

Research Report

FARMING SYSTEMS MANAGEMENT  
IN THE BUEDA/BREDA SUBAREA  
1983/1984

by

Ronald Jaubert  
Mahmoud Oglah

FARMING SYSTEMS PROGRAM

International Center for Agricultural Research in the Dry Areas

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## INTRODUCTION

The management of existing resources, in particular land resources, is a central issue regarding the future prospects of the dry cultivated areas and the design of developmental strategies. In the past twenty years, barley yields have fallen by 50% in many areas (Jaubert, 1983). The problem of degradation has not been restricted to cultivated lands. In the western part of the dry cultivated areas, 20 to 30% of the land cannot be cultivated (USDA, 1980) and are used for grazing livestock. These non-arable areas are usually overstocked and vulnerable. Also, degradation of the steppe is closely related to the expansion of cultivation in the dry areas. This expansion occurred on the best rangelands and resulted in increased stocking rates on less productive steppe areas.

The dry cultivated areas are subjected to a "mining" type of exploitation and current management is leading to the exhaustion of land resources which jeopardizes future prospects for agriculture in these areas. Stabilizing productivity will require more than the introduction of new inputs, changes will need to be made in the current management of land resources, in particular in

land use patterns and grazing practices.

In the drier zones (those receiving less than 200mm of annual rainfall), it is probable that maintaining land resources will require the dropping of cultivation and the replacement of barley by permanent pastures. In areas of relatively higher rainfall where barley can be maintained, alternative solutions studied by the Farming Systems Program, and the Pasture, Forage and Livestock Program are mainly focused on the use of fertilizers and new crop rotations including a forage legume.

Regarding grazing lands, which are an important component of the feed resource base, stabilizing productivity requires the development of appropriate grazing management practices.

The feasibility of such changes, in particular in land use patterns and grazing management will largely depend upon current management practices regarding both crops and livestock in addition to soil and climatic characteristics. Furthermore, drastic changes in the management of land resources will not be adopted all at once. Strategies aimed at stabilizing productivity will require a sequence of gradual changes. Thus, in order to design strategies there is a need to identify as broad as possible a set of potential improvements.

The aim of the present research is to study current crop and livestock management practices in order to analyse constraints to the introduction of new practices currently studied by the Farming Systems and Pasture, Forage and Livestock Programs, and identify new areas offering a potential for improvements to be made.

## 1. METHODS

The dry cultivated areas form a discrete entity in the overall problem of degradation of land resources and their place in the national development strategy. Nonetheless, this entity is heterogeneous in both physical and social characteristics. Several soil types are found in these areas. Population densities vary from less than 10 persons per km<sup>2</sup> in the eastern plains to over 50 persons per km<sup>2</sup> in the western areas. Land holdings range from less than 5 to over 100 hectares. Barley is grown continuously on some lands, while on others, farmers have maintained the practice of fallowing. The livestock population may include large flocks which graze the steppes and smaller sedentary flocks remaining in the cultivated area throughout the year.

As a result of the combination of these physical and social characteristics, the complexity of the problem of degradation and alternative solutions vary according to location. Therefore, in order to select areas in which to undertake detailed studies of farming management practices there is a need to divide the dry cultivated areas into more homogeneous sub-areas.

Zoning of the dry cultivated areas is in a developmental stage. Meanwhile, in order to test a research approach focused on the management of farming systems, a study area was selected in the dry cultivated lands of Aleppo province.

The study area was subjected to a preliminary survey in August-September 1983. This survey conducted at the village level focused on:

- a. The distribution of land and livestock holdings,
- b. Land use and cropping practices,
- c. Livestock management and feeding cycles, and

d. Changes in crop and livestock production since the 1950s

The results of this survey were used to define the main features of the study area and select a sample of farms to undertake a detailed monitoring of farming practices.

The monitoring of the sample farms started in November 1983. Farms were visited every two weeks and data was collected on crop and livestock management and production.

In addition to the regular interview of farmers, plots were selected in order to compare various cropping practices found in the study area. These studies were focused on fertilizer and manure application on barley and three cropping patterns found in the study area; barley/fallow, barley/legumes and continuous barley.

Regarding livestock, a sample of ewes and their lambs were weighed every 14 days to study liveweight changes of ewes and lambs in relation to feeding practices. The results obtained were compared to those obtained in experimental flocks at Tel Hadya, ICARDA's main research station.

Finally, on-farm forage trials on vetch, peas and lathyrus were set up in the farm sample in order to compare the productivity of these three species with and without fertilizer application.

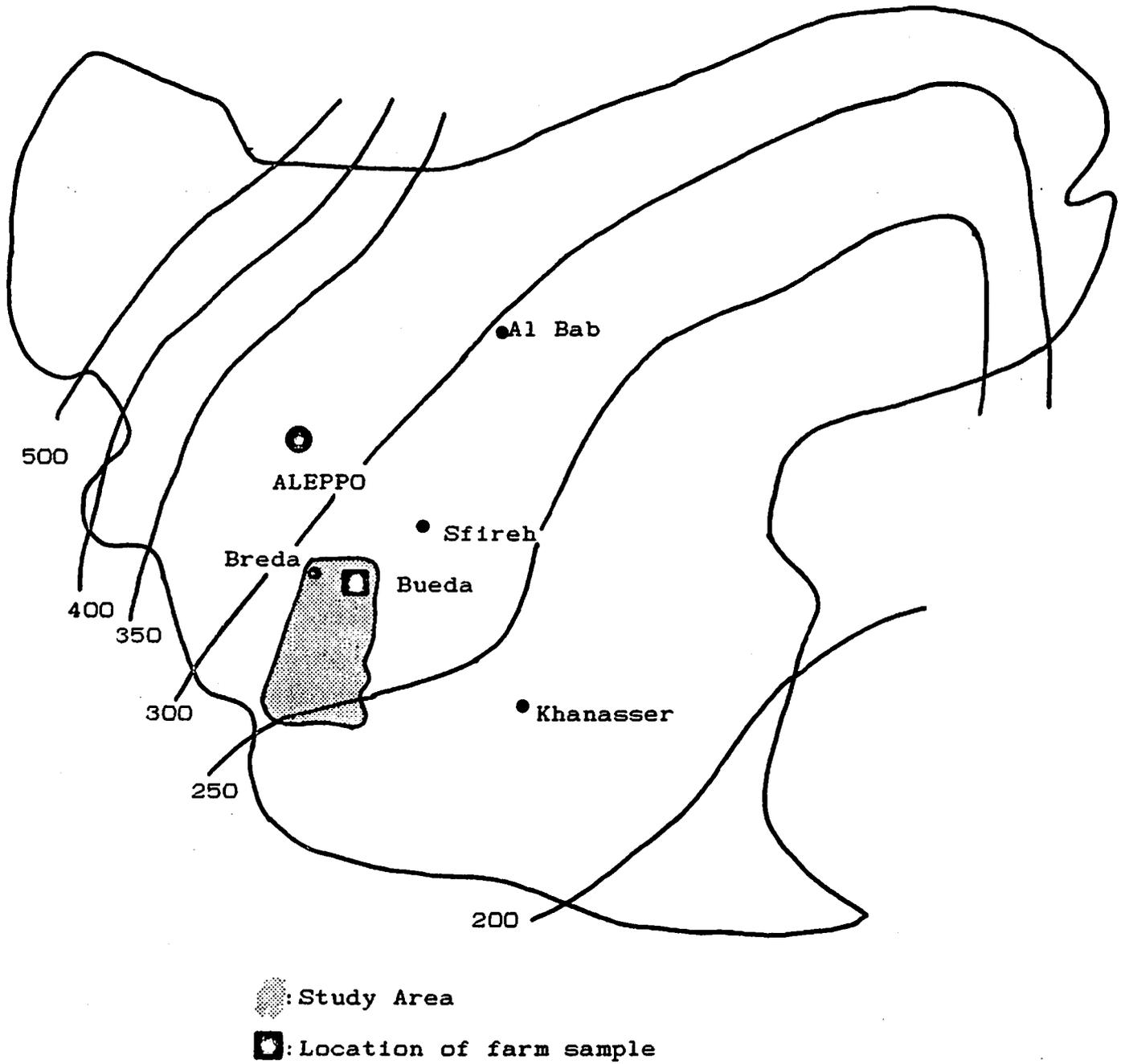
The 1983/84 season was marked by a severe drought and several aspects of the research, in particular those related to crops, had to be dropped since all barley crops in the farm sample were grazed by livestock in the spring. Regarding the monitoring of flocks, the study ended in June when flocks left the study area.

## 2. THE STUDY AREA AND FARM SAMPLE

The study area is located 40 km south of Aleppo in the 250-300mm rainfall zone and is limited to the east by a basaltic plateau (Jebel Haas) and to the west by an area where a large amount of the land is irrigated (Map 2.1). The study area includes 35 villages and covers approximately 25,000 hectares, of which approximately 25% cannot be cultivated. In Jabal Samaan mantika, which includes the study area, 20.9% of the land is classified as non-arable and for Aleppo province as a whole non-arable areas represent 27.3% (Table 2.1). These areas are classified as rocks in the USDA study but are used for grazing livestock and are an important source of feed in spring (Section 4).

We can assume that in other parts of the dry cultivated areas, in particular in the eastern plains, we shall find much larger sub-areas covering 100,000 hectares or more. In this respect, since research findings and alternative solutions will probably be, to a large extent, specific to sub-areas, the selection of a small study area may seem questionable. Indeed, the size of sub-areas should be an important criterion for selection. In the case of the selected study area, the selection was directed by two main factors. Firstly, the Farming Systems Program (FSP) and the Pasture, Forage and Livestock Program (PFLP) are currently conducting in this area detailed on-station (Breda) and on-farm technical studies on alternative crop rotations and fertilizer application. The results of these studies provide a basis on which to build. Secondly, the proximity of Aleppo was essential to conduct detailed measurements such as the weighing of sheep and lambs in order to study livestock performances. Such studies, which would not be feasible in remoter locations, are necessary to identify variables to

Map 2.1: Location of the Study Area and Farm Sample in Aleppo Province



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 Table 2.1: Grazing Lands by Mantika in Aleppo Province
 

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Mantika	Total Area (ha)	%Steppe and pasture	%Rocks and sand
Azaz	155625	1.2	25.7
Afrin	203375	2.2	21.3
Al Bab	195287	0.4	4.3
Manbej	276409	0.7	5.7
Jarablos	64253	0.0	12.5
Einal Arab	273000	1.6	24.5
Jabal Samaan*	277724	2.4	20.9
Sfire	404327	1.3	65.4
Total	1850000	1.4	27.3

\*: Mantika including the study area.

