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APPLE SURVEY- DAHUK AND NINEWA Final Report

April 2006

This publication was produced for review by the United States Agency for International Development. It was prepared by Development Alternatives, Inc.

Contract No. RAN-C-00-04-00002-00

APPLE SURVEY- DAHUK AND NINEWA

Final Report

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**Kurdistan Agricultural, Reconstruction and
Development Organization**

Apple Orchards Survey in Dahuk-Ninewa Governorate

November 5, 2005 – January 5, 2006

FINAL SURVEY REPORT



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I. Introduction

This field survey was intended to assess the needs for the improvement of apple production in Dahuk and Ninewa governorates. There is a great need to have reliable information and data about apple orchards in areas where there is a possibility for establishment of new apple orchards and improvement of apple production. The data collected from the survey will be used to prepare a competitive analysis report of apple production in Iraq.

The objective of this study is to determine the current situation of apple orchards in apple producing areas, identify major/common problems and obstacles that hinder apple production, propose necessary solutions and recommendations for the elimination of these problems/obstacles, and identify the needs of apple producers in the target areas.

This survey targeted 631 villages in five districts: Dahuk, Amedi and Zakho in Dahuk Governorate as well as Akre and Shekhan in Ninewa Governorate.

Some of the technical information contained in this report is rough since many farmers were not able to provide accurate information on their apple orchards.

II. Objectives

The objectives of the survey are as follows:

- Study the current situation and identify obstacles in apple production in the region.
- Identify major needs and propose recommendations for the sustainable improvement of apple production in the region.
- Assist the agricultural authorities in having a clear and reliable picture of the current state of apple production, and problems that affect production, in the region.
- Improve the quality of statistics available to the Ministry of Agriculture.
- Improve the national capacity building in conducting needs assessment surveys.

III. Areas Covered

The survey covered 483 villages in the following sub-districts as per the agreed plan: Kanimase, Batifa, Darkar, Rezgari, Zawita, Dosky, Sarsenk, Bamerne, Chamanke, Amedi center, Deraluk, Atrosh, Akre center, Dinarte and Bejel. It also covered some villages in Qasrok sub-district, which was not included in the plan due to the existence of a number of orchards in some of the villages. Basic information on the surveyed villages, orchards and farmers together with GPS coordinates for the villages are shown in *Annex 1*. Details including all necessary information on the surveyed orchards and farmers are available in a database designed under the project (see enclosed Database 1).



A farmer explaining to a surveyor the pruning method he uses in his apple orchard

Information on the orchards in an additional 148 villages could not be collected because these villages were uninhabited, not secure, the surveyors were unable to locate villagers who were displaced or had immigrated from the villages, non-interest expressed by the farmers in the survey work and subsequent failure (by them) in provision of required information, or non-interest showed by them in apple growing. However, all the surveyed farmers in these 148 villages showed interest in growing apples if orchards are established for them. The highest figures of these farmers were surveyed in Dahuk district, followed by Shekhan and Amedi. A separate database on the information of these villages is also enclosed (Database 2).

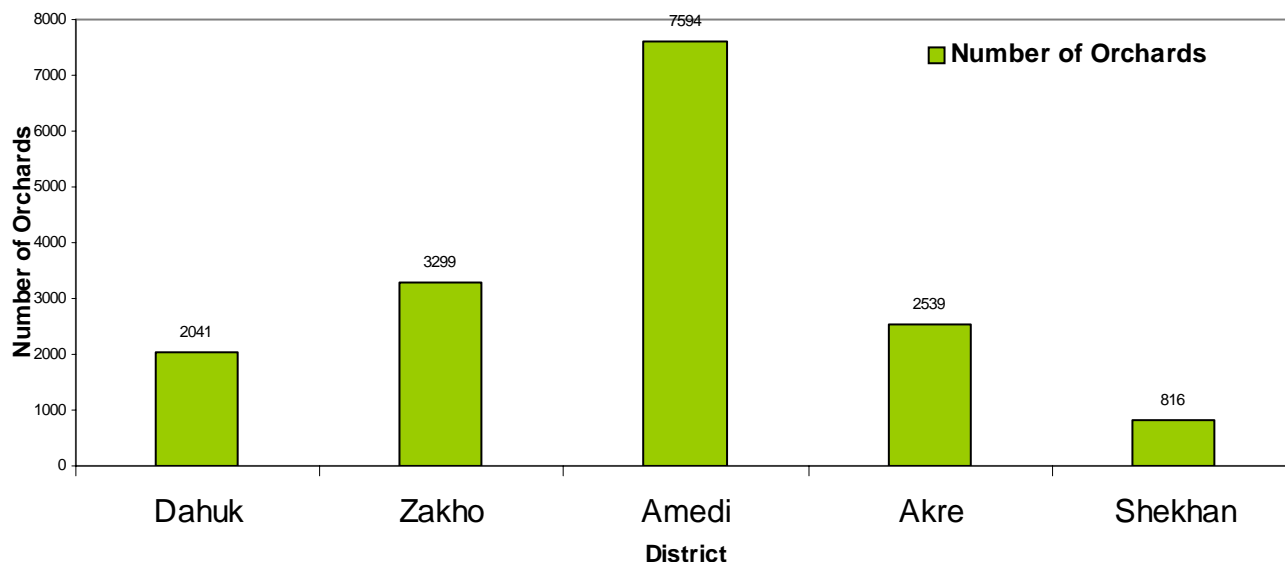
A total of 16,289 orchards belonging to 6,391 farmers in the covered 483 villages were surveyed. The highest figure of surveyed orchards was recorded in Amedi district, followed by Zakho district.

