in Table 12.

Table 12: Sorghum Varieties in the O.P.T.

Variety	Plant Height (mm)	Resistant to	Utilization
Hazera' 226	800-900	birds, lodging	seeds
Hazera' 610	900-1000	lodging	seeds
Hazera' 6060	1000-1300	lodging	seeds
Feedan 697	2000-2500	-------	fodder, green grass, hay
Mitador	2500-3000	-------	fodder, green

3.2 Fertilization

Superphosphate, ammonium sulfate and urea are the three main types of fertilizers used for cereals in the O.P.T. For cereal cultivation, super phosphate and ammonium sulfate are used before or during sowing, while urea is applied as a top dressing especially before the tillering stage.

For wheat, N2 fertilizer at rate of 6-8 kg/dunum and 4 kg/dunum of P2O5 can be used to increase the yield significantly, and the same for barley is preferable if available. For sorghum, the nutrient requirements are up to 18 kg/dunum of N2, 2-4.5 kg/dunum of P2O5 and 3.5-8.0 kg/dunum of K2O. Sorghum is a dual crop which can be planted for seed production or as forage (ICARDA, 1989).

Animal manure is frequently applied in the southern parts of the West Bank. This is mostly due to the availability of natural manure as the farmers have a specific number of livestock (sheep & goats) in addition to farming.

Farmers apply animal manure using an average of 2.5 tons per dunum. This provides the soil with 4 kg of N2, 5 Kg of P2O5 and 10 Kg of K2O. Animal manure is sometimes left for long periods on top of the soil and exposed to

different weathering factors. At least one third of the nitrogen will be lost before manure is ploughed in. Use of untreated animal manure, unfortunately, increases the problem of weeds and minimizes control over the concentration of the necessary nutrients in the soil. Since most Palestinian farmers do not perform soil tests, they risk adding nutrients that are insufficient, unevenly distributed, or could be in excess of the needed amount. Work on soil analysis and the need for different fertilizers is important for this sector.

3.3. Harvesting and Threshing

Manual harvesting is a result of small ownership. It is still used in the hilly areas for cereal cultivation in the O.P.T. It may be also found in other regions where farmers are poor or have enough family members to assist in the harvest.

Binding harvesters are the most common machine used in mechanized harvesting. Combine harvesting machines are rarely used in the O.P.T., as they also require bale-making machines to enable farmers to benefit from the resulting hay. Manual threshing is extremely rare. Even in hilly areas, the whole harvest of biological yield is transferred to the threshing machine site. Most agricultural machines are rented from private owners or sometimes from local cooperatives.

3.4. Cereal Pests and Diseases

Cereal growth and yield, especially for wheat, are greatly affected by environmental stresses. Water stress, nutrient deficiency, drought, and frost weaken the plants and make them more susceptible to diseases and pest attack.

3.4.1. Weed Control

Weeds are considered one of the major pests that hinder the growth of cereals and reduce its yield. Weeds grow among crops and compete for water, light and soil nutrients. As nutrients diminish, crops become more susceptible to diseases. Nutrient deficiency causes growth retardation and reduced production.

The most widespread weeds found in the O.P.T. are of two types: narrow leaf weeds, such as Wild Oats (Avena sterilis) and Wild Barley (Hordeum bulbosum), or wide leaf weeds such as White Mustard (Sinapis alba), etc.

Many farmers tend to plow the land and sow the seeds when enough moisture is present in the soil which enable the farmers to get rid of the unwanted weeds

which were already grown. Ploughing the weeds to the top of the soil and exposing the roots to dryness may be efficient if there is a break in the rain. But this increases the possibility of losing the crop if there is a low rainfall in the season.

Herbicides are used to some extent, and are applied in the early stages of germination (Table 13). Uneven sowing and poor germination of cereals, however, enables unwanted weeds to grow back. Therefore, Palestinian farmers need to learn the comprehensive approach of fighting weeds and to understand all the elements involved in this process.

Table 13: Commonly Used Herbicides in Cereal Fields

Herbicide	Application rate cm3/dunum	Application Time
Alber-M	180-200	Beginning of germination till two weeks before head (spike) formation
Alber-40	150-180	Same period
Alber Super	200	Same period

3.4.2. Rodents and Insects

- Field rats:
  Fields rats are prominent in fallow and cultivated fields. They reproduce quickly and destroy crops, especially in the germination stage. Eradication is carried out using poisoned cereal grains. As this method requires a comprehensive campaign in all the neighboring fields as well, it is not greatly effective. Rats are present in most Palestinian fields but a small percentage of farmers try to fight them.
- Moles:
  Moles are found in both fallow and cereal fields. Moles dig holes in the ground leaving piles of dirt on the soil surface. Poisoned cereal grains are used with other special chemicals to fight moles.
- Cereal leaf beetle (Marseulia dilateventris):
  This light grey beetle lives in large numbers on wheat and barley . Their optinum grouth period is between December and January when they eat and damage the growing points. Chemical such as Lendrin are used to control this insect.

- Cereal Leaf miner (Stringopais temperatella): A worm of 5-6mm in length, the cereal worms eat the plant foliage. The plant soon turns yellow and production decreases sharply. Usually the insect hits fields that have been previously affected or which have not been deeply and well ploughed in summer. Cereal worms are abundant in December to February. Their sensitivity to high temperatures explains their moderate effect on the southern parts of the West Bank when compared to its effect on other areas of lower temperature. Lendrin, Thionix and Gemacide chemicals are sprayed to control the worm, if the incidence increases to over 10% per plant.

3.4.3. Fungal Diseases

- Loose Smut: a fungus called Ustilago tritici affects barley and wheat from the inside the grains. Infected ears become a mass of black spores. They do not remain enclosed within the grain as with the covered smut. 1-4 Oxathiins and Benzimidzoles are used to get rid of the disease.

- Covered Smut: the fungus Tilletia caries attacks the internal part of the grain and brown or black spore bodies replace the grain content. Eradication requires sterilization of the seeds before sowing and the use of disease resistant varieties such as 870, 304. The bread wheat Mariam is susceptible to this fungus disease. Hexachlorobenzene (HCB) and Pentachloronitrobenzene (PCNB) are used to get rid of smut.

- Yellow rust: Puccinia striiformis is a fungus which usually attacks bread wheat more than durum wheat. Yellow collared pustules in parallel lines spread on the leaves, and in some cases to the stem and spikes. Chemical eradication is efficient using Menbigan. Introduction of disease-tolerant or resistant varieties is also required.

- Septoria Leaf Spots: Mycosphaerella graminicola is a fungus which leaves bleached or discolored blotches of varying sizes and shapes on the leaves. The disease has its maximum effect in late autumn to early summer.

Using chemicals such as Maneeb in addition to the introduction of resistant varieties such as Morey, Perico and Arthur, is the best way to get rid of the disease.

3.4.4. Lodging

Many cereal varieties, such as barley, are subject to lodging. Cereal crops that are cultivated in rich soils and with plenty of water and N2 are more vulnerable to this phenomena. In such areas, short varieties such as 870 are more recommended than taller ones since they are more tolerant to lodging.

4. Constraints on and Potential for Cereal Production in the O.P.T.

Field crop production capacity is dependent on annual rainfall and distribution throughout the planting period and on climatic conditions. Production is also affected by soil type and texture, chemical and physical characteristics, nutrient content and crop varieties. Output thus differs according to zone and crop variety.

Great variation in cereal production per unit area was found between the northern and southern parts of the West Bank. The northern areas of the West Bank yield a high production ratio, as they benefit from high rainfall and the use of machinery. In addition, some farmers are more familiar with new crop varieties and technologies adapted in Israeli agricultural research institutes. In comparison, the southern areas of the West Bank, although having the major concentration of livestock, have the lowest crop production potentials. This is attributed to the low rain-fall and lack of information and access to the agricultural support information or agricultural experts.

The average cereal production per dunum in the northern areas of the West Bank ranges between 200-250 kg, while in the southern areas it ranges between 100-150 kg. Providing extension activities and encouraging the use of machinery will greatly contribute to increasing production potential.

The low production of cereals is, to a large extent, attributed to the use of unsuitable seed varieties. Local varieties used currently in the O.P.T. have lost many of their original characteristics. Many farmers used to obtain seeds from the Directory of Agriculture or from Israeli seed producing companies. After the first cultivation of these pure seed varieties, farmers began using the harvested seeds for the next cultivation. Through time, undesirable characteristics began to appear during the segregation process. Mechanized cleaning methods also resulted in reducing grain purity.

The closure of various governmental agricultural research stations in the O.P.T. and the reduction in extension services resulted in isolation of Palestinian farmers from newly-developed varieties or practices. Supplying local Palestinian farmers with suitable, improved varieties of seeds would help to improve production capacity, increase revenue and reduce dependence on imports.

4.1. Cereals and Food Sufficiency

The annual consumption per capita of wheat in the O.P.T. is 120 kg, a total of 240,000 tons year. The average production of wheat in the O.P.T. is 39,000 tons per year. There is a yearly deficit of 200,000 tons which indicates that more than 84% of the annual wheat consumption in the O.P.T is imported.

4.2 Availability of Machinery

Cereal cultivation requires the use of many different agricultural machines, mainly for ploughing, sowing, spraying, harvesting and threshing. Providing access to the various machines may encourage farmers, even small ones, to utilize them. Without assistance, farmers with limited property and income might not be able to obtain their own machines, considering that some, like harvesting and threshing machines, are only used once a year.

Although farmers realize the importance of using machinery and applying various chemicals, many are not able to do so purely for economic reasons. It is difficult for Palestinian farmers to undertake the risks of introducing new agricultural practices unless assisted by agricultural cooperative institutions. This situation is more obvious in the southern areas of the O.P.T., where small farms are dominant, agricultural revenue is less and production potential is lower than that of the northern areas.

4.3 Extension and Research

Agricultural research in neighboring countries and in the world continually introduces new practices and varieties. Follow-up on new research results may reduce costs of production and also provide better income. Introducing new drought or disease tolerant varieties is one major example. Investigation into new methods of agricultural rotation and weed control, and extension activities may greatly assist the farmers.

4.3.1. Applied Research Institute of Jerusalem Demonstration for Developing Wheat Production in the O.P.T.

The results of much research show that annual planting of soft (bread) wheat yields more grains than hard (durum) wheat, and represents about 89.5% of the total annual cultivated area of wheat in the world (CIMMYT, 1990-91).

To demonstrate wheat's higher yield and to encourage West Bank farmers to cultivate it more extensively than durum wheat, ARIJ conducted demonstrations with wheat varieties. Begun in 1992/1993 to last for a period of five years, the study is conducted in Al-Thahiriya area (with average rainfall of 300 mm).

The experimental program included: mechanical ploughing; the effect of adding compound fertilizers (0-7-13) on an average of 50kg/dunum; seeds sown by broadcasting on an average of 8kg/dunum; herbicides for controlling wide leaf weeds; top-dressing 9kg/dunum of urea in February; and harvesting and threshing on physiological maturity.

The results of the first year showed opportunities to increase grain yield in the O.P.T. Using bread as opposed to durum wheat results in higher straw yields and an increase in net returns of monetary input. Results also showed that the use of fertilizer could double both grain and straw yields (Table 14).

Table 14: Productivity and Economics of Wheat Production in the O.P.T.

Variety	Grain Yield kg/dunum	Straw Yield kg/dunum	Net Returns($)/dunum
BREAD WHEAT			
Ateer	250	280	32
Bet-Hashitta	303	318	50
Shaffir	303	316	51
DURUM WHEAT			
Breket			
870 (with fertilizer)	210	216	12
	215	200	10
870 (without fertilizer)	135	150	4.6

* The market prices were $0.21/Kg $0.18/Kg straw

In addition to the ARIJ research and demonstrations for developing wheat production, further experimentation is required. Introducing and propagating new varieties of barley alongside other crops, and changing agricultural practices through introducing mechanization will clarify appropriate techniques and practices to be followed for the future.

4.4. Economics of Cereal Cultivation

The feasibility study for wheat and barley has been conducted in marginal lands with an average rainfall of 250mm, in highlands with an average rainfall of 610mm and in the northern region which is represented here in Tulkarem (569mm) and Jenin (600mm).

Wheat and barley cultivation is more feasible in the northern parts of the West bank due to the high average rainfall of those areas compared to that of the middle and the southern areas of the O.P.T. In addition, large flat fields there make it easy for the farmer to adopt mechanization and thus reduce expenses for labor. this research suggests that cultivating wheat and barley in the northern region of the West Bank would be a rational usage of the land.

Gross revenue depends on yield and final product condition. Knowing actual sale price can fill out the picture about the status of cereal cultivation in the O.P.T. By calculating the total cost of barley production, we can easily find the profit, around $25/dunum. The same result can be obtained if we look at wheat production which gave about $29.6/dunum (Table 15).

Table 15: Economics of Wheat and Barley Production in the O.P.T.

CROP Region	Average net profit per dunum						
	Production				Total Cost V($)		Profit ($)
	Grains		Straw				
	V($)	Q(Kg)	V($)	Q(Kg)			
Barley							
250mm	120	20.4	150	20.4	1.7	36.7	2.4
600mm	251	37.0	200	27.0	2.0	36.7	25.0
Wheat							
250 mm	80	19.0	100	17.0	1.7	38.0	-3.7
500 mm	200	47.6	250	42.5	2.7	54.8	32.6
600 mm	280	66.7	240	20.4	2.7	54.8	29.6

Q: Quantity V: Value

5. Prospects for Cereals in the O.P.T.

Palestinians are in great need of building bridges with international research institutes, mainly ICARDA (International Center for Agricultural Research in the Dry Areas) and CIMMYT (International Maize and Wheat Improvement Centre). Benefiting from the research of these institution will save Palestinians time and expose them to improved varieties and different crops.

Research and investigations must target the use of new technologies through demonstrations and extensions done mainly on projects concerning the high yield varieties. Extension campaigns and workshops should be carried out to explain the results of the experiments to the farmers.

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Part 2: FOOD LEGUMES AND FORAGES

1. Introduction

Legumes have been cultivated since ancient times because of their production capacity and protein content, as food and feed for human and animal populations. They are the second most cultivated crops after cereals, occupying about 66,000,000 hectares throughout the world.

Legumes belong to the Leguminosae family and are divided into two types: food legumes such as broad beans (Vicia faba), kidney beans (Phaseolus vulgaris), soybeans (Glycine max), peas (Pisum sativum), chickpeas (Cicer arietinum), lentils (Lens culinaris), cowpeas (Vigna sinensis) and peanuts (Arachis hypogaea); and forage legumes such as alfalfa (Medicago sativa), Egyptian clover (Trifolium alexanderium), common vetch (Vicia sativa), and others.

Legumes can be harvested as green vegetables or as mature seeds. Green pods of many varieties are edible 2 or 3 weeks before the appearance of fibers and hardening of pods. At this stage, they are juicy and can be used as green vegetables. The mature seeds are good sources of fiber, proteins, minerals, and vitamins.

Proteins of food legumes are rich in lysine and poor in sulphur-containing amino acids and tryptophan. Methionine is the most limiting amino acid in all legumes (Table 1). In contrast, cereal grain proteins are low in lysine but have adequate amounts of sulphur-containing amino acids.

In terms of amino acid composition, Legume grain proteins and cereal grain proteins are complementary. This reinforces the importance of food legumes in improving the nutritional quality of cereal-based diets.

Table 1: Essential Amino Acid Composition for Some Food Legumes (g/100g protein)

Amino Acid	Beans	Lentils	Chickpeas	Peas
Lysine	6.8	5.1	6.3	8.9
Threonine	3.3	3.0	3.4	4.2
Valine	5.4	5.1	5.5	8.2
Leucine	8.9	5.5	8.2	9.5
Isoleucine	6.0	5.8	6.0	7.4
Methionine	1.0	0.6	1.2	1.3
Tryptophan	1.0	0.6	0.8	0.7
Phenylalanine	5.5	4.0	4.9	4.6
Arginine	9.2	7.0	6.9	13.4
Histidine	2.8	2.1	2.3	2.7

The group of plants belonging to the Leguminosae family are known agronomically for two main characteristics:

1. their symbiosis with the Rhizobium bacteria, which fix nitrogen from the atmosphere in the nodules,and
2. the high protein concentration of their products. Because they can fix nitrogen from the atmosphere, legumes can be grown independently of nitrogenous fertilizers, reducing the cost of production.