Source: USDA, 1980.

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 Table 2.2: Arable Land Holdings In Village Sample
 

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	Mean	Maximum	Minimum
Whole village Sample (678 flocks)	14.9	230	0.5
Per Village (20 villages)	16.2	21	5.6

---

consider when approaching other sub-areas. Finally, main features of the study area such as the system of feeding livestock and land use patterns are probably similar to those of other sub-areas located in the western part of the dry cultivated areas.

The preliminary survey aimed at defining the main features of the study area was conducted in 20 villages out of the 35 located in the area. The village sample includes a total of 764 families and 10121 hectares of arable land. The average family size is 8.6 persons.

Nineteen percent of the families do not cultivate land. Some of these families do not, or only marginally, have an agricultural activity and cannot be considered as landless farming families. Unfortunately, it was not possible to precisely evaluate the size of this group. These families make their income from non-agricultural jobs in the area or Aleppo.

## 2.1 LAND HOLDINGS AND TENURIAL SYSTEMS

### 2.1.1 Arable Lands

The 10121 hectares of arable land included in the village sample are cultivated by 678 families. The size of arable land holdings ranges from less than one hectare to 230 with an average for the whole sample of 14.9 hectares (Table 2.2). As shown in Table 2.2, there are large differences in the average size of arable land holdings among villages. These are partly related to the history of settlement. The largest average size of land holdings is found in villages where the population originates from powerful nomadic tribes. The three villages where the average size of holdings is less than ten hectares are those which were owned by large landowners in the late 1950s and where land was allocated to farmers under land reform legislation.

Nine percent of the families cultivating land in the village sample are nonresident. Most of these families are based in Aleppo and return to the village at least twice a year for planting and harvesting. Rainfed crops in the study area, and in most parts of dry cultivated areas, require only two sets of operations: planting and harvesting, which furthermore can largely be done mechanically (Section 3). It is thus possible for nonresident families to cultivate their land rather than selling or renting it out, which limits the possibilities for resident families to increase their cultivated area. The phenomenon is not specific to the study area. In Al Bab for example, nonresident families represent 16% of the total farming families (Tully, 1984). As a result of the increase in population and consequent fragmentation of land holdings, this group is probably increasing and deserves particular attention since the strategy of families leaving the villages will largely affect the future prospects of agricultural production in the study area.

Seventy nine percent of arable lands are privately owned by farmers and the remaining 21% are state owned. Approximately 80% of the land presently under private ownership was owned by the families or the tribe since the establishment of the village, or bought from the state or landowners before land reform. The land presently state owned was part of large holdings broken up in the early 1960s under land reform legislation.

#### 2.1.2 Non-Arable Lands

Approximately 10% of the non-arable area (756 hectares) is privately owned by farmers and the remaining areas are state owned. However, in both cases non-arable areas are generally considered as common land that can be used for grazing by all flocks from the village or group of nearby villages. In addition

to non arable areas, communal grazing lands also include fallows in most cases.

## 2.2 LANDUSE AND SOIL TYPES

The total cultivated area in the village sample is comprised of 94% rainfed areas and 6% irrigated areas.

### 2.2.1 Rainfed Areas

The landuse pattern on rainfed areas is presented in Table 2.3. Although barley/fallow is the dominant rotation applied by more than 50% of the farmers, fallows represent only 32% of the total cultivated area. This results from the fact that 21% of the farmers grow continuous crops, usually barley. Less than 3% of the farmers apply a three course rotation including two years of fallow. This rotation seems to occur only in farms with labour conflicts with another source of income, either from irrigated plots or off-farm employment.

Wheat is grown on less than 20% of the cultivated area and is generally included in a two course rotation with fallow or, in some cases, summer crops. When barley is grown continuously, farmers either do not grow wheat or have a small area on which they apply a wheat/fallow rotation.

Regarding legumes, lathyrus is the main species grown in the study area and is used as winter feed for livestock. Vetch and lentils are also found in the study area, but the area planted to these two species is negligible. Lathyrus is believed by farmers to produce a better quality straw than vetch. This was confirmed by the results of the on-farm trial conducted in the farm sample (Section 5). Lathyrus is usually grown in a two course rotation with barley, as a replacement for fallow. It is worth noting that

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**Table 2.3: Land Use Pattern of Rainfed Areas,  
Village Sample (1982/83).**

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% of rainfed cultivated area.

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Barley	Wheat	Legumes	Summer Crop	Fallow
45	19.5	2	1.5	32

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**Table 2.4: Land Use Pattern of Irrigated Areas and Cropping  
Intensity, Village Sample (1982/83).**

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% of irrigated area.

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Cotton	Wheat	Barley	Vegetables	Sugar beet	Maize	Other	Cropping Intensity
48	31	13	8	6	3	5	114

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according to sample farmers, the replacement of fallow by lathyrus does not have a detrimental effect on barley yields, but these decrease when barley is grown continuously.

Summer crops are grown in rotation with barley or wheat. The area annually planted to summer crops varies from 0 to about 2% depending on rainfall.

### 2.2.2 Irrigated Areas

As shown in Table 2.4, cotton and wheat are the main irrigated crops. In most cases, farmers only grow one crop per year on irrigated areas and cropping intensity is relatively low.

### 2.2.3 Soil Types

With the exception of small areas mainly located on, or at the foot of, the basaltic plateau, soil depth varies from 40 cm to 130 cm or more. Color is the main criterion used by farmers to classify soils. These are divided into four categories: white, yellow/red, black and red. The latter type is found on the slopes of the plateau. As we shall see in Section 3, soil types have a marked effect on yields, they are also important regarding cropping patterns. Wheat is only grown on yellow/red or red soils which are considered as the best. Lathyrus is mainly grown on the black soils and in few cases on white but not on yellow/red or red soils.

Regarding fertilization, as far as rainfed areas are concerned, chemical fertilizers and sheep manure are believed to have a detrimental effect on yield, in particular in dry years, if applied on black soils. As we shall see in Section 3, soil types have a marked effect on yields. The variability in soils is a factor which may have to be taken into account when proposing

alternative crop rotations including legume crops.

### 2.3 FLOCKS

The livestock population in the village sample, excluding poultry and donkeys, is made up of 30,330 head comprised of 93% sheep and 7% goats. Eighty six percent of the resident families have a flock, the size of which ranges from 1 to 650 head with an average of 46 head per flock. The livestock population can be divided into two main categories of flocks.

- Semi-nomadic: These flocks count over 100 head and move to steppe areas in the spring. They represent 78% of the sheep and livestock population and 32% of total flocks. We found no example where small flocks are gathered into one flock and moved to steppe areas.
- Sedentary: These flocks count on average 20 to 30 head, with the exception of severe drought years such as 1984, they spend all year in the villages or nearby areas. Twenty two percent of the sheep and goat population fall into this category which represents 68% of the total flocks. Sedentary flocks can be further divided into two sub-categories depending on whether flocks have or not access to non-arable areas. The latter category is found in five villages and represents 19% of the sedentary sheep and goats in the village sample.

As shown in Table 2.5, there are large differences among villages regarding the average size of flocks. This variability is related to differences in the percentage of semi-nomadic and sedentary flocks in the villages. The proportion of semi-nomadic flocks per village ranges from 10 to 75%. Average stocking rates per hectare of arable land vary among villages between 1.2 and 11.3 head. The average stocking rate per hectare of arable land

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**Table 2.5 Size of flocks, Village sample  
(Sept. 1983).**

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	<b>Mean</b>	<b>Maximum</b>	<b>Minimum</b>
<b>Whole village sample (n=659)</b>	46	650	1
<b>Per village (n=20)</b>	43	103	4

---

for the all village sample is of three head. As shown by this large variability in stocking rates among villages, unlike in areas such as Al Bab where most flocks do not have access to non-arable or steppe areas (Tully, 1984), there is no relation in the study area between arable land areas and livestock numbers at the village level.

In the case of semi-nomadic flocks, farmers only tend their own animals. Between 10 and 15% of the farmers with sedentary flocks tend animals owned by nonresident families, in addition to their own sheep and goats. However, sheep owned by nonresident families represent less than 5% of the total livestock population.

#### 2.4 OFF-FARM EMPLOYMENT

Off-farm employment is important in the study area. In 1983, 54% of the resident farming families had an off-farm income either from steady or temporary jobs. Steady jobs, which are mainly found in Aleppo, represent 55% of off-farm jobs taken by farmers in the village sample. Temporary jobs are taken in main cities of the country such as Damascus or Homs, or abroad mainly in Lebanon and Saudi Arabia. After 1975 Saudi Arabia became the main destination of villagers working abroad. But, since three years, temporary migration to Saudi Arabia has become much more difficult and expensive, and in 1983 over 50% of the villagers working abroad when to Lebanon.

#### 2.5 CHANGES SINCE THE 1950s

Large changes have taken place in the study area in the past three decades. In the 1950s, with the exception of three villages owned by large landowners, the livestock population was mainly

comprised of transhumant animals: sheep, goats and camels. These used to moved to steppe areas for six months or more each year. In some cases flocks were left all year round in steppe areas. The livestock population also included oxen and mules which were used as draught animals, these spent all year in the village area. In the 1960s both camels and oxen disappeared. Also, as a result of the receding of steppe areas and the decline in the size of individual flocks, the practice of transhumance was reduced. According to farmers, the livestock population has declined by 15 to 25% since the late 1950s (before the 1958- 61 drought). These three years of consecutive drought have played an important role in this decline. Indeed, as a result of the drought, sample villages lost between 50 and 80% of their sheep and goat population. Although livestock numbers built up in the following years, they did not reach the level of 1958.

Cropping patterns were also affected by large changes. After the introduction of tractors in the late 1950s and 1960s, land use patterns were sharply intensified. In the late 1950s, approximately 60% of the cultivated area was fallowed as compared to the present 32%. Most probably as a result of this intensification in land use patterns with no increased effort to maintain soil fertility (Section 3), barley yields have fallen by 40 to 55% since the early 1960s in sample villages. In the 1950s, wheat used to be the dominant crop grown on 90% of the area planted to cereals, and the remaining 10% was planted to barley. The replacement of wheat by barley is related to several factors; the decline in yields, the reduction of the fallow area (wheat is usually grown in rotation with fallow) and changes in the livestock system. Although the sheep and goat population has decreased, the number of sedentary animals has increased and semi-nomadic flocks spend more time in the villages, which has increased the need for on-farm produced feed. Also, barley is considered by farmers to be a better source of livestock feed than

wheat because of its better quality straw (Section 4).

In the late 1950s legume crops, mainly lathyrus, were grown on 10 to 15% of the rainfed cultivated area as compared to the present 2%. The decline in the production of forage legumes is primarily attributed to increased labour cost; legumes cannot be harvested mechanically (Section 3). However, it is probable that other factors, in particular the supply of supplementary feed by the General Organization of Feed which was set up by the government to act as a buffer in drought years, also made a contribution to the reduction of lathyrus in the study area

Regarding irrigation, data was collected on the number of wells and the size of irrigated areas. In 1961, 93 wells were used for irrigation. Since then, 208 wells were dug, of which 74 did not succeed and 77 dried after a few years and 57 are still being used. Out of the 93 wells used in 1961, 13 have dried. Overall, the number of wells used for irrigation has increased by almost 50% since 1961. However, the total irrigated area was reduced by approximately 20%.

## 2.6 FARM SAMPLE

The farm sample subjected to detailed monitoring could not include more than 20 farms. Furthermore, in order to study the interaction between farms, in particular in the management of grazing areas (non-arable areas and fallows) the sample had to be selected in a group of interacting farmers. In this respect a choice had to be made between villages where sedentary flocks have access to non-arable grazing areas and villages where this is not the case. The sample which includes 19 farms was selected in the first category of villages which is the largest in the study area and is located in a group of four villages having access to the same non-arable grazing area (Map 2.1). As a result of the drought

flocks were not fed on native grazing in the spring and the interaction of farms in the management of grazing areas could not be studied.

In selecting a small sample for monitoring, there is a trade-off between getting cooperative farmers and getting a representative sample. However, as shown in Figure 2.1 and Table 2.6, the sample includes a large variety of farms and its main characteristics are close to those of the village sample.

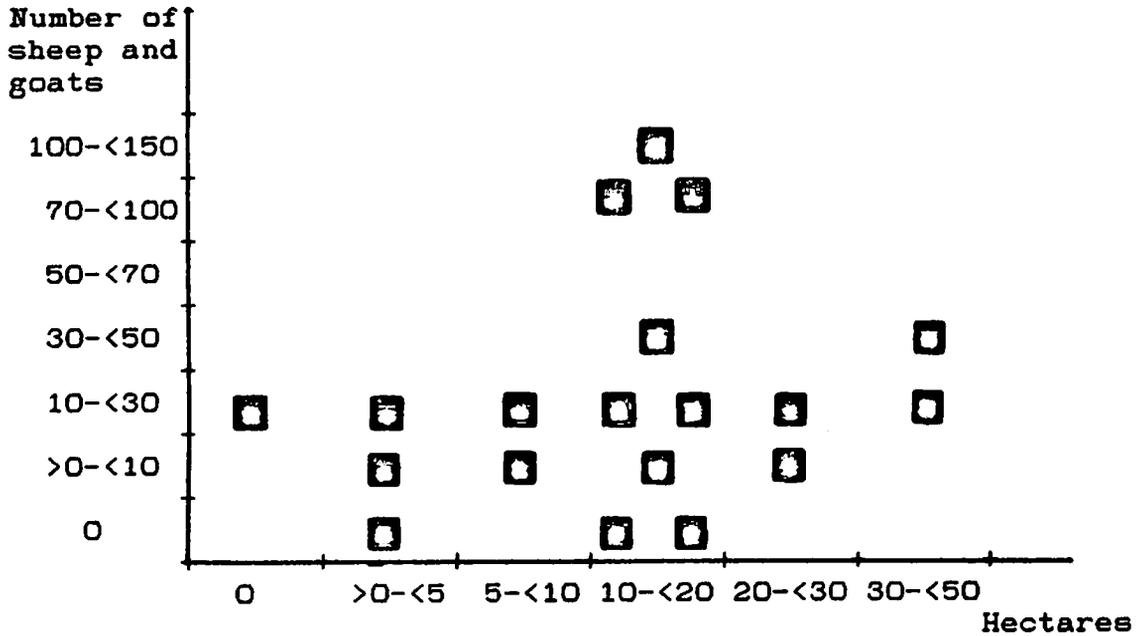
The livestock population in the farm sample is made up of 16 flocks numbering on average 46 head (S.D.=36, November 1983). These 16 flocks include 15 sedentary flocks and one semi-nomadic. Stocking rates in November 1983 ranged from 0.2 to 11.3 head/ha with an average of 2.6 head/ha.

Regarding sedentary flocks which ranged from 3 to 73 head (mean=28), in November 1983 stocking rates per hectare of cropped area ranged from 0.2 to 9 head/ha with an average of 3.2 head/ha. It is worth noting that we found no correlation between the sizes of cropped areas and flocks.

In the case of the semi-nomadic flock, the stocking rate per hectare of cropped area was of 16.6 head/ha. As we shall see in Section 4, stocking rates have fallen sharply in 1984.

In 1983 15 families in the sample had an off-farm income. In two cases, two members of the family had an off-farm activity. Unfortunately, it was not possible to obtain detailed data on the contribution of off-farm jobs to the familial income in the 1983/84 season.

Figure 2.1: Arable Land And Livestock Distribution In Farm Sample (Nov. 1983).



Each represents one farm

Table 2.6: Mean Size of Land Holdings and Land Use Pattern in Farm Sample (1982/83, 1983/84)

	Mean size of holdings	% of rainfed cultivated area				
		Barley	Wheat	Lathyrus	Summer crops	Fallow
82-83	15.9	42	12	6	1.5	38
83-84	15.9	42	12	6	0	40

### 3. CROPS

The study of cropping practices was focused on rainfed barley, wheat and lathyrus.

#### 3.1 THE EFFECTS OF DROUGHT

Rainfall in the 1983/84 season was about 50% lower than the long term average in the area (Figure 3.1). Regarding crop production, December was the most critical month (Table 3.1). Six villages out of eight where rainfall gauges were set up at the beginning of the season had no rain in December. In these villages all rainfed crops died in January and could not even be grazed by livestock. Such total crop failure affected approximately 75% of the study area. In villages where crops survived, such as those including the sample farms, over 90% of the cropped area was totally grazed by sedentary flocks between March and mid-June (Section 4). Consequently, crops in these villages only partially benefited from rainfall in March and April.

#### 3.2 PLANTING METHODS

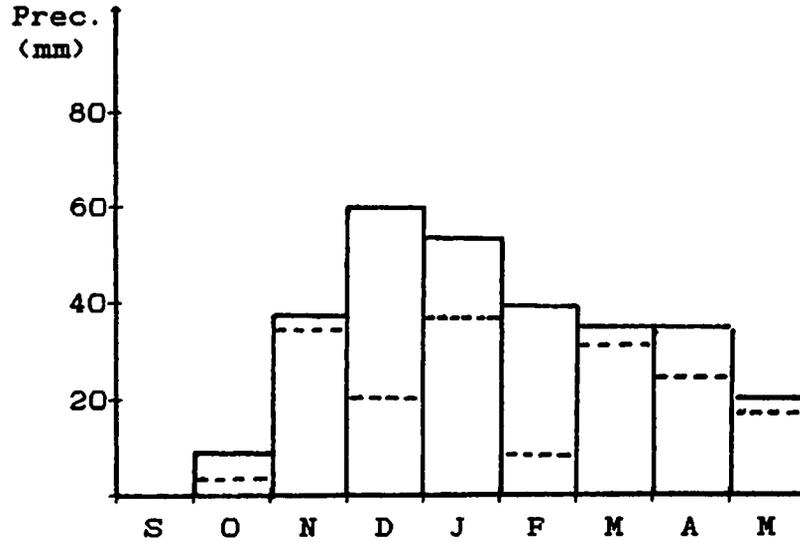
Ploughing and seed bed preparation is almost entirely done by tractor drawn implements i.e. disc ploughs and cultivators. The traditional donkey drawn feddan plough is only used on very shallow soils and small holdings. In the farm sample 1% of the cropped area was worked by feddan.

Depending on whether they were fallowed or cropped in the previous season, plots are ploughed in the spring or summer. Seed bed preparation starts in October and planting ends in December or early January at the latest. Seed broadcasting, either by hand or spinners, is the method used on 89% of the cropped area (Table

---

 FIGURE 3.1: Monthly Precipitation at Breda
 

---



— : Long term average

---- : 1983-84

---



---

 TABLE 3.1: Rainfall Distribution (mm), Village and Farm Sample (1983-84)
 

---

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Village sample (n=8) :	7.2	19.9	2.9	33.3	15.2	19.2	33.5
Farm sample :	0	35.4	15	32.8	8.2	32.4	22.5

---

3.2). Ridges are opened by cultivator and seeds covered by a second pass. In the case of seed drilling, seed bed preparation is done by disc harrow.

The work rates and cost of the various planting operations are given in Table 3.3. The cost of planting, excluding the cost of seeds, was SL 175/ha when ploughed by tractor and SL 203/ha when ploughed by feddan in October 1983.

Spinners were introduced in the area six or seven years ago and are now used on 44% of the cropped area (Table 3.2). The success of spinners, which is related to labour shortages, shows that new techniques when adapted to farmers' needs can rapidly spread in the area.

Seed drills were introduced at the same time as spinners, but have shown far less success. In most cases it is believed by farmers that broadcasting is a better sowing method than drilling.

### 3.3 SEED RATES

The study of seed rates was conducted in the farm sample and results are given in Table 3.4. In the case of barley, in particular in villages where sedentary flocks do not have access to non-arable areas, small barley plots are specially grown for grazing. On these plots, which are grazed down in March-April, seed rates range between 250 and 300 kg/ha.

The large variability in seed rates for barley, wheat and lathyrus is related to the quality of seeds which are usually taken from the previous harvest.

The start-up costs, including the cost of seed, were

Table 3.2: Sowing Method in Village Sample as  
Percentage of cropped area (1982-83)

Broadcasting		Seed drilling
Hand	Spinner	
45	44	11

TABLE 3.3: Work Rate and Cost of Planting Operations  
in Farm Sample.