2. Status of Legumes in the Occupied Palestinian Territories

Broad beans, green beans, green peas, cowpeas, peanuts are planted minimally throughout the Occupied Palestinian Territories and mainly as vegetables. These crops are not dealt with in this report. Vetches are mainly cultivated under rainfed conditions. 1989-91 average area of production was 52,000 dunums, with 77% of total area cultivated by bitter vetch and the rest with common vetch with average productivity of 55 and 65 Kg/dunum respectively. Average production is 2,979 tons. The most important food legume crops planted in the O.P.T. are chickpeas and lentils.

3. Primary Food Legume Cultivation in the O.P.T.

3.1. Chickpea Cultivation

The average chickpea cultivation area in the O.P.T. fluctuates between 25 and 41 thousand dunums. 83% of chickpea cultivation is concentrated in the northern part of West Bank (Table 2), in which the highest productivity is centered around

Jenin (Table 3). The average yield of chickpeas for the West Bank is about 65 kg/dunum. In the Gaza Strip, chickpeas are harvested usually at the green pod stage for human consumption as "hamleh". Because of this Gaza production was not calculated with the rest of the O.P.T.

Table 2: Area of Chickpea Cultivation (dunum) in the O.P.T.

Year	Hebron	Jenin	Nablus	Tulkarem	Ramallah & Bethlehem	Total	Gaza Strip
1985	920	17652	2610	334	3256	24772	500
1986	2770	32680	3675	382	1672	41179	750
1987	3660	24805	4385	773	2869	36492	400
1988	2573	23860	3858	806	1731	32828	430
1989	2300	19000	3796	919	1832	27847	1030
1990	3122	14340	4630	1178	2490	25760	1120
1991	7000	20030	5160	1200	2700	36090	800
1992	3200	20000	9850	1647	2750	37447	1000
Avg.	3193	21546	4746	905	2413	32802	754

Table 3: Chickpea Productivity (kg/dunum) in the O.P.T.

Year	Hebron	Jenin	Nablus	Tulkarem	Ramallah & Bethlehem	Gaza Strip
1985	65	30	55	60	80	1000
1986	55	125	70	30	50	2000
1987	62	100	70	35	60	-
1988	55	70	80	45	67	-
1989	60	50	60	28	59	-
1990	65	70	69	53	76	-
1991	30	100	104	35	90	1300
1992	55	100	90	40	94	500
Avg.	56	81	75	41	72	1200

*Biological yield at the green pod stage (Hamleh).

3.1.1. Land Preparation

Ploughing takes place at the end of fall using moldboard or disc plows in order to incorporate plant residues from the previous crop into the soil. For winter planting, the seed bed should be prepared at the beginning of the season (Oct.-Nov.), while for spring planting, preparation should take place at the end of winter using chisel plows. Harrowing more than once is recommended to make the seed bed more suitable.

3.1.2. Planting Date

Traditionally, chickpea planting in the Mediterranean region is done in spring, during March and beginning of April. Recent research has found that shifting to winter planting, especially during January, will result in doubling yield and increasing plant height, making easier the process of mechanical harvesting.

There are, however, many limitations on winter planting in the Mediterranean area, including Ascochyta blight disease, which causes burning and completely damages crops, and low temperatures. Resistant varieties to both exist and should be cultivated by farmers. Because of greater rainfall during winter, weeds will grow simultaneously with the crop and will need to be more meticulously controlled.

3.1.3. Sowing and Planting Density

After broadcasting, the dispersed seeds should be covered using disc harrows. Fertilizers may be added prior to or simultaneous with sowing. The drilling method accomplishes sowing and fertilizing at the same time, and results in more uniform plant distribution and height than by the broadcasting method. Uniformity of distribution and height of plants facilitates mechanical harvesting, saving both time and cost.

Planting density of 10-12 Kg of grains per dunum is recommended.

3.1.4. Cultivated Varieties

The varieties of chickpeas cultivated in the O.P.T. are of Israeli origin. Their agronomic characteristics are listed in Table (4).

Table 4: Agronomic Characteristics of Some Chickpea Varieties in the O.P.T.

Variety	1000 Seed wt. (g)	Planting Density Kg/dunum		Sowing Date	Ascochyta blight
		Scattering machine	Drilling mahine		
Bulgarian	220 - 260	12 - 13	7 - 9	Dec.	[1]R.
Ayelet	400 - 440	15 - 16	10 - 12	Jan. - Feb.	R.
Portuguese White	500 - 550	17 - 18	12 - 14	Jan. - Feb.	[2]S
Spanish	620 -700	18 - 20	14 - 16	Mar. - Ap.	Very S.
Roneet	380 - 420	15 - 16	10 - 12	Jan. - Feb.	Semi - S.
Hdass	400 - 460	15 - 16	10 - 12	Jan. - Feb.	Semi - S.

Where 1=resistant and 2=susceptible

3.1.5. Seed Inoculation with Rhizobium Bacteria

It is possible to inoculate chickpea seeds with certain strains of Rhizobium bacteria. This process results in the production of more nodules, resulting in increased nitrogen fixation, and thus an improvement in growth and yield. Inoculation is mainly recommended for uncultivated lands, not for cultivated lands especially with chickpeas.

3.1.6. Fertilization

Fertilizer has a positive effect on increasing chickpea grain yield. Phosphate fertilizers are recommended at the rate of 4 kg P2O5/dunum, which equals 10 kg of triple superphosphate (45%). Nitrogen fertilizers are recommended at the rate of 2kg of nitrogen (N2)/dunum, which equals 10 kilograms of ammonium sulfate (21%).

3.1.7. Pests and Diseases

3.1.7.1. Weed Control

Weeds compete with crops for light, moisture and nutrients. Their seeds become mixed in with the cultivated crop seeds resulting in low purity. Both narrow and wide leaf weeds can be controlled by the following methods.

- Mechanically: by harrowing among the rows in preparation for planting by drilling.

- Chemically:

* Pre-planting. Triflan in the amount of 200-250 cm3/dunum should be applied 4-5 weeks before sowing.

* After planting and before emergence. Agran (50)% should be applied at a ratio of 250-300 g/dunum for wide leaf weeds, and Kerb, 100-150 g/dunum for narrow leaf weeds.

* After emergence. Deganol at a ratio of 100-150 cm3/dunum should be applied for narrow leaf weeds, and Lantigran (45%) at a ratio of 300 g/dunum for wide leaf weeds.

3.1.7.2. Insects

- Leaf minor (Lirlomoyza cicerina). The larvae of the leaf minor tunnel into the leaves and feed on the chlorophyll, resulting in the drying out and dropping of the leaflets. Larval infection begins in April.

- Pod borer (Heliothis spp.). Pod borer larvae feed on the leaves, flower buds, and on the grains in the pods.

Both insects can be controlled by chemicals using systemic or contact insecticides, such as theonix, at ratio of 250-300 cm3/dunum.

3.1. 7.3. Diseases

No disease significantly affects spring cultivated chickpeas. Winter varieties, however, are subject to both ascochyta blight and fusarium wilt.

- Ascochyta blight (Ascochyta rabiei). This fungus causes burning of the plant parts, causing brow areas on the stem, leaves and pods. Use of resistant varieties is the most effective way to control ascochyta blight. For susceptible varieties,

fungicides such as Menpigan can control the spreading of disease, using 250-300 g/dunum.

- Fusarium wilt (Fusarium oxysporum). This fungus systematically invades the chickpea plant tissues. Use of resistant varieties is the best prevention of disease, although fusarium wilt can be controlled chemically by Mapingan-80, using 250-300 g/dunum.

3.1.8. Harvesting and Threshing

Manual harvesting is usually practiced, followed by threshing. This traditional method requires time and labor cost.

To improve the agricultural techniques used in fields planted by the drilling method, and to reduce time and labor costs, mechanical harvesting is encouraged. Combine harvesters are effective when used on dry, mature plants of a suitable lowest pod height, and blade cutters or side mowers are appropriate for semi-dried plants and yellow pods.

3.1.9. Crop Rotation

In general, priority is given to production of cereal crops over production of legumes: lentils are not sown until cereal planting is completed. Optimal sowing dates are notobserved, and consequently, plant growth is retarded as a result of poor stand establishment. Delayed sowing leads to considerable losses of potential yield.

Crop rotations over two year periods are common. In the high rainfall zones, lentils, chickpeas and vetches are the most common legume crops planted in rotation with wheat and barley. In the low rainfall zones the majority of farmers include fallowing in the rotation. Such a rotation generally consists of cereal crops one year (barley or wheat) and fallow the next, rarely including legume crops.

A considerable area under a wheat-fallow rotation system is also found in the high rainfall zones.

Recently, some farmers have replaced the fallow period with medics cultivation or a forage mixture (barley and common vetch) for animal grazing. This system has become popular in areas where livestock production is an important component in the farming system.

3.2. Lentil Cu ltivation

In 1985, the area under lentil cultivation in the O.P.T. covered 23,118 dunums in the south, compared to 14,511 dunums in the north. By 1992 the areas had decreased in the south to 18,688 dunums, while the north experienced increases to 17,458. In Gaza Strip, lentils were average area cultivated in 1273 dunums (Table

5). Lentil productivity in the West Bank ranged between 15-70 kg/dunum, while in Gaza the number reached 95kg/dunum (Table 6).

Table 5: Lentil Cultivation Area (Dunum) in the O.P.T.

Year	Hebron	Jenin	Nablus	Tulkarem	Ramalah & Bethlehem	Total	Gaza Strip
1985	19000	10885	1880	1746	4118	37629	430
1986	16680	14150	1840	1935	4207	38812	2000
1987	17640	18615	2250	1802	4243	44550	1250
1988	16180	17915	1955	2812	3641	42503	1150
1989	17600	16270	2030	2820	3627	42347	1150
1990	17950	13270	1974	3605	3899	40698	1300
1991	11000	12500	1600	3450	2500	30050	1400
1992	16340	13000	2460	1998	2348	36146	1500
Avg.	16549	14576	1999	2396	3573	39092	1273

Table 6: Lentil Grain Yield (kg/dunum) in the O.P.T.

Year	Hebron	Jenin	Nablus	Tulkarem	Ramalah & Bethlehem	Gaza Strip
1985	30	30	60	60	50	-
1986	24	40	70	50	45	-
1987	70	80	80	60	50	100
1988	65	60	85	40	37	100
1989	50	20	47	30	46	67
1990	40	60	46	55	47	100
1991	15	30	40	20	28	100
1992	44	20	45	35	28	100
Avg.	42	43	59	44	41	95

3.2.1. Land preparation

As with chickpeas, fall ploughing in preparation for lentil planting turns over the residues of the previous year's crops. The seedbed is prepared in the beginning of winter, preferably using a harrower to level and smooth the soil surface. In areas where gravel and small stones are present, rolling after sowing is recommended. However, for wet soils, rolling will reduce the percentage of seeds which grow into plants.

3.2.2. Planting Date

Early planting of lentils yields higher production of grains and straw. The optimal planting period for lentils is from November to the end of December.

3.2.3. Sowing and Planting Density

Broadcasting is the method most used to disperse seeds. After distribution, the seeds are covered by a disc harrow. It is preferable to use a seed driller for maximum growth and yield, although a wheat driller may be used.

Planting density is recommended at 8 kg/dunum for seeds of medium size in areas of 250-300 mm of rainfall, while for areas of rainfall of 300 mm and more, 12kg/dunum is recommended. Areas of high rainfall provide a greater nutrient base to sustain more plants.

Planting depth should be at 3-4 cm. For fall sowing, the depth increases to 6 cm in order to be sure that enough moisture is present in the soil before emergence occurs.

3.2.4. Cultivated Varieties

Lentil varieties in the O.P.T. are not fully known since there are no pure breeds. Lentil varieties are commonly known by their color, size and cooking facility. The development of new lentil cultivars with improved standing ability and resistance to pod shattering, facilitating mechanical harvesting, and development of those tolerant of cold and drought will considerably enhance crop productivity. The varieties currently cultivated in the O.P.T. are White, Red Local, and Turkish.

3.2.5. Seed Inoculation with Ryizobium Bacteria, Fertilizing, Pests and Diseases, and Crop Rotation:

See Chickpea Cultivation.

3.2.6. Harvesting and Threshing

Grains shattering from matured pods is the primary problem in lentil cultivation, and accounts for 20% of grain loss. Chickpea pods are harder and do not break

apart. Harvesting is done in the early morningor afternoon mainly by hand, and the threshing is done by animals or by a simple machine thresher.

As with chickpeas, mechanical harvesting techniques can be applied, but require plants of good height and grown on level soil. Soft-podded plants can be harvested by a side mower or blade cutter, while for completely dried plants, a combine harvester may be used.

4. Constraints and Potential for Food Legume Production in the O.P.T.

4.1. Food Legumes Sufficiency

The trend towards reducing red meat intake requires introduction of plant protein substitutes into the diet in order to compensate for the lack of amino acids. Chickpeas are considered a primary food resource in the Middle East and are often referred to as the "meat of the poor".

The per capita consumption the O.P.T. of chickpeas was estimated at 12-14 kg/year. It is possible to work out the area needed to grow enough to satisfy this need, based on yields obtained from experiments using optimal varieties and agricultural techniques.

Approximately 25-41 thousand dunums of chickpeas are planted annually in the O.P.T. yielding an average of 65 kg/dunum when using varieties resistant to the ascochyta blight and utilizing different types of fertilizers. Thus, the annual production in the O.P.T. is a maximum of 1.6-2.7 thousand tons of chickpeas, while the actual production needed according to the population consumption is 26 thousand tons. Therefore, the production of chickpeas in the O.P.T. is only 8% of the actual requirement and as a result, 92% is imported.

Lentils, on the other hand, are grown on a slightly larger scale. Nearly 31-45 thousand dunums are planted annually in the O.P.T. with an average production of 45 kg/dunum. Thus, the annual production is approximately 1.4 - 2.0 thousand tons. The per capita consumption of lentils in O.P.T. is estimated at 15 kg/year. The annual production needed is 30 thousand tons. Therefore, 7% of the Palestinian population requirement of lentils is produced in the O.P.T. and the other 93% is imported through Israel.

Although the amount consumed per capita remains the same, the total amount consumed is increasing yearly because of the increasing population. The demand for forage legumes is also increasing each year because of increasing numbers of livestock, mainly sheep and goats.

4.2. Feasibility Study of Food Legumes Cultivation

ARIJ's economic feasibility study of chickpeas and lentils investigated the possible benefits of mechanizing tillage and controlling pests and diseases using different cultivars. The study covered areas of highlands and Jenin the West Bank with average rainfall levels of 500 and 600 mm, respectively. It is based on numbers from the year 1991/92. Gross revenue depends on yield, final product condition, and the actual sale prices (Table 7). High expenses are mainly due to the high price of mechanization, especially in the plane regions as Jenin.

Table 7: Average Gross Revenue per Dunum Average Net Profit per Dunum

Average Net Profit per Dunum						
Crop	**Productivity**				**Expenses**	**Profits**
Region	**Grains**		**Straw**		**Expenses**	**Profit**
	Q	V	Q	V	V	V
Chickpeas*						
500 mm[1]	80	54	150	20	63	11
600 mm[2]	100	68	200	27	76	19
Lentils*						
500 mm[1]	50	60	150	31	66	25
600 mm[2]	50	60	200	40	78	22

1. high lands 2.Jenin
* = Local variety; Q = Quantity (kg); V = Value US $.

4.3. Extension and Research

The most serious problem limiting the expansion of food legume volume is the lack of suitable cultivars that would allow higher yields. Winter planting of chickpeas is not a common practice because of the danger of aschocyta blight disease. The grains are sown in the spring when the risk of

low moisture and poor growth is present as a result of seasonal variation. This results in low productivity making mechanical harvesting difficult. This is particularly true for lentils, which are more affected by pod shattering than are chickpeas. The local varieties have been used for a long time now and are poor in yield and disease resistance, as they have been adapted for spring cultivation. Other constraints on increasing food legume production include:

1. Declining resources in the steppe through overgrazing, soil erosion and desertification.
2. Poor regeneration of pastures because of overgrazing, resulting in low vegetation density with low nutritive value.
3. Poor choice of land for growing food legumes.
4. Unadapted agricultural practices, such as soil preparation, seed bed preparation and weed control.
5. Losses due to hand-harvesting.
6. Lack of machinery.
7. Small holdings prohibit use of machines on a large scale.
8. Low profits derived from products.

4.3.1. Opportunities for Increasing Food Legume Output

There are four main options for increasing legume output, which include:

1. Expanding the net area cultivated by bringing new land into use.
2. Increasing yields through technological change.
3. Developing sustainable integrated land use systems. Increasing water use efficiency, which ought to be a major goal to improve technologies and changes in farming systems in the Occupied Palestinian Territory, where water deficiency is the main limiting factor to increasing productivity.

4.3.1.1. The Work of Applied Research Institute - Jerusalem

The causes of low productivity of chickpea crops, of 40 - 80 Kg/dunum in the O.P.T. can be grouped in three categories: environmental, agronomic and biotic.

To encourage local farmers to cultivate chickpea varieties of higher yields, ARIJ conducted demonstrations with varieties of chickpeas in the O.P.T. Begun in 1992/93 to last for a period of three to five years, the study is conducted at Al-Dahriyeh (average rainfall 300 mm).

The demonstration program included mechanical ploughing; adding superphospate fertilizers; sowing seeds by the broadcasting method on an average of 10 kg/dunum; and harvesting on physiological maturity. It concentrated on studying the effect of winter planting.

The first year's results encourage continuation of work. Winter planting showed opportunities to double grain and straw yields and significantly increase the net returns of monetary input, as compared to the spring planting of local chickpeas, which cultivated as farmers usually done (Table 8).

Table 8: Grain and Straw Yield (kg/dunum) and Net Return ($US) of Chickpeas as Demonstrated at Al-Dahiriya/Hebron (1992-93)

Variety	grain yield kg/dunum	Straw yield kg/dunum	Net return US $/dunum
Bulgarian	108	102	27.0
Hadas	104	100	24.0
Ilit	106	110	26.0
Local*	50	80	11.0
* local variety traditionally cultivated			

5. Needs and Prospects for Improving Food Legume Cultivation in the O.P.T.

1. Collection of local chickpea and lentil germplasms and forwarding them to ICARDA for further identification and conservation in the gene bank.
2. Obtaining and breeding of different chickpea and lentil varieties from ICARDA and carrying out of field trials in order to assess their adaptation to different areas in the O.P.T.
3. Continuation of observations on different varieties of chickpeas, lentils and broad beans, regarding the use of various fertilizers, planting dates and advanced agricultural practices.
4. Investigation of the desi type chickpea, which could be included in breeding programs. This type must be obtained from ICRISAT in India or ICARDA in Syria.
5. Transfer of mechanization technologies in sowing and harvesting from Jordan, Syria and other countries.
6. Establishment of research stations to help introduce and evaluate new varieties of legumes under local environmental conditions.
7. Subsidizing local agricultural institutes to supply farmers with fertilizers, grains and machines.
8. Introduction of a national breeding program, in cooperation with ICARDA, to collect the local food legume germplasms for further identification and conservation.

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SECTION 5

Fruit Trees

Part 1: OLIVE TREES

1. Introduction

The olive is an attractive evergreen tree with gray- green foliage. It was under cultivation long before the time of earliest recorded history, originating in the eastern Mediterranean area.

Olive trees are well acclimatized to low rainfall, drought, and hot summers prevailing in the region, making them the most important cultivated trees. Olive trees live for many hundred of years, if the tops die a new tree often develops from the roots.

2. Status of Olives in the Occupied Palestinian Territories

Olives are the major crop in the rainfed areas covering about 45% of the total plant production in the West Bank, and up to 25% of the gross agricultural income. Their production provides the bulk of income for thousands of olive farmers, each of whom supports an extended family of about a dozen people. As a whole, olive cultivation, picking, pressing and marketing involves more than 100,000 people and is an important economic base in the West Bank.

2.1. Cultivated Areas

Olive trees cover nearly 809,000 dunums in the West Bank and Gaza Strip. The northern West Bank including Nablus district, Tulkarem and Jenin comprises 68.5% of the total planted area, while the southern West Bank including Jerusalem, Ramallah, Bethlehem, and Hebron comprises 30.1%, and Gaza Strip about 1.4%. In Gaza 63% of the trees are irrigated.

The rate of planting new areas of olives has decreased since 1990 in different districts of the West Bank. The area was reduced by 9,800 dunums in 1992 (Table 1).

Table (1): Areas of Unproductive Olive Trees (1000 dunums) in the West Bank

Year	Hebron	Jenin	Nablus	Ramallah &Bethlehem	Tulkarem	Total
1989	21.9	8.7	5.2	3.7	9.3	48.8
1990	27.4	8.4	4.5	4.1	9.0	53.4
1991	26.3	7.5	4.0	3.5	7.2	48.5
1992	23.2	6.8	3.3	3.1	7.2	43.6

The areas of productive olive trees are mainly concentrated in 754.3 thousand dunums in the West Bank, compared to 11.2 thousand dunums in the Gaza Strip. Productive areas are directly affected by the low increases in new areas of olives (Table 2).

Table (2): Areas of Productive Olive Trees (1000 dunums) in the O.P.T.

Year	Hebron	Jenin	Nablus	Ramallah & Bethlehem	Tulkarem	Total	Gaza*strip
1989	46.9	141.0	161.8	163.0	226.1	738.8	11.0
1990	48.5	141.9	162.7	163.7	226.2	743.0	11.1
1991	50.0	146.0	164.2	164.7	226.2	751.1	11.1
1992	52.0	146.2	164.2	165.4	226.5	754.3	11.2
*= 63% of the area under irrigation.							

The proliferation in olive-planted areas in the O.P.T. may be due to political rather than economic factors, since Palestinians believe that planting permanent trees such as olives protects lands from Israeli government confiscation. Olive production also provides more secure long-term income than some other products, as well as a more manageable product for marketing.

2.2. Production

The productivity of olives varies between 3-270 kg/dunum in the West Bank, while in Gaza it varies between 200-500 kg/dunum (Table 3). Total olive production ranges between 7.4-177 and 2.2-5.5 thousand tons for the West Bank and Gaza Strip respectively. The fluctuation in productivity for different years is a result of the alternate bearing habit of the trees. This phenomenon resulted in an average difference between low and high production years of 94% in the West Bank and 60% in Gaza Strip. Gaza's more consistent yields are due to irrigation, which has a positive effect on reducing fluctuation due to alternate bearing.

Table (3): Average Olive Yield (kg/dunum) in the O.P.T.

Year	Hebron	Jenin	Nablus	Ramallah & Bethlehem	Tulkarem	Gaza
1989	22	11	9	9	9	200
1990	200	210	180	180	200	300
1991	25	6	5	3	25	400
1992	270	260	227	208	209	500

2.3. Olive Varieties

The most cultivated varieties in the O.P.T. include:

- Sorri: Distributed in Nablus, Jenin and Tulkarem, representing about 85% of O.P.T. olive trees. Used mainly for oil production.
- Local Nabali Baladi: Occupies the second greatest area after Sorri. Distributed in Nablus, Jenin, Tulkarem and Ramallah.
- Improved Nabali: Cultivated in the southern areas and in Gaza.

The agronomical and other characteristics of Sorri, Local Nabali Baladi and Improved Nabali are illustrated in Table (4).

Less cultivated varieties include:

- Mulleesi: Not widely distributed. Olive fruit weight is 1.4-2g with an oil content of 16-22%. Rarely affected by olive fly and peacock disease.
- Manzinilo: Needs irrigation, so is rarely cultivated. It has large fruits (6g), and is used for making pickles.

- Barenge K18: Hybridize recently, used for making pickles and oil. Oil content of 20-25% in rainfed and irrigated areas. Its vertical growth suits intensive farming (40 seedlings/dunum). Ripens early in October and November.

Table (4): Characteristics of the Most Cultivated Olive Varieties in the O.P.T.

Characteristic	Sorri	Nabali Baladi	Improved Nabali
Fruit weight (g)	2.16	3.1	4.3
Seed weight (%)	34	17	16
Pulp weight (%)	66	83	84
Oil content (%)	31	23	18
Tree growth rate	moderate	moderate	very strong
Response to irrigation	little	very good	very good
Flowering period	end of April	end of April	end of April
Picking for pickling	end of November	mid September	end of September
Picking for pressing	November	November	November
Peacock disease	very. s	very. s	very. s
Olive fly	moderate affected	affected	very affected
s*= susceptible			

The climatic conditions and alternate bearing habits of olive trees affect the oil content of the fruits. The most cultivated varieties have a high oil content. For this reason, Sorri is the most grown, followed by local Nabali then Improved Nabali. This is especially important since olive oil is the main product, for example, 10 thousand tons of olive production were used for pickling, while 153 thousand tons were used for oil production in 1992.

2.4. Climatic and Soil Requirements

2.4.1. Climate

Olive trees are very well-suited to the climate and soil of Palestine. Climatic requirements for commercial olive production include considerable winter chilling; absence of hot, dry winds or prolonged wet, cool conditions during bloom; and the presence of sufficient heat during the summer for fruit maturation. Winter temperatures must not drop below about -10 C or the tree will die. Hot Khamasin winds cause flowers and fruit to drop. The average rainfall needed for normal olive production is 350-400mm, above which an increase in production will occur. Olive trees are best planted at an altitude of 200-500m, in areas where there is neither excessively low temperature nor high moisture, both of which facilitate the spread of peacock disease.

Although the O.P.T is small in area, there is great variation in fruit ripening times due to climatic differences.

This is evident between the cold south and the mid-northwest and between the hills and the plains. In addition, there are different micro-climatic variations within each of the climatic zones of the West Bank, which depend on elevation and location with respect to length of exposure to the sun or the prevailing cold winter winds.

2.4.2. Soil

Olive trees can grow well in a wide range of soil types. They grow and produce well in moderately acid or alkaline soils. They can tolerate high soil levels of calcium or boron. Poorly drained soils or those with a pH of 8.5 or higher are not desirable. Required planting depth for the success of olive cultivation depends on soil texture and rainfall levels.

2.5. Propagation

The most common propagation methods include:

1. Grafting or budding in the nursery. Two types of grafting are done in the West Bank:
    - Bud grafting: The chosen buds are taken with a part of phleom from a healthy branch of a one- or two- year-old tree, then placed between the bark and trunk of the grafted tree and tied.

- Cleft grafting: The chosen clefts must be one year old containing 2 to 3 eyes. The grafted tree must be cut to a height of 1-1.5 meters. Cleft grafting is done in the lateral branches, then covered with copper compounds. The grafting points must be covered with a plastic bag to preserve water.

2. Making leaf stem cuttings of one- or two-year-old growth.

3. Making hardwood cuttings of wood several years old.

2.6. Agricultural practices

2.6.1. Establishment of the Orchards

Establishment of the orchard depends on the site, topography and climatic conditions. The most important agricultural practices for establishing new orchards include:

1. **Tillage and fertilization**

   A soil test is important to determine the amounts of major elements, particularly potassium and phosphorus, as these two elements are usually added before deep tillage.

   Deep tillage after adding fertilizers is done by tractors if the land is level. If not, the amount of fertilizers is decreased since tillage is done by animals. Tillage occurs at the end of summer and beginning of autumn.

2. **Planning for a new orchard and planting distances**

   Planning for the olive orchard is essential since it provides the following benefits.

   - Uniform spaces between olive trees prevent the overcrowding of branches, allowing circulation of air, access to sunlight, and making nutritional requirements equally available.
   - Allowing the option of controlling diseases and insects through use of mechanical sprayers among other methods.

- Facilitating of agricultural operations such as harvesting and mechanical picking.

- Aesthetically pleasing appearance.

Tree spacing is influenced by soil, water supply, and variety. In rainfed areas the distance should be greater than that for irrigated lands. Standard permanent planting distances vary from 8 by 8m to 12 by 12m. The main planting patterns used for olive trees are the squares pattern, triangular pattern and irregular arrangement.

3. **Making holes**

Hole width depends on soil texture. In sandy soil there is no need to make large holes, while in clay loam soil hole width may approach 60 x 100 cm. The depth depends on the age and type of olive tree. In general, the depth required varies from 40-60 cm. Holes are prepared in the end of summer and beginning of autumn.

4. **Planting time**

Optimal planting time depends on soil texture and average rainfall. The best planting time is mid February through March.

5. **Transplanting**

After hole preparation and weed control, the olive seedling should be placed in the hole, keeping a soil ball around it. The loose soil is replaced and packed, then irrigated the same day or the next day if rain does not fall.

6. **Care of the Orchard After Transplanting**

The most important practices following transplanting are tillage, fertilization, pruning.

2.6.2. Tillage

Tillage separates soil particles and thus facilitates water penetration and ventilation. It prevents the formation of hard crust on the surface and controls weeds. There are two types of tillage, depending on soil texture, used in olive orchards:

- Deep tillage: (20-25 cm) takes place in November and December in rainfed areas. Manure is added before tillage to insure that it is buried in the soil and ready for absorption in spring. Deep tillage should not take place more than once a year.

- Minimum tillage: (8-10 cm) takes place when most of the rain has fallen. It is used to break the capillaries in the soil so as to prevent the evaporation of water, control weeds and make the soil free from clods and trashy crop residues.

2.6.3. Application of Fertilizers

Application of fertilizers provides the soil with the essential elements where their presence is limited. It increases disease resistance and production load, sustains strength and prevents dehydration.

Chemical soil analyses are not a reliable means of judging the fertilizer requirements of trees, as the analyses do not allow for the trees' ability to absorb the elements from the soil. Samples representative of the entire orchard are usually not possible.

Leaf analysis, on the other hand, is a reliable method for judging the fertilizer requirement of trees. Average orchards in good condition have leaf nitrogen contents of about 1.3 - 1.8%. Inversely, if leaves are dark green and the new shoot growth is 25 to 50cm a year, the trees are adequately supplied with nitrogen. If leaves are a medium to light green and do not have a shoot growth of at least 25cm per year, it is likely that trees are deficient in nitrogen and would respond to fertilizer application.

Two types of fertilizers are used.

- **Organic fertilizers**

  Fermented animal manure is added before winter with the first tillage so that decomposition will occur during winter. Not less than 5 kg/tree should be added at least every two years, although applying it yearly would be preferable.

- **Chemical fertilizers**

  Chemical fertilizers contain essential elements such as nitrogen, phosphorus and potassium. The applied fertilizer depends on the cultivation system, soil texture, age and size of the tree. Application occurs in February. Gar'oon (10-5- 15) is added on the average of 4-6 kg/tree, depending on tree age and soil texture.

2.6.4. Training and Pruning

Training and pruning improve light penetration, control fruit production, and facilitate picking operations and disease control. Pruning regulates olive production, controls alternate bearing and helps in increasing fruit size. Pruning takes place by removing dead, broken, diseased or interfering branches in addition to removing water sprouts or suckers.

Olives usually bear fruit laterally on the previous year's shoot growth, so fall pruning (after picking) is done usually to encourage the growth of new wood for the next year's crop and to remove unfruitful wood. Spring pruning is recommended since it stabilizes olive production rather than increasing it in years of potential heavy crops, and is done after fruitset in early spring or early summer to reduce alternate bearing tendencies.

During the first growing season, lateral branches that are well distributed around a single trunk and spaced 30 to 60 cm from the ground are retained. The remaining branches, especially suckers, are removed from the base. During the second, third and fourth growing seasons, suckers, and broken branches are removed.

2.7. Alternate Bearing Phenomenon

Olive trees historically have been notorious for their tendency to alternate a heavy crop with a light crop. The physiological basis for this condition is that excessive flowering and fruiting literally exhaust the tree. A heavy crop removes much of

the various carbohydrate materials, organic nitrogenous substances, and other essential nutrients so that adequate stored-food reserves are not available for production of a crop the following year. Maturing the heavy crop may so weaken the tree that it does not even bloom the following spring.