	Work rate (hr/ha)	Cost (SL/ha)
<b>Ploughing:</b>		
Disc plough	4	100
Feddan	20	72.50
<b>Seed bed preparation:</b>		
Cultivator (2 passes)	2.6	60
Disc harrow	0.6	35
Feddan (2 passes)	32	116
<b>Sowing:</b>		
Hand broadcasting	1.6	15
Spinner	0.25	15
Seed drilling	1.2	40

@: Estimation based on an average cost of labour  
of 29 Sl/day (Section 3.6)

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TABLE 3.4: Seed Rates and Cost of Seed for Barley, Wheat  
and Lathyrus, Farm sample (Oct. 1983).

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	Barley	Wheat	Lathyrus
Seed rate:			
Mean (kg/ha)	131	128	167
n	11	9	8
S. D.	25.7	18.6	6.6
Max. (kg/ha)	180	150	190
Min. (kg/ha)	100	100	135
Cost of seed: (SL/kg)	1.1	1.4	1.8
Cost of seed as % of start up cost:	45	50	63

-----

SL 317/ha, SL 354/ha and SL 476/ha for barley, wheat and lathyrus respectively. The relatively high cost of seeds in the case of lathyrus is probably a factor which has contributed to the decline of this production (Table 3.4).

### 3.4 WEED CONTROL

In all sample villages but two, no weed control is done on rainfed crops. In the two villages where farmers weed barley and wheat plots in the spring, this practice is mainly aimed at providing green fodder to the flocks. In these two villages 56% of the farmers have dropped fallowing and sedentary flocks do not have access to non-arable areas.

### 3.5 FERTILIZATION

While both chemical and organic fertilizer are commonly used on irrigated areas, in most cases rainfed areas are not fertilized. This is an important characteristic of cropping systems in the study area which has probably played a large role in the decline in yields in the past 25 years (Section 2). However, there are few exceptions which are worth attention.

#### 3.5.1 Chemical fertilizers

Chemical fertilizers are applied on rainfed areas by 74 farmers in the village sample (11% of total farms) and 2 farmers in the farm sample. We found no cases where chemical fertilizer was applied to lathyrus. This may be related to the fact that this crop is mainly grown on black soils. It is believed by farmers that fertilizer application on these soils can have a detrimental effect on yields.

Triple super phosphate (TSP, 46% P<sub>2</sub>O<sub>5</sub>) is the main type of

fertilizer used on rainfed barley and wheat. TSP is broadcast at planting at a rate ranging from 90 kg/ha to 130 kg/ha. In the case of the two sample farms TSP was applied at a rate of 100 and 110 kg/ha respectively. In one farm, TSP was applied on half of the wheat area, in the second on 20 and 30% of barley and wheat area respectively.

In the study area, government support for the purchase of fertilizer is restricted to irrigated crops. Some farmers with irrigated areas can buy more fertilizer than needed for their irrigated crops and apply the excess amount on rainfed areas. However, it is worth noting that over 50% of the farmers applying fertilizer to rainfed crops, including the two sample farmers, do not own irrigated areas and purchase their fertilizer on the market in Aleppo.

### 3.5.2 Sheep manure

As compared to chemical fertilizer, a larger number of farmers, 15% in the village sample and 6 farmers in the farm sample, apply manure to rainfed barley and wheat. In the farm sample application rates range from 3 t/ha to 6 t/ha with an average of 4.7 t/ha.

Although available in most farms, only a small percentage of farmers apply manure to rainfed crops. Farmers with irrigated plots usually use all the available manure on the latter plots. However, these farmers represent less than 20% of the total farmers in the village sample. In the past, manure was one of the main sources of fuel, but after the widespread diffusion of butane and kerosene stoves, this practice was largely reduced. The amount of manure annually used for fuel in the farm sample is about 500 or 600 kg per family which represents the annual production of one sheep. Part of the manure collected is sold to

farmers with large irrigated areas; unfortunately, it was not possible in the 1983/84 season to obtain data on the amounts sold. The average price of manure was SL 200/t at the beginning of the season. Manure is a valuable product, however, sales correspond to a transfer of fertility from rainfed to irrigated areas which is probably undesirable with regard to the fertility of rainfed areas. Besides the relatively high price of manure, its limited use on rainfed areas is related to the fact that only a small amount of the dung is collected from the pens. Between November and March, in 13 sample flocks subjected to regular monitoring (Section 4), the amount of dung collected from the pens ranged from 0.27 to 0.74 kg/day/head with an average of 0.40 kg/day/head. This average represents less than 30% of the available dung (500 kg/sheep/year). However, three farmers in the sample collected 50% or more of the dung, thus it seems possible to substantially increase the availability of manure.

With an average stocking rate per hectare of cropped area of 3.2 head/ha (Section 2) and assuming that 50% of the available dung could be collected, manure could be applied at a rate of 4 t/ha on 20% of the cropped area. In the case of the sample semi-nomadic flock, 78% of the cropped area could be manured at the same rate of application.

### 3.6 HARVESTING METHODS

Regarding wheat and barley, 57% of the planted area is harvested by combine and 43% by hand. In the case of hand harvesting, plants are either pulled or cut by sickles. The first method is the most widely used in the study area, the second which is said to be slightly less labour demanding, is mainly used on farms where all the cereal area is hand harvested in order to leave stubbles on the ground. Wheat and barley stubbles are the main source of livestock summer feed (Section 4).

The average labour requirement in the village sample for hand harvesting (hand pulling) is 11.3 days per hectare (n=19, S.D.=2.2). The cost of labour ranged from SL 27 to SL 30/day with an average SL 29/day and the average cost of hand harvesting was SL 300/ha. In the case of mechanical harvesting, combine owners receive 7 to 14% of the grain yield depending on yields. The average cost of combine harvesting in the village sample in 1983 was SL 100/ha and SL 110/ha for barley and wheat respectively.

The fact that over 40% of the cereal area is hand harvested, although this method appears to be much more expensive when labour is hired, results from two main factors. Firstly, combines cannot be used on all fields, in particular on slopes and stony areas. Secondly, wage rates do not necessarily represent the actual opportunity cost of the available familial labour force.

Lathyrus harvesting raises two problems which have largely contributed to the reduction of this crop (Section 2). Firstly, harvesting cannot be done mechanically; hand pulling is the only method used in order to collect all the straw. The latter is fed to livestock during the winter. Secondly, due to the problem of seed shattering, the crop is harvested before maturity and the harvesting period is very short; two weeks compared to five or six weeks in the case of barley. In the 1983/84 season lathyrus was harvested early April, but in more normal years, the crop is harvested in the last two weeks of the month.

### 3.7 YIELDS

In the 1983/84 season it was not possible to undertake yield measurements as initially planned, however data on yields obtained in the previous season was collected in the farm sample. The results are presented in Table 3.5, these show a clear effect

of soil types. According to farmers, the large variation in barley yields is mainly related to the temperature regime of the various categories of soils. Yields are said to be negatively affected by high spring temperatures on black soils and by low winter and spring temperatures on white soils. The average barley yield in the 1983/84 season in the farm sample was of 755 kg/ha. However, according to sample farmers, the average yields were 650-680 kg/ha in the group of four villages in which the sample farms are located. This is probably related to an over representation of the best yellow/red soils in the farm sample.

The average straw yield of lathyrus was of 1150 kg/ha. Assuming a harvest index of 0.4, the grain yield should have been 766 kg/ha. The difference between this figure and the 421 kg/ha obtained by farmers is probably related to grain losses at harvest, which are said to be high, and from the fact that the crop is harvested before maturity. Thus, even without increasing yields a low shattering variety could, in addition to reducing labour constraints, substantially increase the available grain production.

An economic comparison of barley, wheat and lathyrus is presented in Table 3.6. Prices of grain and straw, and harvest indexes used in this calculation are given in Table 3.7. Wheat appears to be less profitable than barley. However, on the basis of an annual wheat consumption of 221 kg per person (FSP, 1980), and with eight persons per family, the annual household requirement in the village sample is 1768 kg. The average wheat production per household in the 1982/83 season was 1076 kg; 35% less than the estimated household requirement. Like in the Al Bab area we can assume that most of the wheat is grown for household consumption and valued more by farmers than market prices indicate (Tully, 1984).

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TABLE 3.5: Barley, Wheat and Lathyrus Yields  
Farm sample 1982/83.

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Soil Category	kg/ha		
	Mean	S. D.	N
Barley:			
Yellow/red	943	52.7	11
White	715	26.4	9
Black	434	39.4	8
Red	929	33.8	5
Wheat:			
Yellow/red	619	31.0	7
Lathyrus:			
Black	421	13.0	5

---

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TABLE 3.6 Economic Comparison of Barley, Wheat and Lathyrus  
(figures in SL)

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Soil Category	(A) Start up +harvest cost	(B) Harvest value (straw+grain)	(B)-(A)
<b>Barley:</b>			
Yellow/red	667	1660	993
White	638	1258	620
Black	609	734	155
<b>Wheat:</b>			
Yellow/red	702	1598	896
<b>Lathyrus:</b>			
Black	824	2023	1198

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**Table 3.7: Price of Straw and Grain and Harvest Index of Barley, Wheat and Lathyrus.**

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	Barley	Wheat	Lathyrus
Straw (SL/kg)	0.6	0.6	1.1
Grain (SL/kg)	1.1	1.4	1.8
Harvest index	0.50	0.33	0.40

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**TABLE 3.8: Economic Comparison of Crude Protein Sources**

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	Lathyrus	Cotton seed cake		Wheat bran	
		A	B	A	B
Crude Protein gr per SL	251	380	277	306	200

A: Official price (General Organization for Feed)

B: Average price of feedstuff fed between Nov. and Dec.  
(Section 4)

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Lathyrus, without taking into account the cost of threshing, appears to be more profitable than barley on the type of soil on which it is grown. However, lathyrus needs to be compared with alternative livestock feedstuffs available on the market, such as cotton seed cake and wheat bran. The results of this comparison are presented in Table 3.8. It appears that cotton seed cake was a cheaper source of crude protein than lathyrus at the two price levels considered. Wheat bran was also cheaper if purchased at official price. In order for lathyrus to compete with cotton seed cake at average prices paid by farmers, the available grain production needs to be increased at least by 20%.

#### 4. LIVESTOCK

The management of flocks was markedly affected by the drought. As a result, several aspects such as grazing practices in the spring, and the productivity and profitability of flocks could not be studied in the 1983/84 season. However, the survey of 20 villages and the monitoring of sample flocks provides valuable information on feeding cycles, supplementary feeding and the performance of flocks.

##### 4.1 FEEDING CYCLES

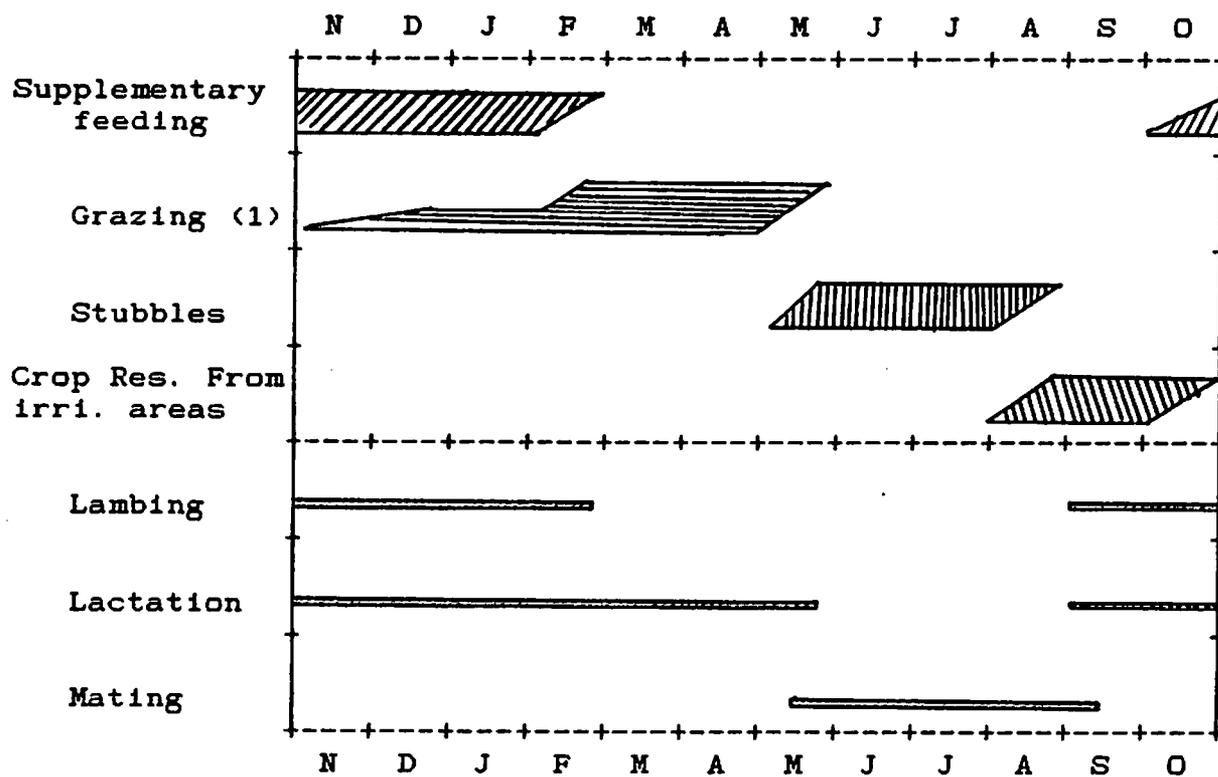
Before examining the effects of the drought (Section 4.2), we shall first present the patterns followed in more normal years. Three types of flocks found in the study area : semi-nomadic, sedentary with, and sedentary without access to non-arable areas (section 2). Their typical feeding cycles are summarized in Figure 4.1. The main difference among the three types of flocks is found between mid-February and May, when native grazing is the main source of feed.

Most semi-nomadic flocks leave the villages around mid-

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 Figure 4.1: Typical Feeding and Breeding Cycles
 

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1: Grazing areas according to flocks:

Semi-nomadic: Steppe areas

Sedentary with access to non-arable areas: non-arable areas

Sedentary without access to non-arable areas: fallows

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February. In the 1982/83 season, less than 10% of the semi-nomadic flocks moved to steppe areas between November and February. In years following a drought, when feed reserves are low, a larger number of flocks are moved to steppe areas in December or January. All semi-nomadic flocks return to their village after the beginning of harvest in May.

In the case of sedentary flocks, supplementary feeding is stopped around mid-February and native grazing is the main source of feed until the beginning of harvest in May. Flocks with no access to non-arable areas graze the fallows and barley plots grown for this purpose (Section 3). In villages where sedentary flocks have access to non-arable areas, flocks spend 10 to 12 hours per day on these areas and fallows are little used for grazing. Between November and mid-February, some of the sedentary flocks grazed non-arable areas for a few hours. In the case of the sample flocks two-thirds of the sheep and goats grazed non-arable areas between November and mid-February (Table 4.1). As we shall see in discussing levels of supplementary feeding during the winter (Section 4.3), it seems that this practice does not contribute to the productivity of the flocks.

Both sedentary and semi-nomadic flocks are entirely fed on barley and wheat stubbles from mid-May to mid-August. This period, which corresponds to the mating season (Figure 4.1), is of great importance regarding the reproductive performance of flocks. Crop residues from irrigated areas are the main source of feed until October. Supplementary feeding starts in September and, with the exception of semi-nomadic flocks sent to steppe areas, flocks are almost entirely dependent on supplementary feeding from November to mid-February.

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**Table 4.1: Proportion of sheep grazing non-arable areas  
from November to mid-February and duration of  
Grazing, Farm Sample (1983-84)**

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	Nov.	Dec.	Jan.	Feb. (First 2 weeks)
Size of Sample	602	602	580	414
% grazing non-arable lands	64	64	68	68
Duration of grazing (hr/day)	4	4	5	5

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## 4.2 THE EFFECTS OF DROUGHT

### 4.2.1 Feeding cycles

The feeding cycles followed in 1983/84 are presented in Figure 4.2. The available herbage on steppe areas, non arable lands and fallows was not sufficient to cover feed requirements. As far as feeding cycles are concerned, the drought had a marked effect after mid-February when flocks are usually fed on grazing.

Semi-nomadic flocks which moved to steppe areas in December or January had to return to the villages in early February. All semi-nomadic flocks were moved to higher rainfall or irrigated areas in the second half of February. Similar movement towards higher rainfall or irrigated areas occurred in 1958-61 and 1973.

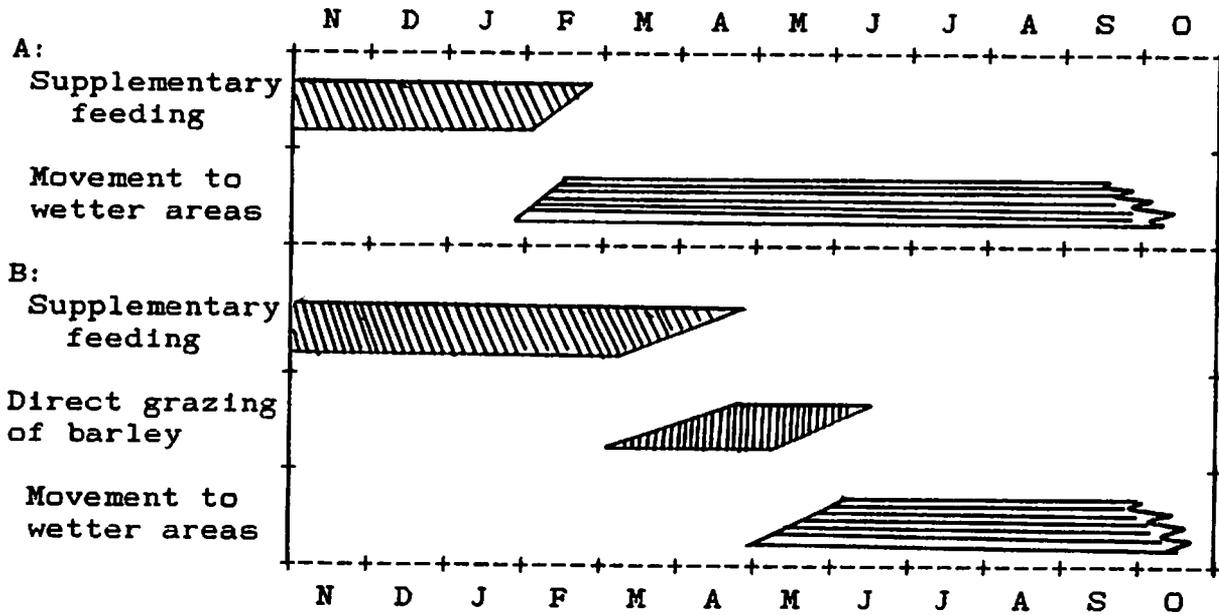
Regarding sedentary flocks, the strategy adopted by farmers depend on the state of crops. In villages where crops died in January (Section 3) flocks were sent to higher rainfall or irrigated areas in the second half of February along with semi-nomadic flocks.

In villages where crops could be grazed, sedentary flocks were kept in the villages and fed on green barley. Most of these flocks left the villages between mid-May and mid-June when the crops had been completely grazed. Supplementary feeding was continued in these villages until March or April.

### 4.2.2 Livestock numbers and prices

As shown in the previous section, higher rainfall and irrigated areas play an important role in drought years by supplying spring and summer feed to flocks from the dry areas. However, these areas only provide a partial buffer. The feed shortage led to large sales of livestock, mainly ewes. In order

Figure 4.2: Feeding Cycle in 1983-84



A: Semi-nomadic flocks and sedentary flocks from villages where crops died in January.

B: Sedentary flocks from villages where crops could be grazed.

to evaluate the first effects of the drought on livestock numbers, the 20 sample villages were visited in the last week of March. As compared to the results of the first visit in August-September 1983, an 18% decline in the sheep and goat population was observed.

Farmers, fearing a fall in prices, started to sell part, and in some cases all, their flock in January. The widespread sales of livestock had a marked effect on prices. In the case of ewes, the average price fell from SL 700-800/head in October to SL 150-200 in March. The liveweight price of lamb was SL 6-7/kg in March 1984 compared to SL 12-13/kg in the previous year.