The best method for preventing alternate bearing is to prevent excessively large crops. Because the olive has an erratic bearing behavior, it is difficult to predict excessive fruitset, which cannot be determined until about the middle of June.

The most effective way to prevent an excessively heavy crop is to thin out some of the young fruits after they have set by the use of chemical spray thinning.

There is no evidence that alternate bearing can be overcome by pruning but it is possible that if pruning can be delayed until late June of the "on" year, it may lessen the alternate bearing tendency. Pruning is not as efficient as fruit thinning, however, because the latter method removes leaves as well as fruit.

No fertilizer practice can be relied upon to eliminate alternate bearing in olives, although nitrogen fertilization may increase production without greatly changing the long- term patterns of fluctuating yield-patterns which are similar to those of unfertilized orchards. On the hand, excessive application of nitrogen in winter or early spring may cause a heavy fruitset and initiate an alternate bearing pattern.

2.7.1. Recommendations for Minimizing the Alternate Bearing Phenomenon

- Chemical thinning: N.A.A. compound (Naphthalene acetic acid) is used in concentration of 100-150 ppm. It is sprayed after 0.5-2.5 weeks from fruit setting. This compound should be mixed with summer oil in concentration of 100 ppm N.A.A. + 1.5% summer oil. This compound must not be applied if the temperature exceeds 38c and the soil moisture is low.

- Hand thinning: Dense fruit on branches are thinned by removing 5-6 fruits from each branch, leaving 3-5 fruits/30 cm on the branch.

2.8. Pest Control

1. **Olive Fruit Fly *(Dacus oleae)***

   In nature female fecundity is lowest during the hot months of summer, higher in early summer, and reaches a peak during the autumn months.

The flies are most active during daytime. The female uses its pointed ovipositer to puncture the olive fruits and lay a single egg. Egg development takes only a few days before the neonate maggots begin to tunnel into the olives.

Their presence may be distinguished by the slight depression at the oviposition site which turns a light brown. Many maggots leave the ripe and soft olives and fall to the ground where they pupate in the upper soil layers. The infested olive fruits become more acidic.

Control can be achieved through plowing under olive trees; cleaning the land from crop residue and weeds; collecting the fallen fruits and getting rid of them; and using insecticides such as Roger 1cm3/L.

2. **Olive Kernel Borer (*Prays oleae*)**

This insect has a dangerous effect on olive trees. It is found intensively on small trees and new branches. In late winter larvae-containing mines may be found in leaves. Larvae pupate outside the mines on small twigs. The adults emerge between late March and early April and oviposit on flower buds, a single egg being laid per bud. The neonate Larva penetrates the buds feeding on and destroying the stamens. On reaching a maximum size, it spins a cocoon at the feeding site or beneath a leaf and pupates.

In later generations the females oviposit on the olive fruit, the larva penetrate the kernel which has hardened slightly, and gnaw tunnels leading towards the fruit stem. The larva leaves the fruit to pupate either beneath a leaf or in a concealed place close to ground level. The damaged fruits are shed after infestation.

Control can be achieved by collecting the infested olive fruits from healthy one; pruning the tree and tilling the soil; and spraying with Demecron 2cm3/L or Roger 1cm3/L and spraying again after two weeks. Also phermones traps could be used to monitor the level of the insect infestation

3. **Olive Psylla (*Euphyllura olivina)***

In late winter females lay their oval-shaped eggs on leaf buds. In winter and in early spring whitish waxen flakes secreted by the psyllids may be noticed on the young olive shoots. The larvae are found within their flakes. They feed on the sap of buds, flowers, and young leaves, retarding

the development of the affected parts. Psyllids can be controlled by spraying Metasestox 25cm3/20L.

4. **Leopard Moth (*Zeuzera pyrina*)**

The Leopard moth is one of the most dangerous pests that attacks olive trees, mainly between early August and April. The female lays most of its eggs on the rough bark of trees. The larvae hatch after 10-14 days and bore into the bark where they gnaw extensively at the surrounding wood tissue. After a month or two the larva begins to burrow into the

inner wood. From this moment, infestation is early recognized by the presence of reddish brown frees pellets which are ejected from the hole. The larva return and pupate close to the gallery opening, after two or three weeks the adult moths emerge.

Control can be achieved by killing the larva inside the tunnels throughout the year, especially from April to September, by using one D.V. pan capsule in each hole, or using a piece of cotton wetted by Dorspan (10cm3/L) and closing the hole; pruning the infested tree or burning it in the case of high infestation, or hooking out larva by a wire; spraying with Super acid in July and August.

5. **Olive Bark Borer (*Phloeotribus oleae)***

Olive bark borers attack the bark of the tree and wounded areas, laying eggs in March and April. The borer needs 16 weeks to complete its life cycle. Control can be achieved by burning dried and broken branches; and spraying with Dorsban 1.5cm3/L or Super acid 2cm3/L.

6. **Peacock eye spot (*Cycloconium oleaginum)***

The disease affects olive leaves. The infection appears as single or aggregated black or brown spots surrounded by yellow hallows giving the shape of eye for which it is named. Responding well to cold nights and heavy dew, the infection appears in the beginning of autumn causing the leaves to fall, and becoming most severe in the end of winter and beginning of spring.

Control can be achieved by spraying with a copper compound like Coside 3g/L or Coprazan 5g/L. The first application should be made in the end of October, the second application in November, and the third application, if high infestation occurs, in February.

2.9. Olive Picking

1. **Signs of Ripening**

   Ripening depends on the site and varieties. The main sign of ripening is the changing of olive fruit color from green to violet or black.

2. **Time of Picking**

   Most of the farmers pick olives before fully ripe, which negatively influences quality, quantity and storage of oil, and increases oil acidity. For this reason olives used for oil production must be picked when fully ripe. Experiments done in the O.P.T. and interviews with olive farmers and press owners show that harvesting for maximum oil production should take place no earlier than the end of October in the northern West Bank and no earlier than the second week of November in the central West Bank because it has a colder climate. Harvesting of olives in the cold mountains of the south should not be done before mid- November.

3. **Picking Methods**
   1. Hand picking. Hand picking is gentle but requires a long time and labor expenses. This way is the most used in West Bank as the families participate in olive picking. It is considered the best way for olives used for pickling.

   2. Picking with sticks. Trees are beaten with a long thin stick. This method, while labor intensive, can lead to damaging vegetative growth and thus production in the next year. This method decreases production by 20-30%.

   3. Mechanical picking. Because of expansion of olive cultivated areas, the high cost of picking and the difficulties in using workers, machines are frequently used to facilitate picking operations.

While, the machine mainly used in rainfed areas is the "shaker machine", its use is limited due to its high expense, fragmentation of land ownership and topography of olive areas (on hillside terraces).

4. Picking by using chemicals. Al-sol suspension is sprayed on trees to weaken the attachment between the fruits and the tree. The fruits need from 3-4 days to fall down. Spraying should take place in the evening when humidity is increased, to give a long duration for active material to be absorbed.

2.10. Olive Pressing

Most of the olive production in the O.P.T. is used for the production of olive oil. In 1990, over 90% of the 150 thousand tons of olives harvested were used in producing 28,500 tons of olive oil, and the rest was used for olive pickles.

About 4000 tons of olive oil produced in 1990 were sold in the Gaza Strip and Israel, about 3000 were sold to an Italian company through the West Bank agricultural marketing cooperatives and 9500 tons were consumed locally. This leaves 12,000 tons for storage as farmers realized that due to delayed rainfall there would be a poor crop in 1991. All West Bank olive oil is pure virgin oil obtained by mechanical cold pressing of the olives without interference of chemicals or adverse physical treatments. Adverse treatment of European oil includes heating, cooling, vaporization, deodorization, decolorization, coloring and blending with different types and grades of low quality olive oil.

There are about 300 presses in the West Bank. Of these 10% are fully automatic, where all oil isolation steps from washing and crushing to the separation of liquid from solid and liquid from liquid by centrifuge are done mechanically.

Virgin oil must have a light yellow to golden yellow and green color, good taste and low acidity. Many factors affect oil quality and production phases which start from training of olive trees till canning and storage. Any negligence in any phase increases the acidity of oil. The most important factors include:

1. The cultivar: The type of cultivar affects fruit health and oil color.

2. Infection by olive fly: The exposure of infested olive fruits to air and sun will cause decay and rot and thus increase oil acidity.

3. Ripening and methods of picking: Picking of olives when fully ripened will increase the quality of oil, early picking will yield bitter oil, while late picking yields highly acidic oil. The method of picking affects the relative acidity. For example hand picking yields 0.4% acidity while picking with sticks yields 1.2% acidity.

4. Heaping of olives: Aireated boxes must be used to prevent accumulation or heaping for too long, since this will increase the acidity of oil.

5. Exposure to sun: exposure to sun after picking increases the acidity and reduces oil quality.

6. Type of presses: Type and age of mills, working habits and experience of workers have a great influence on oil quality.

2.11. Economics of Olive Cultivating

The alternate bearing phenomenon causes great fluctuation in the profitability of olive production per dunum, which ranges from US$-9 to $59 (Table 5). Despite this low profitability, and in some seasons loss, olive trees continue to be an essential crop and remain important for Palestinians' social and religious traditions.

This economic study is concentrating on two consecutive seasons (1990-1991) for average productivity of O.P.T.

Table 5: Economics of Olive Production Per Dunum

		Expenses in US$								
Year	**Yield kg\dun**	**Plough**	**Fertilization**	**Pruning &picking**	**Oil pressing**	**Missing variables**	**Total**	**Olive oil Kg/dun**	**Price in $US Per Kg oil**	**Profit$US**
1990	194	14	4	31	13	8	70	43	3.0	59
1991	18	14	4	8	2	0.7	29	4	5.0	-9

2.12. Problems in Olive Oil Production

Olive production faces many obstacles beginning with cultivation through the production phase. The most important problems include:

1. Farmers and farm laborers are taking up employment in Israel due to higher salaries. For this reason the expenses of labor and plowing has doubled while oil price remains low.

2. The income from olive sales remains low even in years of good yield due to marketing costs and high production expenses. Olive marketing is restricted to the local market, not including the Israeli market. Direct export to Arab markets is restricted, but occurs indirectly through Jordan only.

3. Lack of agricultural extension.

4. The presence of olives in hilly lands which are not easily accessible for mechanized cultivation.

5. Fluctuations in rainfall levels.

6. Competition with lower-priced imported oil, since there is no local authority protecting the domestic market.

7. Fragmentation of land ownership making mechanization more difficult.

8. High cost of insecticides and fungicides.

9. Lack of financial support for conducting research.

10. Lack of laboratories that conduct analyses and grading of Palestinian olive oil.

11. Israeli authorities' discouragement of olive cultivation in order to make confiscation of lands easier. Many olive trees in confiscated lands are pulled out.

2.13. Needs and Prospects for Improving Olive Production Sector

Olive cultivation does not need continuous care and intensive labor, in contrast to other fruit trees; in fact olive crops tend to be neglected. Palestinian farmers cultivate their lands with olive trees in order to protect their lands from confiscation. Because they do not produce immediately, the time factor for olive production sometimes discourages cultivation as a risk, in contrast to vegetables and field crops.

Olive production is characterized by natural fluctuation due to alternate bearing and to annual rainfall fluctuations, causing variation in production prices as well as influencing the entire agricultural sector in the O.P.T.. Political, economic and marketing problems are encountered as well. In the Gaza Strip, for example, planting new orchards is forbidden unless farmers have permission from Israeli authorities.

Among the most important recommendations are those which improve olive products to meet the needs of the consumer. These include quality and marketing

considerations. Improving the production quality to yield high grade virgin olive oil would facilitate oil export and sale to western markets at higher prices. It is also important to develop new ways of canning, labelling and marketing, to improve public relations when participating in trade exhibitions. For this purpose expert advice for producers about marketing would assist greatly.

Finally, financial support for research aiming to develop this crop, and establishment of agricultural factories for making pickles and canning of olives would assist in crop development.

Knowing all the factors that cause variation in olive cultivation in the O.P.T. will make it easier for farmers, press owners and producers to make the right decisions concerning olive production and marketing.

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Part 2: GRAPE VINES

1. Introduction

Grapes are temperate climatic plants characterized by climbing stems and prostrate canes. Tendrils fix the canes to any support, aiding in cane distribution and penetration of sunlight. Grape cultivation in Palestine can be traced back to

the earliest recorded history, introduced in North Africa and then in Spain by the Phoenicians.

Grape production ranks first in all fruit cultivated, accounting for one third of the total fruit production in the world.

2. Status and Production Potential of Grapes in the O.P.T.

Grape varieties in the O.P.T. are all essentially related to the European Vitis vinefera. These grapes respond well to the local climate conditions.

Grape vines of rainfed cultivation are mainly grown in altitudes greater than 800m, with annual rainfall of more than 400mm and average temperature of 20oC.

They are concentrated in the southern parts of the West Bank, in Hebron, Bethlehem, Ramallah, and Gaza, and are irrigated in Jericho.

Grape yard areas have not increased significantly over time. Hebron ranks first with 58.8% of the total vineyard area, followed by Ramallah and Bethlehem with 26.7%, the Gaza Strip with 7.8%, and finally the northern West Bank (Jenin, Nablus, Tulkarem) with 6.7% (Table 1).

Table (1): Grape Cultivation Area (dunums) in the O.P.T.

District	1988-89	1989-90	1990-91	1991-92	Average
Hebron	51,303	51,467	51,523	51,700	51,498
Ramallah &Bethlehem	24,200	24,200	22,528	22,600	23,382
Jenin	3,720	3,730	3,730	3,730	3,728
Nablus	1,087	1,117	1,117	1,120	1,110
Tulkarem	956	946	946	946	949
Gaza	6,870	6,870	6,870	6,870	6,870
Total	88,136	88,330	86,714	86,966	87,537

Average yields do not change significantly year to year, indicating that grapes are well-acclimatized to the Palestinian environment. The highest average overall productivity was recorded for Jenin with 763 kg/dunum, while the lowest was for the Gaza Strip with 238 kg/dunum. The average production of grapes in the O.P.T. for the last four years is about 52.2 thousand tons, of which Hebron contributed 57.7% to the total.

Table (2): Grape Productivity (kg/dunum) in the O.P.T.

District	1988-89	1989-90	1990-91	1991-92	Average
Hebron	560	600	550	630	585
Ramallah &Bethlehem	700	700	500	600	625
Jenin	800	800	700	750	763
Nablus	500	500	650	600	563
Tulkarem	300	300	300	300	300
Gaza	200	250	200	300	238

2.1. Grape Varieties Cultivated in the O.P.T.

There are over 13 seeded varieties of grapes grown under rainfed conditions in the O.P.T. These grapes are consumed as table fruit or after processing, in such forms as dibis (molasses), jams, malben (fruit roll), raisins, juice, vinegar, and wine. Cultivated grapes are classified as follows:

1. **White Grapes**
    - Dabouki: This is the most popularly grown variety in the O.P.T., constituting more than 50% of the total production. Dabouki are characterized by medium-sized clusters with juicy fruits, and are suitable for consumption and processing. They are generally 72% juice and 21% sugar. Shelf-life is very short which makes the Dabouki unsuitable for transport.

    - Zaini: Zaini are very similar to Dabouki but with a longer shelf-life.

- Marrawi: These are characterized by medium to big clusters with juicy, fleshy fruits. Marrawi are suitable for consumption, processing, and export. Juice and sugar content are similar to Dabouki.

- Hamadani: Hamadani have medium clusters with juicy, fleshy fruits. They are excellent for consumption and processing and suitable for export. Juice content is approximately 72% and sugar content over 20%.

- Beiruti (Romani): These are characterized by large clusters of very fleshy but firm fruit. They are excellent for consumption and very good for export. Beiruti are however, sensitive to disease. They merit greater cultivation in the O.P.T.

- Jandali: Jandali have medium to big clusters with fleshy, juicy fruits. They are suitable for consumption, processing, and export. In juice and sugar content, they resemble Dabouki.