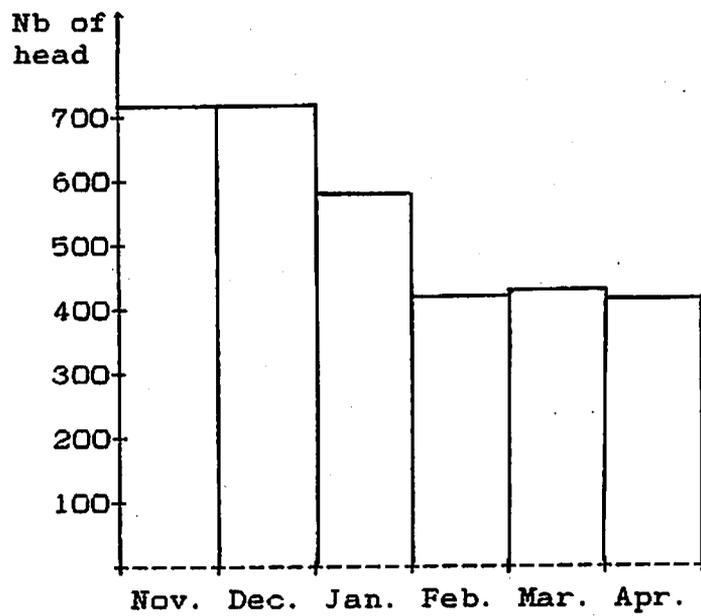
In all villages, whether crops died in January or were grazed in the spring, farmers were left with no feed reserves and the final effects of the 1983/84 drought on livestock numbers will largely depend upon the availability and cost of supplementary feed in the 1984/85 winter.

Regarding flocks in the sample, the changes in size between November and April are given in Figure 4.3. By the end of April, before flocks started to move to higher rainfall or irrigated areas, the sample size was reduced by 45%. Most sales were made in January and February, but in the first month only part of the sales were related to the drought. At the end of April, 35% of the sales were due to the drought. As compared to the village sample, farmers in the farm sample sold a larger percentage of their flock mainly in order to reduce feed requirements and purchased supplementary feed which became very costly. Although crops could be grazed, supplementary feeding had to be continued until March. One farmer who had sufficient feed reserves took advantage of the low prices and purchased 27 ewes in March (Table 4.2).

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FIGURE 4.3: Size of Flock Sample (Nov. to Apr. 1983-84)

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TABLE 4.2: Change in size of flock sample (Nov. to Apr.)  
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	Number of sheep and goats	% of total flock sample
Opening inventory: (November)	736	100
Sales:	-348	-47.3
Deaths:	- 10	- 1.4
Consumption:	- 4	- 0.5
Purchases:	27	3.7
Closing inventory: (April)	401	54.5

  
-----

#### 4.3 WINTER SUPPLEMENTARY FEEDING

The study of supplementary feeding practices is based on the results of the monitoring of 13 flocks out of 16 included in the farm sample (Section 2). As a result of the sales of ewes in January and early February, three flocks had to be dropped from the sample. The sample flocks were monitored every 14 days, in order to collect accurate data regarding the levels of supplementation, the feed offered daily to the sample flocks was weighed once per month.

Supplementary feeding in the 1983/84 season was continued longer than usual. However, from November to mid-February when supplementary feeding is usually stopped, the levels of supplementation and the composition of diets are representative of normal practices.

##### 4.3.1 Levels of supplementary feeding

The levels of supplementary feeding recorded for the sample flocks are given in Table 4.3. Before discussing these results it should be noted that they refer to the quantities of feed offered to flocks. It was not possible, such as is usually done in the case of scientist managed flocks, to measure the actual feed intake of ewes. However, feed is distributed four to six times daily and refusals are very limited, thus, the figures presented in table 4.3 are close to actual feed intakes of ewes.

From November to mid-February, the average quantity of dry matter offered daily remained constant. However, in January-February, both metabolizable energy and crude protein levels were increased by 10% and 17% respectively. This increase which results from a change in the composition of diets, is related to

Table 4.3 Levels of Supplements Offered to Sample Flocks in Terms of Dry Matter (DM), Metabolizable Energy (ME) and Crude Protein (CP) ( $\pm$ S.D.)

	Nov.-Dec.	Jan.	Feb.	Mar.	Apr.	mean Nov./mid-Feb.
DM kg/day/ewe	1.9 ( $\pm$ 0.4)	1.9 ( $\pm$ 0.4)	1.5 ( $\pm$ 0.6)	0.8 ( $\pm$ 0.5)	0.2 ( $\pm$ 0.1)	1.9 ( $\pm$ 0.4)
ME MJ/day/ewe	17 ( $\pm$ 4)	19 ( $\pm$ 5)	19 ( $\pm$ 6)	9 ( $\pm$ 4)	3 ( $\pm$ 1)	18 ( $\pm$ 5)
CP g/day/ewe	163 ( $\pm$ 33)	190 ( $\pm$ 52)	182 ( $\pm$ 68)	96 ( $\pm$ 43)	55 ( $\pm$ 18)	174 ( $\pm$ 49)
Size of sample	602	580	414	416	401	
% of ewes receiving supplementary feed	100	100	100	57	23	

the lactation period (Figure 4.1).

In the 1983/84 season, the lambing period started in October, but 80% of the lambs were born after December (Figure 4.4). The sharp fall in lambings in February resulted partly from the sales of pregnant ewes in January and February.

Compared to scientist managed flocks subjected to a supplementary feeding trial at ICARDA's main research station, (Tel Hadya) the levels of supplementary feeding in the flock sample appear to be above requirements during both the end of pregnancy and lactation (Thomson et al, 1983).

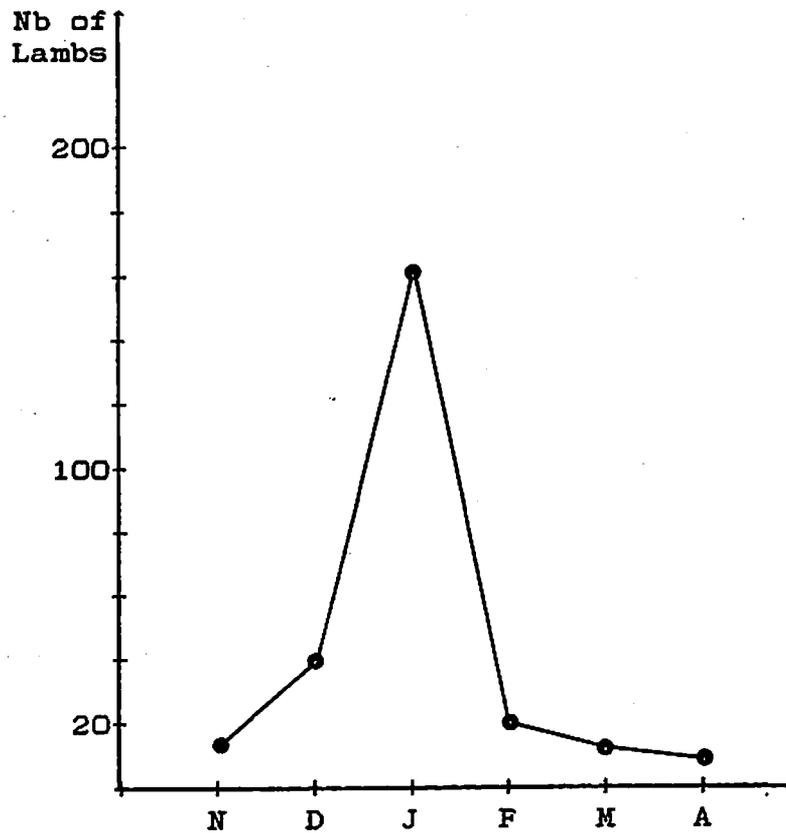
As indicated previously, some of the sample flocks grazed non-arable areas during the winter (Table 4.1). However, regarding the levels of supplementary feeding it is doubtful whether this practice actually contributes to feeding these flocks. Indeed, sheep and goats grazing during the winter required a greater amount of supplementary feed than those staying in the villages; 2.2 kg of dry matter per head compared to 1.7 kg per head. According to these results, it seems that herbage consumed on non-arable lands, which rise 200 or 300 meters above the plain, does not compensate for the energy required to trek there and back. These results are consistent with the measurements of herbage yield undertaken by the PFLP (Cocks, 1985). These measurements indicate that the total herbage production on non-arable areas was under 500 kg/ha, an amount usually accepted as the minimum necessary to maintain body weight (Cocks, 1985). Farmers are aware of the fact that winter grazing actually increases feed requirements, this even in more normal years. The practice of sending flocks onto non-arable areas is aimed at exercising the sheep.

Direct grazing of barley started in the second half of

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**FIGURE 4.4: Distribution of Lambings in sample flock.**  
(Nov. to Apr. 1983-84)

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February, but supplementary feeding was continued until early March in all sample flocks (Table 4.3).

#### 4.3.2 Composition of diets

The composition of the diets and the contribution of the various commodities fed to the flocks regarding dry matter, metabolizable energy and crude protein content are given in Tables 4.4, 4.5 and 4.6. From November to mid-February, diets were made up of over 80% barley grain and straw on a dry matter basis. Barley provides 80% and 63% of the metabolizable energy and crude protein respectively. The contribution of wheat straw to winter diets appears to be low compared to the size of the area planted to this crop (12% of the cultivated rainfed area in the farm sample, Section 2). Wheat straw is believed by farmers to have a lower nutritive value than barley straw and is mainly fed to flocks in autumn (September-October).

Cotton-seed-cake only makes up 5% of the dry matter, but, due to its high crude protein content, this commodity is the second most important source of crude protein after barley grain. Lathyrus straw was fed by only three farmers who grow this crop and is used as a partial substitute for cotton-seed-cake. The small contribution of lathyrus grain, which only provides 1.4% of the total crude protein of diets, is because grains are mainly kept for seed (Section 3).

The increase in metabolizable energy and crude protein content discussed in the previous section results from a change in composition of diets as the season progressed. From November to mid-February, the percentage of barley grain remained constant, but in January-February, straw was reduced while the percentage of protein rich commodities, such as cotton seed cake and wheat bran, increased.

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 Table 4.4: Contribution of Feedstuffs as Percentage of Dry Matter
 

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	Nov./Dec.	Jan.	Feb.	Mar.	Apr.	Mean Nov./mid-Feb.
Barley straw	50.0	43.0	44.6	38.0	-	46.2
Barley grain	36.0	36.0	35.2	39.0	56.0	36.0
Wheat straw	3.0	-	-	-	-	0.8
Lathyrus straw	3.0	6.5	0.4	6.0	-	3.5
Lathyrus grain	-	0.3	1.0	-	-	0.5
Wheat bran	3.0	4.5	7.4	3.4	44.0	4.0
Cotton seed cakes	3.0	4.5	8.0	6.6	-	5.0
Cotton seed hulls	0.7	2.6	-	-	-	1.5
Sugar beet pulp	1.3	2.6	3.4	7.0	-	2.5

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Table 4.5: Contribution of feedstuffs as percentage of Metabolizable Energy.

	Nov./Dec.	Jan.	Feb.	Mar.	Apr.	Mean Nov./mid-Feb.
Barley straw	33.4	29.3	29.5	24.9	-	31.6
Barley grain	47.7	48.7	46.3	50.5	59.0	48.8
Wheat straw	2.0	-	-	-	-	0.5
Lathyrus straw	2.4	5.3	0.3	4.7	-	2.9
Lathyrus grain	-	0.4	1.4	-	-	0.7
Wheat bran	3.5	5.3	8.5	3.8	41.0	4.7
Cotton seed cakes	3.8	5.8	10.1	8.2	-	6.5
Cotton seed hulls	5.6	2.2	-	-	-	1.3
Sugar beet pulp	1.6	3.1	3.9	7.9	-	3.0

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 Table 4.6: Contribution of Feedstuffs as Percentage of Crude Protein
 

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	Mean Nov./Dec.	Jan.	Feb.	Mar.	Apr.	Mean Nov./mid-Feb.
Barley straw	21.5	16.3	14.5	13.0	-	17.5
Barley grain	51.6	45.6	38.3	44.3	48.0	45.5
Wheat straw	1.3	-	-	-	-	0.3
Lathyrus straw	2.7	5.2	0.3	4.3	-	2.8
Lathyrus grain	-	0.9	2.5	-	-	1.4
Wheat bran	5.9	7.8	11.0	5.3	52.0	6.9
Cotton seed cakes	14.8	19.7	30.0	25.9	-	21.8
Cotton seed hulls	0.5	1.5	-	-	-	0.9
Sugar beet pulp	1.7	3.0	3.4	7.2	-	2.9

---

#### 4.3.3 Cost of supplementary feeding

As shown previously, barley is the main commodity fed during the winter. Although it is the main crop grown in the area, 12% of the barley straw and 27% of the grain fed to the flock sample between November and mid-February was purchased. Eight farms out of 13 were deficient in grain and six were deficient in grain and straw.

The cost of feedstuffs supplied by the General Organization of Feed (GOF) at the beginning of the 1983-84 season are given in Table 4.7. The GOF supplies only part of the required feed and farmers also purchase feed on the market, usually at a higher cost. The average cost of feedstuffs fed between November and mid-February is given in Table 4.7.

The daily cost of supplementary feeding ranged from SL 1.1 to SL 2.5 per head with an average of SL 1.75 per head in November-December and from SL 1.6 to SL 2.6 per head with an average of SL 1.9 per head in January-February.

#### 4.4 FLOCK PERFORMANCE

In nine flocks, 20 ewes, or all the flock if less, and lambs from these ewes, were weighed every 14 days. The monitoring provided data on the reproductive performance of ewes and the liveweight changes of ewes and of their lambs during the first two months of lactation. As a result of the sales of pregnant ewes in January-February and lactating ewes in February-March it was not possible to study lambing rates and milk production in the 1983/84 season.

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**TABLE 4.7: Price of Feedstuffs (figures in SL/kg)**

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	General Organization for Feed	Average price of feedstuffs fed during the winter
Barley grain:	1.15	1.25
Barley straw:	/	0.66
Lathyrus grain:	/	1.80
Lathyrus straw:	/	1.10
Cotton seed cake:	1.00	1.37
Cotton seed hull	0.50	0.60
Wheat bran:	0.49	0.75
Sugar beet pulp:	0.70	0.80

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#### 4.4.1 Reproductive performance

In the nine flocks in which ewes and lambs were weighed on a regular basis, we recorded the lifetime number of lambs born alive from each ewe. This data was used to evaluate the lifetime lambing rate (LTLR) of the monitored flocks. The LTLR was calculated using the following formula:

$$\text{LTLR} = \frac{\text{Total number of lambs born from sample ewes}}{\sum (\text{age of sample ewes} - 2)}$$

The ewe sample includes ewes over two years old which were either born in the flock or purchased before the age of two. The sample included a total of 247 ewes, the age of which ranged from 2 to 8 years with an average age of 5 years.

The LTLR per flock ranged from 0.6 to 1.05 lambs per ewe with an average of 0.9. Lamb mortality in the 1983/84 season was less than 2% and average weaning rates exceeded 0.85 lambs per ewe. Compared to the results obtained by the Livestock Unit at Tel Hadya (1.06 lambs per ewe in 1982/83, Thomson et al 1983), the reproductive performance of ewes in the sample flocks appeared to be relatively low. This may be due to poor body condition of ewes at mating.

#### 4.4.2 Changes in liveweights of ewes and lambs

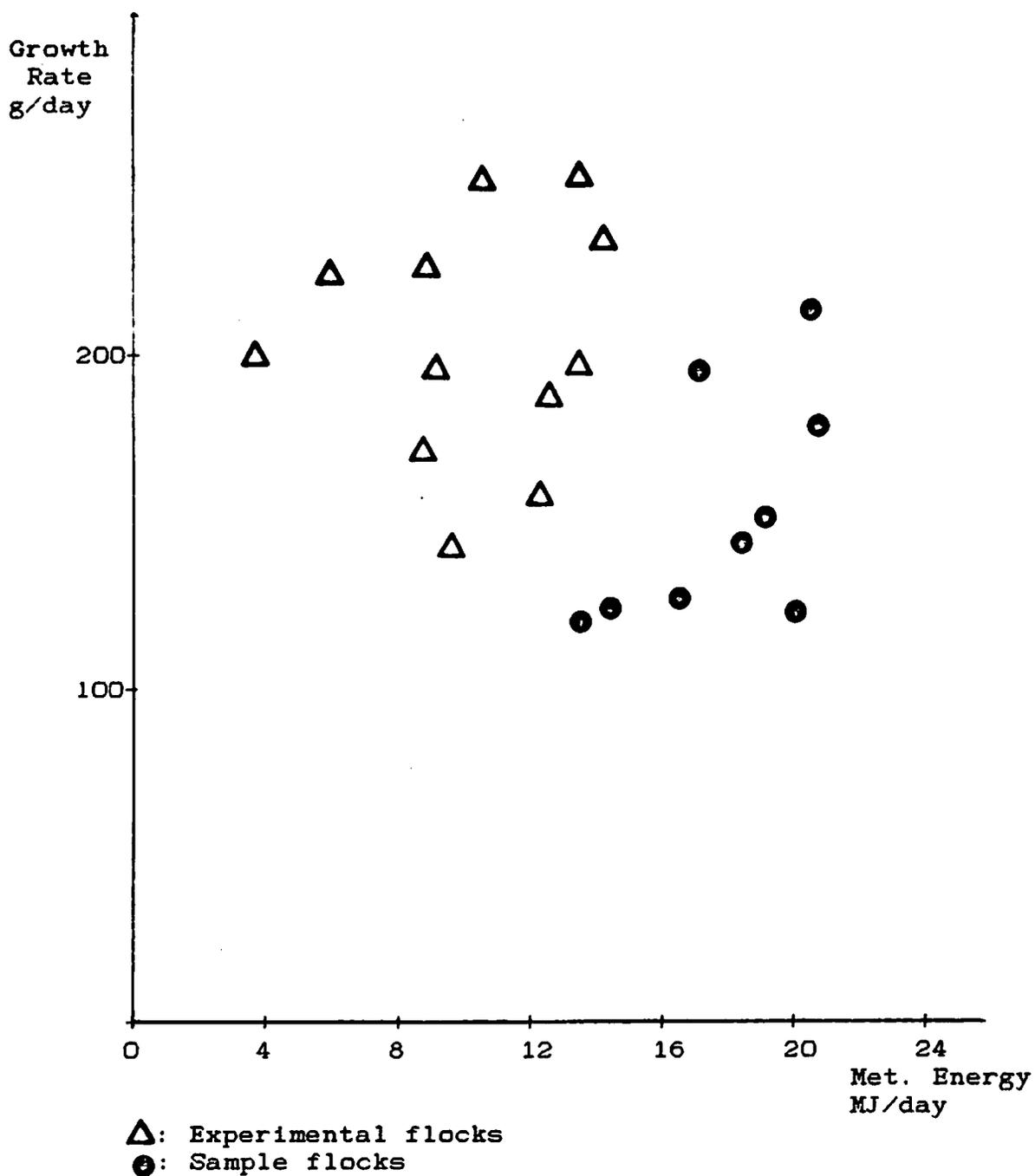
The average weight of ewes at lambing in the nine sample flocks ranged from 41 to 59 kg per head with an average for the whole sample of 51 kg per head. Although receiving higher levels of supplementary feeding at the end of pregnancy, the weight of ewes at lambing were lower in the sample flocks than in the H flock at Tel Hadya (Table 4.8).

Table 4.8: Comparison of Levels of Supplementary Feeding, Liveweight at Lambing and Liveweight Changes in the last 2 Months of Pregnancy and First 2 Months of Lactation in Experimental and Sample Flocks.

Pregnancy:	Experimental flocks@			Sample flock
	L	M	H	
Dry matter: g/day/ewe	540	747	1043	1890
Met. energy: MJ/day/ewe	3.8	6.1	9.5	17.0
Crude protein: g/day/ewe	45	72	110	160
Liveweight at lambing: (kg)	36.6	45.9	58.1	51.0
Lactation:				
Dry matter: g/day/ewe	689	1040	1452	1914
Met. energy MJ/day/ewe	5.3	9.3	13.9	19.5
Crude protein: g/day/ewe	69	113	167	194
Daily liveweight losses: g/day	-73	-126	-137	-49

@: Thomson et al, 1983)

Figure 4.5: Growth Rates of Lambs and Levels of Supplementary Feeding of Ewes in Early Lactation in Experimental and Sample Flocks.



Liveweight changes in the first two months of lactation ranged from +10 to -75 g per day with an average of -49 g per day. Liveweight losses appear to be low compared with the experimental flocks at Tel Hadya (Table 4.8).

Regarding lambs, the daily liveweight gains in the first months of suckling ranged from 123 to 214 g per day with an average of 157 g per day. In spite of levels of supplementary feeding during lactation exceeding estimated requirements, the daily liveweight gains of lambs are well below the potential of the breed which is about 300 and 250 g per day for males and females respectively.

As shown in Figure 4.5 the efficiency of feed utilization during lactation was low as compared with the results obtained at Tel Hadya. It should be noted that experimental flocks are comprised of unimproved ewes, thus, the lower efficiency of feed utilization in the sample flocks can mainly be attributed to management factors.