2. **Red Grapes**
   - Halawani: The Halawani variety is characterized by big clusters with fleshy, firm fruits. They are excellent for consumption and suitable for export. Halawani have a long shelf-life and high productivity.

3. **Black Grapes**
   - Shami: These are characterized by big clusters with fleshy, firm fruit which make them excellent for consumption. They are very good for export.

- Shoyoukhi (Darawishi): Shoyoukhi have big clusters with fleshy, firm fruit. They are excellent for consumption and export. This variety is suitable for processing raisins.

- Beituni (Baloti): This variety is characterized by medium to big clusters with fleshy fruits. They are good for consumption.

- Fahaissi: Fahaissi have big clusters with reddish to black, fleshy and firm fruits. They are excellent for local consumption and for exporting.

- Motartash: Motartash are red to black, fleshy, and firm. They are excellent for local consumption and for exporting.

Other varieties of seedless white grapes, recently introduced in Jericho and mainly under irrigation, include Berlait and Superior.

2.2. Climatic and Soil Requirements

2.2.1. Climate

Temperature is very important in determining vineyards' success. The physiological growth of root stands requires temperatures of 7.2-7.8oC, while buds require 10-12oC, canes 15-18oC, flowering 18-20oC, fruit setting 20-25oC and fruit ripening 21-30oC. Temperatures in excess of 30oC harm vegetative and fruit growth. Two to three months of winter weather between -1 and 10oC are suitable for breaking bud dormancy. Rainfall levels of 400-500mm are suitable.

2.2.2. Soil

Deep soils with good water-holding capacity are most appropriate. Grapes may be cultivated in different types of soil, although shallow, poorly drained, and salty soils should be avoided. Moderately saline soils generally do not inhibit growth but should not exceed 2000 ppm. Some varieties, Thompson seedless for example, can withstand high salinity.

2.3. Propagation

Different methods of grape propagation include cutting, layering, and grafting.

- *Cutting*

  Taking cuttings is the easiest and most successful method. They are preferably taken from dormant canes of moderately productive vines 25-30cm long with a diameter of 1-1.2cm. IBA (Indole buteric acid) is used to induce rooting.

- *Layering*

  Tip or air layering is usually done on the vine canes.

- *Grafting*

  The most preferable method is tongue grafting, in which the grafting of a scion 5cm long onto a rootstock of the same diameter and 30cm long is done during a dormant season. This method is most suitable and encouraged, especially if the root stock is resistant to the most prevalent diseases such as nematodes and phylloxera.

2.4. Agricultural Practices

2.4.1. Planting and Distances of Seedlings

After ploughing and harrowing the vineyard, the holes are prepared in dimensions of 30cm x 30cm x 30cm. Fermented animal manure may then be added to the hole. One-year-old grape seedlings are transplanted in February or March. The seedling roots must be thinned out by cutting, and the stem should be cut to a height of 40cm, leaving one cane with 2-3 eyes to encourage growth of the canes the following season. The plants spacing is 2-5m between plants and 2-5m between raws, mainly depending on the soil fertility and amount of annual rainfall.

2.4.2. Vineyard Training Systems and Pruning

1. Head training system. The vine stem is supported by a wood support for 4-8 years, to a height of 1-1.5m. The head of the vine is concentrated in the upper part of the stem. It requires pruning, resulting in weakness of the vine. The number of eyes per spur is less than in other training systems. Crowding of vegetative growth and fruit clusters increases the incidence of diseases. This system is not suited for varieties bearing on long spurs. To obtain a mature vine, the training period should last five years. Pruning of a mature vine should leave about 3-6 canes, each one having a spur of 2-4 eyes. This method involves lower costs than the trellis training system.

2. Trellis training system. The best training system supports the vine, providing good aeration and sunlight. Pest and disease control and harvesting are easier with this system, but it involves more costs than the others. Vine training requires one strong stem to reach the upper edge of the trellis and the growing head must be on the trellis itself. The canes are distributed on the surface of the trellis.

3. Ground training system. Disadvantages of this system are many: the clusters touch the soil, are susceptible to disease, and the incidence of rotting is high and difficult to control. Pruning is done by leaving 2-3 long canes on the ground.

2.4.3. Fertilization

Grape vines are very sensitive to nutrient deficiency for both macro and micro-elements. Application of animal manure, and chemical fertilizing, as ammonium sulfate should be applied to sustain a good productivity.

2.4.4. Pests and Diseases

2.4.4.1. Pests

Annual Weeds

Weeds can be controlled by spraying Symnix-50 at a rate of 250-300g/dunum or Symazin-50 at a rate of 250-300g/dunum. Chemical application should be carried out in December directly after the first ploughing.

Insects

- **Phylloxera (Phylloxera vitifolia)**

  Phylloxera damage and yellow the leaves and root-knots. Severe infection results in the death of tree. To control phylloxera, resistant root stocks and infection-free seedlings should be used.

- **Grape Thrips (Retithrips syriacus)**

  Grape Thrips suck the leaves, causing a glazed appearance. They may be controlled using Dorisban at a rate of 3cm3/liter.

- **Grape Fruit Moth (Polychrosis botrana)**

  Grape Fruit Moth larva bore holes in the fruit. They may be controlled using Dorisban-4 at a rate of 3cm3/liter or Simposh at a rate of 2cm3/liter.

2.4.4.2. Diseases

- Powdery mildew (Uncinula necator)

  Powdery mildew affects the leaves, flowers, and fruits, and results in a reduction of fruits per cluster and cracking of the fruit. Control is by using Ropigan at a rate of 1 cm3/liter, Padifidan at a rate of 1 cm3/liter, and Sulfur-70 at a rate of 2.5-4 kg/dunum.

2.5. Ripening Period

The ripening date and duration of picking for local grape varieties fluctuates within a seven month period, from June to December. The highest rate of production is concentrated between August and October (Table 3). The duration of the picking period primarily depends on the prevailing climatic condition where the grapes are grown.

Statistical data for the total tonnage of grape varieties sold in different local markets (Table 4) shows that the highest tonnage was brought to market in August to November. That correlates positively to the results of Table 3, with the exception of November, because Halawani and Shami varieties are the most available in the market and have high productivity.

The period between August and October shows high production. Higher supply than demand results in low selling prices (0.14 $US) and makes remaining grapes available for processing and consumption. In the later period of production, demand surpasses supply, resulting in higher selling prices (0.5 $US) for consumption.

Table (3): Grapes Ripening Period in the O.P.T.

Grape Varieties	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1. White Grape							
a. Dabouki			x				
b. Zaini			x	x			
c. Marrawi			x	x			
d. Hamadani			x	x	x		
e. Beiruti			x	x	x		
f. Jandali					x		
2. Red Grapes							
a. Halawani				x	x	x	x
3. Black Grapes							
a. Shami		x	x	x	x	x	
b. Shovoukhi			x	x	x		
				x	x		

c. Beituni d. Fahaissi e. Motartash		x		x	x		
4. Seedless Grapes	x	x					

Table (4): Quantity of Grapes Locally Marketed in the O.P.T.

Month	Quantity (tons)
June	4.2
July	30.5
August	157.6
September	196.8
October	183.4
November	106.3
Total	678.8

2.6. Economics of Grape Production

The 1991-92 season's net returns for different training systems revealed that the highest average profits were registered for the trellis training system, at $US 309, followed by the head and ground systems at $US 46 and -29 respectively (Table 5). The trellis system gives both the highest yield and the best grape quality.

Table (5): Economics of Grape Cultivation (per dunum)

		Expenses $US							
Training system	**Yield kg/dunum**	**Plough**	**F& H*&**	**Labor**	**Marketing**	**Total**	**Price per Kg**	**Income $US**	**Profit $ US**
Ground	500	10	32	85	22	149	0.24	120	-29
Head	600	14	32	78	34	158	0.34	204	46

Trellis	1500	14	32	78	77	201	0.34	510	309
* F&H= Fertilizers, Herbicides, and Pesticides.									

2.7. Problems in Grape Production

Roughly 60-80% of the varieties cultivated ripen in August through October creating high surplus production. Surplus results in local marketing crises. These could be solved by export to other markets.

Exporting outside the country is very difficult, although Jordan represents an important potential market. The local market cannot absorb the large output of grapes, but to export the surplus to Jordan, farmers need the permission of the Israeli authorities and high taxes must then be paid. As the taxes are higher than potential export earnings, the farmers are obliged to sell at low prices in the local market.

For those who are permitted to export, high transportation costs are prohibitive. Few transport vehicles have permission to cross the Jordanian border. Delays and searching are long, and damage fruit that is permitted to be exported.

Other problems include the high costs of intermediate merchants, who charge between 10-20% of the product value;

lack of product grading according to quality, so good quality products are degraded when mixed with those of lesser quality; and the limited range of production; lack of asphalt roads in agricultural areas; and phylloxera.

2.8. Recommendations to Improve Grape Cultivation

From the beginning of the marketing process through to the product stage, potential exists for improvement in the grape sector. Suitable boxes marked with the grade type and number would make the sale of different classifications easier. Special cooling containers for storage could increase the period during which grapes could be marketed. Finally, building new factories to press grapes in order to produce juice and jams for marketing locally and to other countries would diversify the market.

Opening new markets in neighboring countries, though dependant on political developments, is important for agriculture in the O.P.T. Qualified persons able to improve and carry out marketing procedures should be in place to specify the amount of daily marketable grapes in the Bethlehem - Hebron region, providing

information to grape sellers in the markets so that supply is measured against demand, in order to get better prices.

The provision of paved roads is an important infrastructure development. Roads should reach agricultural areas, particularly mountainous rocky areas.

Support of local research and institutions would ensure that extension would improve grape varieties and suggest suitable soil types, specify appropriate distances between trees and suitable training system, choose the best insecticides and pesticides to overcome pests, and make laboratory studies of phylloxera.

Finally, small loans would assist in all the above steps, from production to processing to marketing within the country and in other markets.

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Part3: STONE FRUITS

1. Introduction

Stone fruit trees are related to the Prunus genus and are members of the Rosacaea family, including almonds, plums, apricots, peaches, nectarines, and cherries. They are deciduous and require a certain chilling period during the winter in order to break bud dormancy. Because chilling requirements vary among varieties within the same species, it is possible to match suitable varieties with specific environments.

2. Status of the Stone Fruit Sector in the O.P.T.

Stone fruits comprise nearly 132,246 dunums in the West Bank: 76,281 dunums in the north and 37,539 dunums in the south. In the Gaza Strip, almonds are the major stone fruits cultivated (Table 1).

Stone fruits are grown throughout an extensive manner. Fluctuation between locations, varieties, rainfall, farmer skills.

Surplus stone fruit production is common in the O.P.T. and is generally exported to Jordan or Israel. Peach cultivation, however, does not satisfy local demand, which is supplemented by imports (Table 2).

Table (1): Stone Fruit Cultivation in the O.P.T. 1991-92

City	Area (dunums)
Jenin	32,749
Tulkarem	24,491
Bethlehem & Ramallah	19,081
Nablus	19,041
Hebron	18,458
Gaza	18,426
Total	132,246

Table (2): Stone Fruit Poduction and Consumption in the O.P.T. 1991-92

Type	Production (ton)	Consumption (ton)	Surplus (ton)
Almonds	4,503	1,200	3303
Plums	13,859	7,400	6,459
Apricots	2,651	2,280	371
Peaches	356	15,800	-15,444
Total	21,369	26,680	-5,311

2.1. Stone Fruit Varieties Cultivated in the O.P.T.

2.1.1. Almonds *(Prunus amygdalus)*

Almonds constitute the largest cultivated area of any single stone fruit, although due to low productivity, total production ranks second after plums. Regional production values generally fluctuate between 10-70 kg/dunum. Cultivation is highest in the north, primarily in Jenin, Tulkarem, and Nablus, followed by production in Gaza and the southern West Bank.

Low productivity of almonds is a dominant phenomena in many parts of the O.P.T. As they neglected and grown extensively, so the productivity figures don't reflect the actual potential.

Table (3): Area, Yield and Production of Almonds in 1991-92 in the O.P.T.

City	Area (dunum)	Yield (kg/dunum)	Production (ton)
Jenin 2	7,224	10	272
Tulkarem	20,727	70	1,451
Ramallah & Bethlehem	8,631	40	345
Nablus	16,688	50	834
Hebron	4,244	30	127
Gaza	18,426	80	1,474
Total	95,940	--	4,503

The varieties of almonds cultivated in the O.P.T. include two types according to their taste:

Bitter Almonds. The varieties cultivated are distinguished not by name, but by seed size.

Sweet Almonds. Many varieties are known to local Palestinian farmers. The most cultivated varieties include the following.

- Local Almonds have small rounded fruit, with moderate productivity.

- Auja are long, hard-shelled, and have a twisted tip. This variety is moderately productive.

- Mokhmalihas large fruit with hard-shelled, large, flattened seeds, and moderate productivity. Mokhmali usually are eaten green.

- Naba has long fruits and seeds, and moderate productivity. The seeds are soft-shelled.

- Neobolishas a long, soft-covered fruit and moderate productivity.

- Om-Elfahem has a medium, soft-covered fruit and high productivity.

- Bureh 81 has small fruit with tiny filled seeds. Locally it is called Bondoki.

Climatic and Soil Requirements

Almond buds open in February and need slightly low temperatures to break bud dormancy, although the temperature required differs according to variety. Because they bloom earlier than any other deciduous fruit trees, the blossoms and young nuts are particularly susceptible to frost damage. The best way to avoid frost damage is to select an orchard in a warm area which has good air circulation.

Almonds do not grow well in heavy, poorly drained soils. They require annual nitrogen fertilization, and in some areas, potassium and zinc fertilization.

2.1.2. Plums

After almonds, plum orchards occupy the second greatest area, comprising 23% of the total area of stone fruit cultivation, yielding 65% of the total production of stone fruits. Plum production is concentrated in the southern part of the West Bank where 23,135 dunums are cultivated, compared to 7,266 dunums in the north (Table 4).

In 1991-92, the highest productivity was recorded in Nablus, with 750 kg/dunum, and the lowest in Tulkarem, with 300 kg/dunum, while Hebron gave the highest production with 5,210 tons of plums.

Table (4): Area, Yield and Production of Plums in 1991-92 in the O.P.T.

City	Area (Dunum)	Yield (kg/dunum)	Production (Ton)
Jenin	4,110	580	2,384
Tulkarem	1,450	300	435
Ramallah & Bethlehem	10,110	450	4,550
Nablus	1,706	750	1,280
Hebron	13,025	400	5,210
Gaza	------	---	-----
Total	30,401	----	13,859

European and Japanese plum varieties are cultivated in the O.P.T. as listed below:

1) European Plums*(Prunus domestica)* include early, moderate and late varieties, and are classified according to ripening time.

A. Early Varieties (Prunus salicina) include those ripening in May and June.

- Varieties that ripen at the beginning of May:

- White European has small, white fruit, and is usually eaten before ripe. This variety, when ripened, is juicy and is always used for making jams.

- Red European is larger than the white type. It has a sour taste before ripe, a dark green fruit, and is juicy at maturity. Red Plums are usually used for making jams.
- Shami is medium sized with white to green fruits, and is usually eaten before ripe. Mature fruits are juicy and used for preparing jams.
- Varieties that ripen at the beginning of June:
- Laila (Methly) ripens from late May until the beginning of June.
- Floransia (Waransia) has red fruit at the beginning of maturity, is not juicy, and is used as a pollinator. They change to a black color at maturity, and ripen in mid-June.
- Meska resembles Formosa and ripens after the 20th of June.
- Auqden has yellow fruit and a moderate size. It is usually used as a pollinator and in preparing jams.
- Tyliani has hard, sweet, green and rounded fruits.

B. Moderate Varieties ripen in July and are the following:

- Banjari have sweet, white dotted fruit of medium size.
- Duarte an American odorous variety, looks like Banjari but is more juicy and is larger. It is grown in warm areas to keep it from frost.
- Nopyana resembles Laroda and Marybosa, but has a pointed end and a light red fruit. Usually ripens in mid-July.
- Banat Brar has a yellow to green, sweet, soft and juicy fruit.
- The fruits of the last three varieties show splitting along the outer skin, at which the fruits might be attacked easily by fungus before ripening or during maturity.