## 5. ON-FARM FORAGE TRIALS

On-station trials conducted by the FSP indicate that cropping systems in the study area can be improved by alternative crop rotations (Keatinge 1985). Legume crops can be used as a replacement for fallow in barley/fallow rotations or as a break crop when barley is grown continuously. The inclusion or expansion of forage legumes in current crop rotations could contribute to the supply of livestock feed and maintain soil fertility.

The Livestock Unit of the PFLP conducted on-farm trials on peas and vetch. In addition to these two species, lathyrus was included in three of the trials. Each trial involving three

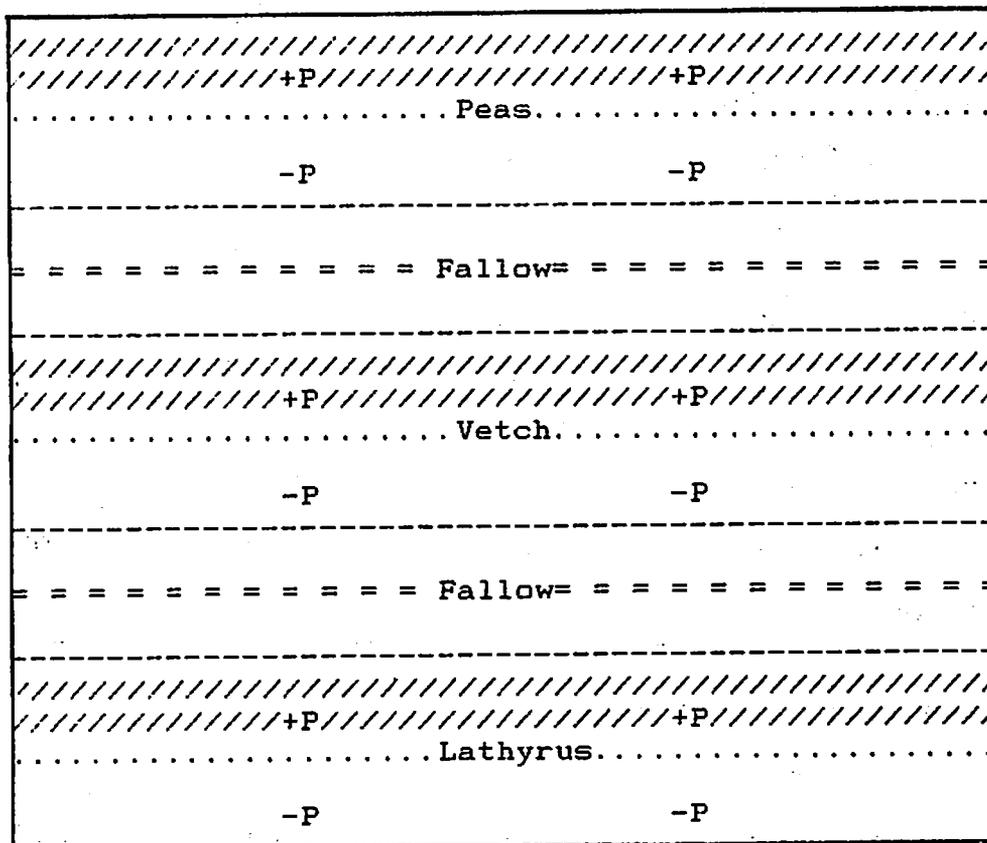
species included five plots of one donum, two of which were left fallow. The trials were set up on fields which were planted to barley in the previous season and would have normally remained as fallow in the 1983/84 season. The design of the trial is presented in Figure 5.1. Peas, vetch and lathyrus were planted by farmers at a seed rate of 140 Kg/ha. Each plot was split by phosphate treatment.

Samples (6m<sup>2</sup> treatment) were taken on 1 March to estimate dry matter available for green grazing and on 3 April to estimate dry matter production when harvested by farmers (Section 3). At each sampling, the samples were analysed for crude protein content and in- vitro digestibility. The results of these studies are given in Table 5.1.

On the first sampling date, dry matter production was low. Phosphate application significantly increased production in all three crops. Lathyrus had a lower dry matter production than the two other species, but due to its much higher percentage of crude protein, it produced good yields of protein. On the second sampling date, there were no significant differences in dry matter production between the three species and in the case of vetch and peas, phosphate application significantly increased yields. Yields of crude protein were again higher in the case of lathyrus.

As indicated in sections 2 and 3 harvest labour is a serious constraint to the expansion of forage crops in the study area. One way to avoid this problem is to graze the forage in the spring. To test this alternative grazing trials were conducted in the study area. The trial was conducted on 0.76 ha of vetch which was grazed in March-April by 5 ewes for 36 days. The gross revenue from milk sales was only 3% below the cost of establishing the vetch (Jaubert, Thomson and Norblom 1985). Considering

Figure 5.1: Basic Plot Layout, On-Farm Forage Trial



+P: With 50 kg of P205 per ha  
 -P: Without P205

Table 5.1: Forage yields (kg/ha) and nutritive value on 1 March and 3 April.

treatment		Total D.M. kg/ha	In-vitro Digestibility of D.M.	% Crude Protein	Protein yield kg/ha
First sampling (1 March)					
Peas	-P	370	73.8	14.4	53
	+P	617	67.6	12.2	75
Vetch	-P	457	59.8	15.4	70
	+P	674	59.5	14.7	99
Lathyrus	-P	343	73.3	23.2	80
	+P	447	72.1	21.7	97
LSD (0.05)		99			
Second sampling (3 April)					
Peas	-P	900	54.4	8.8	79
	+P	1220	59.1	9.6	117
Vetch	-P	843	54.5	10.4	88
	+P	1090	56.6	12.6	137
Lathyrus	-P	923	58.3	13.0	120
	+P	1053	58.4	15.6	164
LSD (0.05)		225			
-P: Without P205					
+P: With 50 kg of P205 per ha					

yields were largely affected by the drought, these results are encouraging.

## 6. CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Research plans in the 1983/84 season were largely affected by the drought and several important aspects related to cropping practices, feeding cycles and the profitability of crop and livestock production could not be studied. However, several constraints to the introduction of new practices currently studied by the FSP and PFLP were identified. The results obtained also indicate several areas for future research.

### 6.1 SOIL FERTILITY AND LAND USE CAPABILITY

The conservation of land resources is a central issue regarding the future prospects of agriculture and the design of strategies aimed at stabilizing productivity in the dry cultivated areas. However, we have limited information on the physical and chemical factors involved in the decline in soil fertility affecting these areas. Furthermore, as shown by the present study, there is a large variability in the actual, and presumably potential productive capacity of cropped areas. This variability will probably affect the design of alternative cropping patterns and crop management practices in particular regarding forages and fertilization.

In order to design appropriate cropping strategies aimed at stabilizing productivity in the long run, there is a need to undertake soil fertility and land use capability studies.

### 6.2 NON-ARABLE AREAS

Non-arable areas are an important component of the resource

base of farming systems in the study area. Although degraded , they are the second most important source of feed for sedentary flocks after barley. These areas have benefited from limited research as compared to cropped areas. However, non-arable areas are closely linked to the latter through the system of feeding livestock and should be included in strategies aimed at stabilizing and increasing productivity of farming systems.

Studies by the PFLP show that primary herbage productivity of non-arable areas is well below its potential. These areas are subjected to intensive grazing particularly in the spring. In order to increase seed yields, which are presently low, and thus herbage availability in the subsequent season, stocking rates should be reduced at the end of spring. This will require the development of an alternative source of grazing which could be fulfilled by a forage crop. In addition, since non-arable areas are used as common lands developing appropriate grazing management practices may require the development of grazing regulation at the village level.

Increased herbage production, in particular in winter, could have a marked effect on supplementary feed requirements and improve livestock profitability. Presently, available herbage in winter is insufficient to compensate for the increase in energy needs related to grazing and this practice should probably be dropped until herbage production has increased.

### 6.3 FORAGE LEGUMES

The inclusion of forage legumes in a two course rotation with barley is, with the use of phosphate fertilizer, a central component of alternative cropping practices studied by the FSP. Forage legumes can either be grazed or harvested. Under current circumstances the latter option seems most difficult to promote.

In the absence of non-shattering varieties, grazing the forage crop seems the most promising option for reversing the decline in forage production. In villages where flocks do not have access to non-arable areas, forage legumes in the place of fallows could be grazed by both ewes and lambs. In villages where flocks do have access to non-arable lands, the latter are considered as a free commodity which, not taking into account the need to preserve non-arable areas, may limit from the farmers' point of view the economic value of grazing ewes. However, in these villages, forages could be used for grazing lambs. Forages for grazing raise the question of seed supply. Presently both vetch and lathyrus seed are available on the market but probably not in sufficient quantities to allow a large expansion of the area planted to forages. Developing forage crops for grazing may thus imply the involvement of local authorities for organizing the supply of seed produced in higher rainfall or irrigated areas.

#### 6.4 PHOSPHATE FERTILIZERS

The removal of policy constraints to the use of fertilizers in dry rainfed areas is an important aspect of the problem and is currently under study (FSP/MAAR, 1985). However, fertilizers are presently available on the market and used on rainfed areas by a small group of farmers. Thus in addition to policy constraints it can be questioned whether other factors also limit the use of fertilizers by most farmers. In this respect, complementary to the phosphate trials conducted in collaboration with the Soils Bureau of the Ministry of Agriculture, it would be of interest to study in greater depth factors which currently limit the use of fertilizers on rainfed areas. Such a study would provide valuable indications regarding the strategy to be adopted in order to promote the use of fertilizers on rainfed areas.

### 6.5 SHEEP MANURE

Under current crop management practices most of the biomass produced, with the exception of roots, is removed and organic matter inputs are most limited. The recycling of organic material is probably an important issue regarding soil fertility and deserves particular attention.

Presently it is most improbable that farmers would plough in material which can be use as livestock feed, such as stubbles or green manure. According to the data collected from the monitored flocks, it seems that there is a potential for increasing the recovery of sheep manure which could be more widely used on rainfed areas. Presently, dung collection is generally very low compared to the quantity potentially available and could probably be substantially increased.

### 6.6 THE EFFICIENCY OF FEED USE

As shown by the study of supplementary feeding practices and flock performance, the efficiency of supplementary feed use appears to be low. Also, fertility levels are below their potential. In both cases, as indicated by the results obtained at Tel Hadya, low performance in sample flocks is largely related to management factors. There is a large potential for substantial gains in flock profitability to be achieved through improvements in current management feeding practices, in particular regarding winter grazing and summer feed. This is an area which certainly deserves special attention since it could have an immediate and large impact at the farm level.

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