C. Late Varieties include the following:

- Golden King is yellow, hard, juicy, sweet and medium sized, and is suitable for storage.
- Kelsey has green fruits, ripen after 15 August, resemble Wickson (see under Japanese Plums, below) and is rarely found in this region.

II) Japanese Plums include varieties of hard, late ripening fruits, and are easy to store and export. They include the following:

- Beauty are dotted red-white, the fruits are juicy, medium sized, and ripen in early June.

- Formosa has sweet, large and fleshy fruit, but is not juicy. Formosa ripens in mid-June.
- Santarosa is a widespread, black fruit and preferable for marketing.
- Wickson is sweet and not juicy, and has yellow to green fruit of medium size. It is usually used for preparing jams and ripens in mid-July.
- Mariposa is a highly productive and very widespread variety with a hard, red fruit which ripens in mid-July.
- Laroda looks like Santarosa, but has a light red color, pointed and flattened neck, and is moderately sized. It usually ripens in mid-July.

Climatic and Soil Requirements

While most varieties are cold-tolerant, this will vary depending on their type. The flower buds in Japanese Plums resist cold to the same degree as European ones.

Although plum flowers resist frost at temperatures higher than -2 or -3 oC, the young fruit itself is very sensitive to frost in late spring and will die when exposed to temperatures of -1 oC. Plums grow well in many soil types but do best in deep, well-drained soils of medium texture. European plums seem to require less nitrogen than do Japanese plums, but all respond well to potassium fertilizers.

2.1.3. Apricots *(Prunus armeniaca)*

Apricots are mainly cultivated in the northern West Bank covering 4,352 dunums, while in the south, they cover only 641 dunums. In 1991-92, the highest productivity rates were found in Jenin, at 900 kg/dunum, and the lowest, in Tulkarem, at 300 kg/dunum. Jenin also produced the highest tonnage, at 1,273.5 tons of apricots (Table 5).

Table (5): Area, Yield, and Production of Apricots in 1991-92 in the O.P.T.

City	Area (Dunum)	Yield (kg/dunum)	Production (Ton)
Jenin	1,415	900	1,274
Tulkarem	2,290	300	687
Ramallah & Bethlehem	304	500	152
Nablus	647	650	421
Hebron	337	350	118

Gaza	-----	---	---
Total	4,993	---	2,652

There are three main varieties of apricots cultivated in the O.P.T.:

- Klabi has bitter seeds and a light orange fruit.
- Ra'nana has bitter seeds, and moderately sized, yellow to red fruit.
- Mestkawi has sweet seeds, is smaller than Ra'nana, and has yellow to red fruit.

Climatic and Soil Requirements

Apricots have an early flowering period, so exposure of the flowering trees to very low (-2.5 oc) temperatures will damage the flowers. Apricots are shallow-rooted and suffer from a lack of moisture when competing with grasses. The trees respond well to potassium fertilizers to improve strength, bloom, and to increase yield. Clay, loamy, well-aerated and drained soils are preferable for apricot planting.

2.1.4. Peaches *(Prunus persica)*

Peach cultivation accounts for a small percentage of the total cultivated stone fruit area, covering only 912 dunums. Cultivation is concentrated mainly, in descending order, in the Hebron, Bethlehem and Ramallah areas. The northern West Bank experiences low productivity (300 kg/dunum) and cultivation there is only found in Tulkarem. Given the low production rates, it is estimated that about 15,444 tons of peaches are required to supplement the shortage in peach production in the O.P.T. (Table 6).

Table (6): Area, Yield and Production of Peaches in 1991-92 in the O.P.T.

City	Area (Dunum)	Yield (kg/dunum)	Production (Ton)
Jenin	---	---	---
Tulkarem	24	300	7

Ramallah & Bethlehem	36	450	16
Nablus	---	---	---
Hebron	852	390	332
Gaza strip	---	---	---
Total	912	---	355

The most cultivated varieties in the O.P.T. are classified according to different ripening periods and include:

Early Varieties such as Texas

Moderate Varieties such as Sueling and Alberta

Late Varieties such as Almog

Climatic and soil requirements

Weather conditions and cold temperatures needed to break the rest period differ among varieties. Peach flowers do not succeed in areas of low temperature where frost appears at -3 oC. Peach trees prefer light and well-drained soils, and must have continuous soil moisture during the growing season, from either rainfall or irrigation. The trees have a high nitrogen fertilizer requirement, and respond well to potassium fertilizers. They respond very little or not at all to phosphorous fertilizers.

2.1.5. Nectarines *(Prunus persica var. nectarine)*

Due to the limited areas of nectarine cultivation in the O.P.T., there is no statistical information about them. Nectarine trees do not differ from peach trees in shape, size, flower type, leaf shape or in their response to different agricultural practices. The only difference is that nectarine fruit is smaller in size, is sweeter, and has smooth skin.

2.1.6. Cherries

Cherry cultivation and production are in short supply, as consumption demands in the O.P.T. are primarily met by importation. Creation of new orchards must be considered in order to increase production in the West Bank and Gaza.

The most cultivated varieties in the O.P.T. include the following:

- Local cherries have red and small fruit, and are sour at maturity.
- Shami cherries have wide leaves, and the fruits are sweet and bigger than the local cherries.

Climatic and Soil Requirements

Cherry buds can withstand relatively low temperatures. As brown rot disease causes serious damage to the fruit, it is preferable to grow cherries in areas with dry and cold spring.

Deep, well-drained and aerated loamy soils are most suitable for cherry trees. The trees respond well to nitrogen fertilizer applications, and in some areas, to zinc.

2.2. Propagation

Traditionally, scions of different varieties of stone fruits are grafted onto bitter almond seedlings as root stock because the seedlings are resistant to capnodis. Nursery stone fruit trees, on the other hand, are propagated by T-budding on various seedling root stocks in the genus. These procedures are usually carried out in the spring. Attention must be given to choose a root which is compatible with the budded variety and with physical and chemical soil characteristics, which is resistant to soil borne diseases such as root-knot nematode, and which can withstand drought conditions.

2.3. Fertilization

Mineral elements provide essential assistance in the production of roots, stems and leaves. Since trees exhaust nutritive soil elements more than any other crop, fertilizers must be added to supplement the scarcity of essential nutrients.

Laboratory tests of random samples of orchard soil show the percentages of different elements found. Leaf analysis also shows element deficiencies and excesses, especially of micro- elements, necessary for production and growth. Traditionally, local farmers do not utilize testing procedures to determine levels of nutrients and suggest fertilizer amounts. Wherever fertilization is necessary, organic fertilizers such as manure are recommended after treatment.

Stone fruits in general respond well to chemical fertilizers, especially those containing nitrogen, phosphorous and potassium, as well as zinc and iron.

2.4. Pests and Diseases

Pests and diseases are serious threats to crops, as epidemics may destroy one crop and move on to another, or live in trees from season to season.

2.4.1. Insects

The larvae of the Almond borer (Capnodis carbonaria) are among stone fruit pests. Females lay groups of eggs in the upper layer of the soil, near superficial tree roots, or adjacent to the trunk. The larvae pass through the soil and penetrate the wood, after which they bore galleries within the cambium directly beneath the bark. Gallery length varies and may reach a meter or more. The affected trees develop yellow leaves and dry limbs, gummosis, and finally die.

Various species of stone fruit trees serve as host plants for the almond borer. Laboratory experiments have shown that young larvae most affect almonds, then apricots, peaches, and plums.

Strong vigorous trees generally resist the pest. The almond borer can be controlled chemically by adding Katinon-4 at the rate of 50-70 g/tree at the beginning of April through June, or by using Gamoside through broadcasting at the rate of 50-100 g/tree.

Other insects that affect stone fruit trees are Green aphids (Myzus persica), Red spiders (Tetrany chustelarius), Nematodes root knot, Mediterranean fruitflies (Ceratitis capitata), San Jose scale insects (Apiddiotus perniciosus), and Almond fruit swaps (Eurytoma amygdoli).

2.4.2. Diseases

- Fungal diseases

A number of fungal diseases affect stone fruit trees. Brown rot is caused by Monillia fructincola, silver leaf is caused by Stereum purpureum, scab is caused by Cladosporium carpophilum, powdery mildew is caused by Sphaerotheca pannosa, and gummosis is caused by Exosporium sp.

- Bacterial diseases

Bacterial canker (Gummosis) is caused by (Pesudomonas syringae) and crown gall (Agrobacterial tumefaciens) also affects the trees.

- Viral diseases

Many stone fruit clones are affected by virus disorders such as ring spot and dwarfing. Viruses reduce plant growth, crop production and interfere with the grafting success. Trees affected by viruses cannot be cured, but these disorders can be prevented by using virus-free propagation material and certified virus-free trees.

2.4.3. Integrated Pest and Disease Management

Methods for controlling diseases and pests should be carefully followed when they are necessary.

- Pruning, gathering all cut branches and infected fruits, and burning them outside the orchard should prevent further spreading among trees.

- Spraying for diseases and insects during the growing season requires proper use of chemical concentrations. This will reduce side effects on humans and on the environment.

- Well-drained and aerated soils are preferable to prevent the incidence of gummosis.

- Planting rootstocks resistant to prevailing diseases in the orchard area, e.g. nematodes, will increase the success of growth. For viral diseases, certified virus-free trees must be used.

- Tree stems must be sprayed against the stem borer, and fruits and leaves sprayed against flies, aphids, scale insects and red spiders. Special chemicals must be used after appearance of these pests.

- Proper weeding, hoeing and fertilizing result in healthy trees, which give more yield with higher quality fruits.

2.5. Economics of Stone Fruit Production in the O.P.T.

The ARIJ survey done on the status of stone fruit cultivation in the West Bank showed this sector overall to be nearly neglected since the occupation in 1967, which reflected directly on the productivity and quality of produced stone fruits. However, in some parts of the West Bank, such as in Hebron, individual farmers have started to improve the production by introducing new varieties and improved agricultural practices. The economic study was based on average productivity in the West Bank with farmers' using traditional practices. The highest average net profit was for apricot production at 530 $US, followed by peach, plum and almond. Since the potential for increasing almond production is excellent, area devoted to it is already high, and there is marketing potential both in and outside the O.P.T., we consider it worthwhile to research improving almond cultivation to increase its productivity potential. Likewise peach production should be increased, since they are currently imported to meet consumer demand and would well in the marketplace. (Table 7).

Table (7): Agricultural Expense per Dunum per Season for Stone Fruit Production in the O.P.T.

Stone Fruit	Expenses in US$				yield Kg/dunum	Price US$/kg	Returns in $US	
	Tillage1	Fertilization & pesticides	Pruning & Picking	Total			Total	Net
Apricot	20	20	20	60	530	1.00	530	470
Plums	20	20	20	60	390	0.74	289	229
Peach	20	20	20	60	450	0.34	153	93
Almonds	10	--	10	20	45	1.00	45	25

1. Ploughing done by tractor.

2.6. Problems in Stone Fruit Production

Currently, stone fruits cultivation requires intensive labor and often brings net returns low enough that many farmers have found it more worthwhile to work in Israel. This has resulted in little or no improvement in this sector, either in cultural practices or introducing new promising varieties. Furthermore, this has resulted in a reduction of the number of skilled laborers available for stone fruit cultivation and maintenance.

While almond is the most produced stone fruit, occupying about 72% of the total cultivated land area, it is also probably the most neglected. Almonds account for only 21% of the total stone fruit production. This can be compared to plums, which cover about 23% of the area devoted to stone fruits, while counting for 65% of production.

The production of stone fruits is concentrated in June, July and August (Table 8). This concentration makes difficult the task of marketing farmers' produce either in the local markets of the O.P.T. or for export.

The lack of varieties studies to local environmental conditions, with higher productivity, quality and a wider range of ripening dates is the primary problem facing this sector.

Table (8): Stone Fruit Picking Times in the O.P.T.

Types	May	June	July	Aug.	Sept.
Plums					
Santarosa		X			
Laila	X	X			
Auqden		X			
Florensia		X			
Beauty		X			
Duarte			X		
Banjari			X		
Black Sageve				X	
Red Sageve				X	

White sageve				X	
Golden King				X	
Kelsey				X	
Mariposa			X		
Laroda			X		
Nopyana			X		
Banat Brar			X		
Meska		X			
Farmosa		X			
Wickson			X		
Cherries					
local cherry		X			
Washna		X			
Peaches					
Early Peach		X	X		
Mid Peach			X	X	
Late Peach				X	
Apricots					
Mestakawi			X		
Ra'nana		X			
Almonds					
Local Almond					X
Ouja					X
Mokhmali					X
Naba					X
Neobolis				X	
Boreh 81				X	
Om-Elfahem				X	
Bitter Almond					X

2.7. Prospects for Improving the Stone Fruits Sector

In order to combat the current peach production shortage and more general problem of low production for a dunum of stone fruits, suitable strategies must be followed to increase production for local consumption and export abroad.

The following is necessary to achieve this:

1. Intensive extension programs for farmers, helping them to follow new methods and techniques for orchard management.

2. Establishment of new peach orchards, replacement of local low productivity varieties with new ones characterized by high productivity, and concentration on increasing the areas of nectarine and cherry production.

3. Research and establishment of suitable programs for introducing improved varieties, fertilizing and controlling pests and diseases.

4. Initiation of cooperative societies in different areas of the O.P.T. and support of these societies with machines and implements for cultivation, pruning, spraying and picking.

5. Encouragement of nurseries in the O.P.T., in order to use healthy, certified and well-known rootstocks, and cultivated varieties.

6. Protection of farmers from marketing crises through the opening of new markets, and creation of produce storage stations as well as new processing centers.

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4. FIGS

1. Introduction

Fig trees originated from the Arabian Peninsula, dispersed first in the Mediterranean region, then in other parts of the world. Always an economically important crop, historical records of fig tree plantation show that figs have been found in Palestine since 2375 B.C.

2. The Status of Figs in the O.P.T.

Like the olive trees and grapes, fig trees are also cultivated for their traditional and historical importance in Palestine.

2.1. Fig Cultivation Area and Production

The area of fig cultivation is distributed among the different districts of the West Bank. There is no data recorded about its plantation in the Gaza Strip. The largest area is found in Ramallah, with 52% of the total area, followed by Nablus with

22% (Table 1). There is no significant change in fig areas over time, as the total remains within the average of 23 thousand dunums.

Table (1): Fig Cultivation Area (1000 dunums) in the O.P.T.

Year	Tulkarem	Jenin	Nablus	Ramallah &Bethlehem	Hebron	Total
1987	2.7	0.3	5.3	12.8	1.8	22.9
1988	2.8	0.3	5.1	12.8	1.9	22.9
1989	2.7	0.3	5.1	13.6	1.8	23.5
1990	2.8	0.3	5.1	12.9	2.0	23.1

Fig trees are well-acclimatized to the conditions of the region. Productivity is generally stable, never ranging far from 437 kg/dunum. The total production is also noticeably stable at an average of 9.6-10.7 thousand tons.

Table (2): Fig Productivity (kg/dunum) in the O.P.T.

Year	Tulkarem	Jenin	Nablus	Ramallah &Bethlehem	Hebron	Avg.
1987	460	460	460	500	460	468
1988	500	250	500	500	350	420
1989	500	250	550	400	350	410
1990	500	400	600	400	350	450
Avg.	490	340	528	450	378	437

2.2. Varieties of Figs in the O.P.T.

More than 50 varieties are found in the O.P.T., but only 19 of them are well known. These varieties are classified according to their fruit colors and origin as follows:

- **Local Varieties**

1. *Green or Yellow varieties*

   Khdari, Biadi, Shnari-Abied, Mowazi, Ajloni, Na'emi, Kbari, Klibi and Sfari.

2. *Green colored or Violet varieties*

   Khortmani, Slati, Enaqi, Hmadi and Ghzali.

3. *Blackish to Black colored varieties*

   Kharobi, Swadi, Odicy and Zraqi.

- **Introduced Varieties**

  Nasrati, Sultani and Kadota.

2.3. Climatic and Soil Requirements

Fig trees generally lose their leaves in the late fall and early winter and become dormant. They will withstand considerable cold, recovering, or smiling, again during spring.

Figs thrive under conditions of low relative humidity and intense sunshine and heat during the summer months. The trees grow well in a wide range of soils but do best in deep, non-alkaline clay loams.

2.4. Agricultural Practices

Planting is usually done in dimensions of 5-6 meters between each seedling and 7-8 meters between each row.

Fig trees are generally propagated by cuttings, and then grafted or budded to change undesirable characteristics of fig fruits. The pruning system does not have to be specific since the fruits are produced in the axles of the current season's shoots.

Fig trees have a shallow and well distributed root system, so deep tillage may cause damage to feeder roots.

Fig tree productivity is characteristically good in low fertility soils, responding well when fertilizers are added. The tree is rarely affected by iron and zinc deficiencies in the soil.

The main pests and diseases are the Fig scale (Lepidosaphes conchiformis), mite (Tetranychus urticae), endosepsis caused by fungus (Fusarium moniliforamae) and fig mosaic virus.

Picking dates vary depending on whether the figs are intended fresh for consumption, locally or for export markets, or for processing as dry figs (qutain) or for jam making.

2.5. Economics of Fig Production

Fig productivity is already stable, providing reliable profits. However, if more care and improvement of agricultural practices is given, both productivity and quality will increase, yielding even higher returns.

Table (3): Economics of Fig Cultivation (per dunum)

Expenses (US$)							
Yield kg/dunum	**Plough**	**F&P***	**Labor**	**Total**	**Price per Kg**	**Income $**	**Profit$**
437	20	17	52	89	0.54	236	147
F&P*= Fertilizers and Pesticides.							

2.6. Problems Facing Fig Production

The major problems in fig production are the expense of tillage practices, methods of pest and disease control, the competition by imported dried figs (qutain), the small size of land holdings, and the lack of viable alternatives for

farmers to traditional methods in packaging and marketing, which reduce fruit quality and selling prices.

2.7. Prospects for Improving Fig Production

Agricultural extension services would improve farmers' knowledge about the best cultivation, picking, packaging, and transportation methods. Improvements in these areas would improve not only fresh fig production and marketing, but also the fig drying (qutain) industry. Investigating local varieties more suited to drying would help in stopping the flow of qutain imports from abroad and make the local market more competitive.

For these tasks, more financial support is needed in the form of loans for crop development.

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SECTION 6

Vegetables

1. Introduction

Vegetables in the O.P.T. are usually cultivated in open field and under plastic houses. The open field agriculture is divided into irrigated and dry farming.

150 thousand dunums in the West Bank and 66 thousand dunums in Gaza Strip are devoted to vegetable crops. In total, 117 thousand dunums of vegetable production is rainfed, breaking down to about 60% of productive area in the West Bank and 40% in Gaza Strip.

Dry farmed vegetable crops tend to give moderate yield per dunum compared to other types of cultivation. But in general the fruits produced are characterized by better aroma and flavor, as they are seeded and are not parthenocarpic, like those from intensive plastic houses. Because of these characteristics these products are more demanded by Palestinians, and receive higher prices in the market.

2. Status of Vegetables Production in the O.P.T.

In the O.P.T. rainfed farming produces 11 major vegetable crops. In Gaza Strip the most important cultivated vegetables crops are watermelon, muskmelon, okra, snakecucumber, and tomatos. In the West Bank these crops are tomato, dry onion, squash, okra, and snakecucumber.

As table (1) shows, between 84-94.1 thousand dunums of vegetables were cultivated between 1987 and 1991 in the West Bank. Of that, tomato was the crop that covered the largest area, 22.7% of the total, and snakecucumber the least with 9.8%.

The productivity varies among different crops, districts and years. In 1991 the yield of all cultivated vegetable crops was reduced significantly due to the late rains and low precipitation (Table 2).

Table 1: Areas of Vegetables in the West Bank (1000 dunums)

Vegetable	1987	1988	1989	1990	1991	Avg.
Tomato	13.0	16.7	23.1	23.3	25.7	20.4
dry onion	15.5	15.9	15.2	15.8	11.0	14.7
Squash	9.0	10.0	12.6	10.6	11.1	10.7
okra	7.6	9.3	11.2	12.2	12.2	10.5
Snakecucumber	6.0	7.7	9.4	10.4	10.7	8.8
Watermelon	16.2	8.1	1.8	1.7	1.5	5.9
Cauliflower	2.5	2.8	3.0	2.6	2.0	2.6
Muskmelon	2.4	3.6	1.9	1.7	0.7	2.1
Garlic	2.1	2.0	2.0	2.5	1.4	2.0
Potato	1.3	2.2	2.0	2.0	1.7	1.8
Broad beans	1.1	2.0	2.2	2.5	0.8	1.7
Others*	7.3	12.3	9.7	6.8	5.8	8.4
Total	84.0	92.6	94.1	92.1	84.6	89.6

* Others: green-peas, cowpeas, radish, pumpkin, long neck squash, green-onion, lettuce, parsley, spinach.

Table 2: Yield of Vegetables (kg/dunum).

Vegetable	1987	1988	1989	1990	1991
Tomato	972	600	685	1328	403
dry onion	1405	675	1200	992	709
Squash	288	325	262	396	289
Okra	190	180	280	381	271
Snakecucumber	344	300	275	351	252
Watermelon	994	1200	1000	1200	396
Cauliflower	470	450	400	563	300
Muskmelon	750	800	1000	972	292
Garlic	380	400	350	468	435

potato	602	600	500	697	328
Broad beans	197	300	250	187	158

Jenin, Gaza Strip, and Tulkarem have the largest area of vegetable crops averaging of 40.8, 22.7, 14.7% of the total cultivated area in the O.P.T., respectively (Table 3).

The total production of vegetables in the West Bank in 1990 reached to 69.3 thousand tons, with tomato the most produced followed by dry onion with 44.6, 22.6% of total production (Table 4).

Table 3: Area of vegetables in different districts of the O.P.T. (100 Dunum) In 1990

District	area	%
Jenin	48.5	40.8
Tulkarem	17.5	14.7
Nablus	3.8	3.2
Ramallah & Bethlehem	11.6	9.8
Hebron	10.4	8.8
Gaza Strip	27.0	22.7
Total	118.8	100.0

Table 4: Total vegetables production in the West Bank in 1990

Vegetable	production (1000) tons	%
Tomato	30.9	44.6
dry onion	15.7	22.6
okra	4.6	6.6
Squash	4.2	6.1

Snakecucumber	3.6	5.2
Watermelon	2.0	2.9
Muskmelon	1.7	2.5
Cauliflower	1.5	2.2
Potato	1.4	2.0
Garlic	1.2	1.7
Broad beans	0.5	0.7
Others	2.0	2.9
Total	69.3	100.0

2.1. Cultivation of Vegetable Crops :

There are two seasons during which rainfed vegetables are grown:

Winter vegetables, planted in early winter, include dry onion, cauliflower, garlic, potato and green broad beans.

Summer vegetables, planted after mid spring when the danger of frost has passed and temperatures have begun to warm, include tomato, squash, okra, snakecucumber, watermelon, cantaloupe.

Traditionally farmers tend to plant vegetables of small seed size as seedlings, while planting those of medium to large seed size directly in the field. The exception is potatoes, which are usually planted as tubers.

Traditionally, farmers in the O.P.T. have started their own seedlings using basins in which the soil is well prepared, sowing the seeds and caring for the watering and maintenance themselves. They would also transplant their mature seedlings to the field. In the last decade, however, commercial nurseries have emerged, and some farmers have begun to buy commercially guaranteed healthy seedlings, often of better varieties. While the seed stock may be of better quality from the nurseries, it is frequently costly.

The planting date for different vegetables is dependent for the most part on crop growing temperature, rainfall and location.

Preparing the land well by ploughing and harrowing will help to conserve water, reduce run-off, and create a better bed for either seed or seedling.

Vegetable crops are sensitive to nutrient deficiencies. Amount, type, and date of adding fertilizers must be based on soil analysis and crop requirements.

Controlling pests and disease is very important for vegetable crops, as they are mainly planted for their fresh fruit, leaves, or tubers. Any damage caused by disease or insects will affect the quality of production, resulting in low selling prices. Weeds are usually controlled through weeding, harrowing or by spraying with herbicides.

Proper timing and methods for picking and packaging vegetable products are important for marketing. Local farmers traditionally pick their vegetables in early morning or late afternoon to give a more fresh rigid appearance to their products.

2.2. Problems in Vegetables Production

The basic problem facing vegetable production in the O.P.T. is finding new export markets such as Europe and other Arabic countries.

Watermelon marketing is a clear example of this problem and of how political constraints facing Palestinian farmers restrict agricultural development. Until 1987 the total surplus of watermelon production of the O.P.T. was exported to Jordan. After that year the Jordanian Government put limitations on these imports accepting a very low tonnage of that surplus. This resulted in high losses for the farmers. Table (1) shows, the resulting drop in the total area of watermelon production, from 16.2 thousand dunums in 1987 to 1.5 thousand dunums in 1991.

Farmers in the O.P.T. are further hindered by the limited extension services to help them with their individual needs.

2.3. Prospects and needs of vegetables production

Dryland farming is less chemically intensive than other intensive farming, thus making it more healthy for human consumption. For this reason more attention should be given to improving this type of planting.

More research and investigation must be done on cultivation methods, picking and packaging systems, and the use of improved varieties, starting with breeding programs to improve the productivity and quality of well adapted local varieties.

The extension service must be improved, and an agricultural development credit agency should be established to provide farmers with a source of needed financial resources.

New exporting markets must be found to overcome the current marketing crises.

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SECTION 7

Range Management - Natural Pastures

Introduction

Despite its small size, the Occupied Palestinian Territories enjoy a diversity of climatic conditions and plants, of which pasture plants are one type/genre. A close look at grazing areas will provide many details about the pasture plants of the West Bank and Gaza.

Due to numerous restrictions by Israeli authorities, pasture areas have been reduced in size and the movement of shepherds controlled. Unfortunately, no previous research has been documented on this topic, and maps and other detailed information on grazing areas are not available. To identify boundaries and create accurate area maps, extensive survey work is needed.

Natural pastures contain native herbs, shrubs, and other plant life which proliferate without human intervention. Green cover of these pastures differs in nature, type, and density from one region to another, depending mainly on the variation of environmental conditions such as rainfall, temperature, and soil.

The importance of natural pastures for economic development is found primarily in their provision of feed and forage for livestock. Levels of animal production and livestock improvement are closely related to the condition of the country's pastures.

Background

Before 1967 natural grazing areas constituted 40% of the total area of the West Bank and Gaza. Most of this land was situated on the eastern slopes and highlands where the average annual rainfall ranges between 100-300mm. Presently less than 15% of the pre-1967 grazing areas are still accessible, constituting a marginal 3% of the total land area of the West Bank and Gaza.

Most of the natural pastures in the southern and eastern parts of the West Bank were open to farmers before 1967. These areas were covered with herbs and shrubs which provided feed for livestock for at least six months out of the year. Since the Israeli occupation in 1967, military restrictions have gradually reduced the total number of dunums available for grazing. Broad areas of pastures have

been closed or are in use by the military government, confiscated for settlement location, or designated as natural reserves where wild gazelles make their habitat. Based on an estimate reached using Geographical Information Systems, approximately 400-500 thousand dunums can be classified as natural pastures, of which nearly 90% are presently closed to farmers.

Before 1967, farmers followed a special rotational grazing system which protected the flora consumed by livestock and even assisted in spreading and propagating these pasture plants. Likewise, animal manure was scattered throughout the pasture areas, reclaiming soil that had lost organic materials. Grazing served to prune the herbs, promoting their vegetational growth.

Access to diminished grazing areas resulted in overgrazing and the disappearance of many herbs. Available pastures are almost bare and cannot sustain livestock without the provision of supplemental feed. But due to the outrageous prices for fodder, farmers occasionally enter closed military areas to graze their animals. Penalties for such a violation include fines of 50 JD per head ($68), imposed by the Natural Reservation Authority, or livestock confiscation by military authorities.

Based on accounts from farmers and shepherds, closed pastures in the southern part of the West Bank are filled with herbs, shrubs, and plants of economic importance such as Qataf, Sheeh, Acacia, and Sidder. Many important plants have disappeared completely, such as Handaquq and Nafal, due to overgrazing.

Water shortage is another serious problem that farmers face. Water holes, where rainfall collects during the wet season, are important water sources for the herds. Previously when rainfall was insufficient, farmers moved their livestock frequently to water at the various wells. Now most of these wells are inaccessible, forcing farmers to purchase water in dry seasons.

1. Location of Pastures

Because of the scarcity of available information and the absence of essential aerial and geographical maps, identifying the location and boundaries of pastures is extremely difficult. Specific topographical and climatic conditions, however, may indicate the presence of pasture areas. Figure 1 represents the correlation between pastures and average annual rainfall in the West Bank.

Pastures in the O.P.T. are concentrated in the southeastern region, particularly in the areas east and south of Bethlehem and Hebron. The area extends east to the Dead Sea and north to Jericho.

Natural pastures in the West Bank include several important fields, such as Al-Bkai'a between Deir Mar Saba, the Dead Sea, and Al-Nabi Musa. Fields in the south include Arab Al-Ta'amreh, Al-Rashayda, Dhahret Al-Koula, and Wadi Abu Hayyatt, among others, where farmers from Al-Dhahariyya, Al- Samu', and Al-Ramadin graze their animals.

Using geographical analysis programs, total pasture areas can be estimated at 500,000-550,000 dunams. Seasonal pastures or uncultivated areas are not included although they may be useful for agriculture. Pasture lands can generally be found in altitudes ranging between 500-600m and are concentrated in the eastern heights between Arab Al-Ta'amreh and Bani Na'im. They are located in the rain shadow region where average annual rainfall is 100-350mm.

2. Indigenous Herbs in the Southern West Bank

2.1. Natural Pasture Regions

2.1.1. Arab Al-Rashayda, Wadi Al-Juhhar, and Wadi Sa'ir

Located east of Sa'ir and Hebron, these pasture areas receive between 150-250mm of rainfall each year. Existing rocks are of calcite and sand and thus hold little moisture, preventing high fertility of the herbs. Most herbs in this region are annual. The quantity of rainfall in December contributes significantly to the germination rate. Plant growth continues until spring, after which they dry in the summer months of July and August. The grazing season also accurs at this time, usually between the months of February and June.

The most widespread herbs found in the Arab Al-Rashayda area are Natish (Sarcopoterium spinosa), Ghaisalan (Urginea martima), Zohhaif, Nafal (Medicago polymorpha), Handaquq (Melilotus indicus), Sheeh (Artemisia herba alba), Oqhuwan (Anthemis palestina Reut), Lufaiteh (Sinapis alba), and Za'atar (Thymus vulgaris). Of these, Sheeh, an important medicinal plant and nutritional component for grazing, is the most threatened by overgrazing.

In Wadi Sa'ir and Wadi Al-Juhhar to the east of Sa'ir village, Sleeh (Sisybrium irio), Ghareh, Hasak (Tribulus terrestris), Natish (Sarcopoterium spinosa), Busbas (Conium maculatum), Nafal (Medicago polymorpha), Sofaireh (Isatis iusitanica), and Khnaineh are traditionally found.

Many fields in this area are restricted under military order or designated natural reserves and therefore prohibited to farmers.

2.1.2. Arab Al-Ka'abneh Region

This region is located to the east of Bani Na'im and Yatta and includes the villages of Arab Al-Ka'abneh, Al- Rowaye'en, Al-Najajdeh, Al-Fakeer, Arab Al-Saray'a, Al- Azazmeh, and Al-Zwaedeen. Most farmers graze their animals in Wadi Al-Hamam, Al-Khanzireh, Wadi Abu Hayyatt, and Dhahret Al-Koula. Average annual rainfall in this area is very low, not exceeding 200mm. Many of the herbs found in the eastern area can also be found here, such as Nafal, Handaquq, and Sheeh. Sha'raneh, Ghadruf, and Thalthul are salty plants concentrated in this area. Mitnaneh (Chenopodium vulvaria) is found in Al-Ka'abneh area but is not suitable for grazing as it has bad odor.

2.1.3. Al-Bkai'a Region

Al-Bkai'a region is located between the Dead Sea and Deir Mar Saba to the east and west, respectively, and Al-Nabi Musa and Al-Rashayda to the north and south, respectively. Average annual rainfall is 150mm, with high temperatures in the summer and a warm moderate winter.

Herbs in this area have thin, waxy leaves that resist transpiration. They include Al-Bahmeh (Stipa capensis), Nafal, Handaquq, Al-Khubaizah (Malva parviflora), and other herbs such as 'Athbeh, Sha'raneh, and Ajram. The grazing season is primarily in winter due to the warm climate. In the summer, farmers seek hilly areas where water and vegetation are more abundant and the weather cooler.

2.1.4. Arab Al-Ta'amreh Wilderness

Arab Al-Ta'amreh wilderness is located to the east of Bethlehem and villages bordering the Judean Desert (Dar Salah, Shawawreh, Za'atara, Al-Furdes, and Al-Tuqou') and to the north of Arab Al-Rashayda. Located in the rain shadow region, average annual rainfall does not exceed 200mm. This region is very rich in annual herbs that appear after rainfall, grow in spring, and dry in summer. Animals frequently graze the area, resulting in a noticeable reduction of existing herbs such as Handaquq, Nafal, Al- Khubaizah, Muwasleh, Ghaisalan (Urginea martima), Naz'a, Sleeh, Natish, Lufaiteh, and Khurfaish (Onopordum acanthium).

2.2. Characteristics of Common Herbs

Prevalence and economic significance of many indigenous herbs have been determined through field surveys of pasture plants and interviews with farmers and shepherds.

2.2.1. Family Leguminosae

- Medicago species
- English name: Flat-podded Medic
- Arabic name: Nafal
- Scientific name: Medicago orbicularis (L)

Annual. 15-50cm long. Stem branching from base. Procumbent and hairless plant. Leaves trifoliate, leaflets with round and dentate tips. 1-5 small flowers per stalk, bright yellow in color. Pods discoid, spineless with 3-7 coils. Seed round with reticulation. Flowering in March-May.

- English name: Toothed Medic
- Arabic name: Nafal
- Scientific name: Medicago polymorpha (L)

Annual. 10-50cm long. Hairless plant. Stems branching from base, procumbent or ascending. Leaves trifoliate, leaflets wide and flat at top, sometimes with purple flecks. 2-8 small flowers per stalk, bright yellow in color. Pods with 2-6 coils, spiny or spineless 4-8mm in diameter. Flowering in March-April.

Medics are mostly distributed in the southern region but are decreasing in density due to overgrazing. Survey results demonstrated an awareness among farmers about the effects of over- grazing, particularly since many farmers depend on this herb as the sole source of feed for their livestock.

- Melilotus species
- English name: Indian Melilot
- Arabic Name: Handaquq Mor
- Scientific name: Melilotus indicus (L)

Annual. 15-50cm in height. Erect stem. Leaves trifoliate, toothed around margin. Flowers small and yellow in long racemes. Pods are small, ovoid, and one-seeded. Coumarin smelling herb. Flowering in March-April.

- English name: Italian Sweet Clover
- Arabic Name: Handaquq
- Scientific name: Melilotus italicus (L) Annual. Up to 1m in height, same characteristics as Indian Melilot but with longer racemes.

A favorite of livestock, farmers often note the availability and condition of these herbs. In the pre-flowering period, farmers commented, the vegetative parts are low in dry matter and nutrients.

2.2.2. Family Cruciferae

- English name: Wild Mustard, Charlock
- Arabic name: Shilweh, Lufaiteh
- Scientific name: Sinapis arvensis (L)

Annual. 30-70cm in height. Hairy with stem erect. Branched simple leaves with terminal lobes and smaller lateral lobes. Lobes coarsely toothed, uppermost leaves sessile. Flowering racemes dense, short, elongating in fruit, yellow in color. Pods 2.5-4.5cm long. Flowers in the southern West Bank where climate is warm, especially in February and March. Ripens and dries in April and May.

- English name: White Mustard
- Arabic name: Lufaiteh
- Scientific name: Sinapis alba (L) Similar to the Sinapis arvensis, but with compressed pod and larger foliage.

Many farmers prefer this as a source of feed to follow legumes. Sinapis can be found in almost all pastures but is more abundant in warmer climates, especially in Al-Bkai'a and Arab Al-Ka'abneh regions and areas to the east of Bethlehem and Arab Al- Ta'amreh.

2.2.3. Family Rosaceae

- English name: Thorny Burnet
- Arabic name: Natish or Bilaan
- Scientific name: Sarcopoterium spinosa Perennial.

Bushy, half-spherical, thorny herb. Compound leaves, each having 4-7 leaflets which drop in summer. Small branches end in bi-spines which become harder and

brown in color. Fruits are spongy and turn light red. Flowering in March and April.

Survey results indicate that Natish propagates in the eastern villages near Bethlehem and Hebron, competing with the growth of other herbs which are often crowded out. In Al-Ramadin region, Natish is used as a cooking fuel and disappearing as a result.

2.2.4. Family Chenopodiaceae

- English name: Stinking Goosefoot
- Arabic name: Mitnaneh
- Scientific name: Chenopodium vulvaria (L) Annual.

10-50cm in height. Leaves entire or with two lateral alternating lobes near the base. Plant contains trimethylamine which gives it the disagreeable odor of decaying fish. Flowering in April-October.

This herb is prevalent in Arab Al-Ka'abneh and Al- Saray'a and to the east of Bani Na'im and Yatta in Wadi Abu Hayyatt and Dhahret Al-Koula area. Animals rarely eat this unpalatable herb.

2.2.5. Family Liliaceae

- English name: Squil white
- Arabic name: Ghaisalan, Bussel
- Scientific name: Urginea maritima (Barker) Perennial.

Common in the southern regions of the West Bank. Propagated by bulbs. Leaves appear in winter, but the flowering racemes appear in March and April. Fruit matures in May and June.

This herb propogates easily as animals do not graze on it between the vegetative stage and bulb formation. During the summer, dried leaves constitute a good diet for livestock. It is mostly found in Al-Rashayda region and to the east of Arab Al-Ta'amreh and Obeidiyya.

2.2.6. Family Compositae

- English name: Worm Weed

- Arabic name: Sheeh
- Scientific name: Artemisia herba alba Perennial. Flowering in July-December.

The most extensively distributed herb in the southern part of the West Bank, especially east of Bethlehem and to the east of Sa'ir in Wadi Al- Juhhar. Overgrazing and low rainfall result in a disappearance of this herb in Arab Al-Rashayda and Al-Ka'abneh.

2.2.7. Family Gramineae

- English name: Twisted-awned spear grass
- Arabic name: Al-Bahmeh
- Scientific name: Stipa capensis Annual. 20-40cm in height. Inflorescent panicle erect and branched with silvery spikelets. Awns 6- 10cm long, flowering in March-May.

This herb is found mainly in Al-Bkai'a but can also sighted in southern areas of the West Bank. Farmers emphasize that Al-Bahmeh is relatively drought-resistant compared to other herbs. Animals do not eat this herb until the awns drop which injure the mucous membrane of the animal.

2.2.8. Family Malvaceae

- English name: Egyptian Mallow or Cheese-weed
- Arabic name: Al-Khubaizah
- Scientific name: Malva parviflora Annual. 5-50cm in height. Erect stem. Simple kidney shape leaves with 3-5 lobes. Single white flowers or in clusters. Aggregate fruits in circular carpels. Flowering in February to May.

Egyptian Mallow is commonly found in local pastures and is denser in areas of higher rainfall. Animals eat this herb in all stages of growth, but it is more nutritious afer flowering.

2.3. ARIJ's Work

ARIJ's Pasture Plant Survey focused predominantly on the south and southeastern regions of the West Bank where natural pastures are prevalent. Most herbs in

these areas flower between February and September, especially during the months of March, April, May, and June.

The number of flowering herbs per month has a direct correlation to a field's grazing capacity and the duration of the grazing period. Future studies on natural pastures must concentrate on the prevalence of flowering herbs, especially for increasing the biomass and regulating grazing in these areas (Table 1).

Table 1: Flowering Pasture Plants in the Southern West Bank

Pasture Plants	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Handaquq (Melilotus indicus)					X	X	X	X	X			
Al-Khubaizah (Malva parviflora)	X	X										
Nafal (Medicago orbiculatis)		X	X	X								
Khurfaish (Onopordum acanthium)			X	X	X	X	X	X				
Bussel (Urginea martima)								X	X			
Lufaiteh (Sinapis arvensis)	X	X	X	X								
Ja'deh (Teucrium polium L.)				X	X	X						
Al-Bahmeh (Stipa capensis)			X	X	X							
Sheeh (Artemisia herba alba)									X	X	X	X
Sleeh (Sisybrium irio)	X	X	X	X	X							

Ijer Al-Asfur (Parnoychia argebrea)	X	X	X	X						
Natish (Sarcopoterium spinosa)			X	X	X					
Muraar (Centaurea iberica)					X	X	X	X		
Kursa'aneh (Eryngium creticum L.)					X	X	X	X		
Babunaj (Martrocaria chamomilla)					X					
Hasak (Tribulus terrestris)				X	X	X	X	X		
Shilweh Beida(Diplotaxis erucoides)		X	X	X	X	X	X	X	X	X
Hannun (Adonis aleppica)		X	X	X						
Qos (Carthamus tenius)					X	X	X	X	X	
Mulleeh (Aizoon canarienseh)	X	X	X	X						
Qrain (Astragalus hamosus)			X	X	X					

3. Pastures and the Status of Livestock

The relationship between the political environment and the economy of the occupied West Bank and Gaza has been closely examined, but little has been done to improve the status of the livestock sector under current conditions. Realistically, this will require applied research and technology transfer. Development of the livestock sector should clearly correspond to the development

of other agricultural sectors. For instance, developing pasture lands will help reduce production constraints.

Small ruminants are generally more abundant in the southern West Bank than in the north. The Assaf variety of sheep, however, is more abundant in the north. Of the total number of sheep and goats, about 60.9% are found in the southern region and the remainder in the north (Table 2).

Table 2: Geographical Distribution of Sheep and Goats in the West Bank, 1990

	Sheep		Goats	Total
District	**Awassi**	**Assaf**		
Nablus	66815	5595	22715	95125
Jenin	44190	5830	23400	73420
Tulkarem	6128	6014	3958	16100
Qalquilia	9630	1535	4140	15305
Salfit	7733	1082	12818	21633
Ramallah	52949	2831	52661	108441
Jericho	9750	461	12080	22291
Bethlehem	24735	600	21497	46832
Hebron	104658	2950	59695	167303
Gaza Strip*	------	----	-----	------
Total	326588	26898	212964	566450
% of total	57.65%	4.75%	37.6	100

* No data are available for Gaza.

Farmers in the southern West Bank are concerned about increasing the area and number of pastures and improving pasture characteristics and conditions in an effort to provide a better source of feed for their livestock. Numerous farmers from Arab Al-Ka'abneh, Al-Rashayda, Arab Al- Ta'amreh and Al-Ramadin frequently visit pasture areas to graze their animals.

Table 3 shows a high ratio of goats and sheep to the human population. The number of animals that graze in pasture areas during grazing seasons in the southern West Bank is estimated between 180,000 and 200,000.

Table 3: Human Population to Sheep and Goat Population in the Bethlehem and Hebron Districts

District site	Human Population	Goats and Sheep (No. of Head)
Bethlehem Al-Rashayda Obeidiyya Shawawrah Za'atara Al-Taqou' Dar Salah	1000 7500 2000 3500 9000 3000	20000 10000 1500 5000 1000
Sub Total	**26000**	**41000**
Hebron Area Al-Ramadin Al-Dhahariyya Al-Samu' Al-Zwadeen Bani Na'im Sa'ir Yatta Al-Shyoukh	2000 14000 10000 800 8000 1000 16000 4600	5000 20000 30000 8000 35000 4000 10000 2000
Sub Total	66400	114000
TOTAL	92400	155000

4. Economic Feasibility

Survey results demonstrate that farmers generally suspend or reduce the provision of fodder and concentrate to their livestock between April and September. Each head requires approximately 1.4kg of clover and 700g of concentrates per day. In good seasons, grazing will sufficiently provide the necessary nutrients. In a

drought, animals feed on roughage and concentrate to compensate for the shortage in pasture feed.

The following equations suggest the importance of grazing:

- Forage Component in Typical Ration

  1.4 kg/day * 180 day/head * 200,000 animals
  = 50,400,000 kg
  = 50,400 tons of fodder

- Concentrate Component in Typical Ration

  0.7 kg/day * 180 day/head * 200,000 animals
  = 25,200,000 kg
  = 25,200 tons of concentrated fodder

The expense of providing fodder to any size herd is tremendous and can be significantly reduced through grazing.

Given that:

1 ton of forage fodder = $170
1 ton of concentrate = $221,

50,400 tons of forage fodder $170/ton = $8,568,000
25,200 tons of concentrate $221/ton = $5,569,200

Total Fodder Expenses = $14,137,200

5. Pasture Production Capacity in the Southern West Bank

Throughout a normal season when average annual rainfall varies between 100-250mm, the production capability of southern pastures does not exceed 12kg of dry matter per dunum, taking into account that the moisture content of naturally dried forages is 12% after air drying. In six months each animal should consume approximately 219kg of dry matter, requiring 18.3 dunums of pasture land per head each season.

It can be deduced, therefore, that the West Bank's natural pastures, including those which are restricted or closed, have the capacity to support 27,000-30,000 animals annually. At present, however, farmers are grazing their livestock on just 10% of this area as the remaining 90% are inaccessible. Moreover, they are increasingly dependent on forage and concentrates as a supplement to grazing due to the thinning cover in pasture areas and the growing scarcity of many natural plants. Obviously farmers' net returns are also decreasing, threatening the viability of the livestock sector as a whole.

6. Prospects of Improving Pastures

Because of the importance of natural pastures, both in the preservation and protection of indigenous herbs and towards long-term viability of the livestock sector, a concerted effort must be made to reopen restricted areas and to place them under the supervision of a local authority. Such an authority would be responsible for monitoring and protecting the natural plants found in these areas and promoting grazing in a sustainable, efficient manner. In order to reclaim these natural pastures, a number of obstacles must be confronted using an integrated approach must be made as follows:

1. To introduce new plant varieties which livestock will find more palatable and which are resistant to drought and soil salinity. For example, various types of perennial plants, shrubs, and forage legumes may prove suitable. Other herbs may be targeted for platability and high nutrient content, such as Nafal and Handaquq which also improve soil fertility through nitrogen fixation. The promotion of under groung vetch (Vicia sativa subsp. amphicarpa), specifically, may be promising as it has pods both above and below the soil surface thus protecting itself from eradication (ICARDA, 1990).

2. To increase available water for each plant. This can be achieved through proper use of runoff water in the valleys and by increasing water holding capacity of the soil. Al-Bkai'a area contains waste water, which can be used after processing and purification to provide pastures with water. When planting seeds, appropriate planting density must be observed to provide enough moisture for each plant.

3. To study the grazing capacity of available natural pastures. By initiating a periodical grazing system, livestock can graze when nutrient values are high and plant life can be protected during the critical growing stages.

4. Replacing local goats (Samar), those which pull up herbs by the root instead of nibbling the upper part, with another species with lower damage effect.

5. To investigate the effects of phosphate application to yield higher dry matter and to increase the quality of natural pastures (ICARDA, 1986).

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List Of Abbreviations

Word or Sentence	Abbreviation
Applied research Institute of Jerusalem	ARIJ
0.1 Hectar	Dunum
International Maize and Wheat Improvement Centre	CIMMYT
International Center for< Agricultural Research in the Dry Areas	ICARDA
International Crops Research Institute for the Semi-Arid Tropics	ICRISAT
Occupied Palestanian Territories	O.P.T