Table No. 1: Numbers of Surveyed Orchards, Farmers and Villages District Wise

District	Orchards	Farmers	Villages
Dahuk	2041	982	112
Zakho	3299	904	129
Amedi	7594	2462	206
Akre	2775	1537	138
Shekhan	580	506	46
	16289	6391	631

See Annexes 1 & 2 for more details.

Diagram 1
Number of Surveyed Apple Orchards



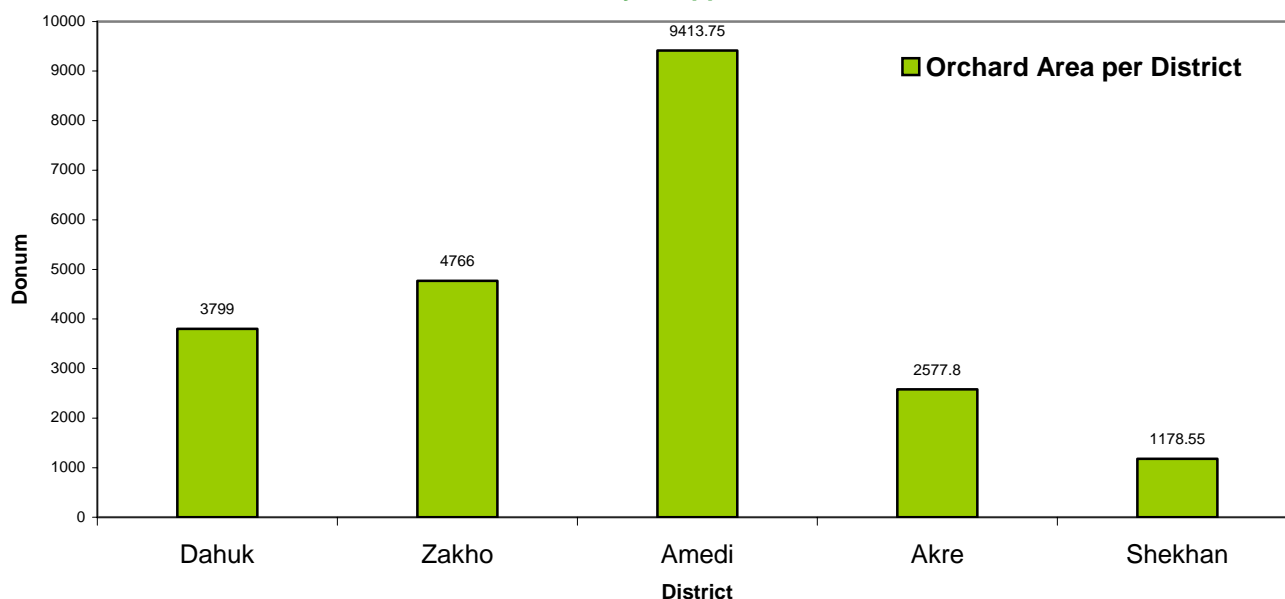
The total area of these orchards is estimated at 21,735 donums – irrigated and rain-fed.

Table No. 2: Total Area of Surveyed Orchards

	Orchard Area (Donum)			% of Total Area	
	Irrigated	Rain-fed	Total	Irrigated	Rain-fed
Total	21,188	547	21,735	97	3

See Annex 3 for more details.

Diagram 2
Area of Surveyed Apple Orchards



IV. Apple Environment and Ecology

Rain and Temperature

Dahuk-Ninewa region is situated between longitudes (43.01 degree E), latitudes (36.847 degree N), and altitude (583 meters). Its climate is continental and sub-tropical, which is characterized by cool to cold winter (temperatures below zero are possible) and hot summer (temperature reaching 40⁰ C). The prevailing climate is Mediterranean, which is dry and hot in summer, and wet and rainy in winter. The region is located in a secured and semi-secured rain zone. Rainfall occurs in winter months starting in September and increasing in October. Average rainfall reached 508 mm from 1976 to 2002. Both September and October are months of transition between completely dry period (July to August) and rainy season (November to May).

Apple production generally requires cold climate (an average of -1 – 4 °C) and high humidity (89-95). Therefore apples are grown very successfully in the region, due to the favorable weather conditions (cold weather). Apples are grown at large scale in the areas with very cold winter weather, especially in the mountainous areas that start from Zawita to Amedi and Barwary Bala. This area is characterized with cold weather, high humidity and elevation.

Soil

Abundant fertile lands and the type of existing soil favor growth of apple in the region more than other areas of Iraq.

V. Existing Apple Varieties

Some varieties that are grown in the Dahuk-Ninewa region are of superior quality and are in demand in the Iraqi market. Most of the apple trees found in the surveyed orchards are of Golden Delicious variety followed by Barwary Bala (an improved variety alleged to be introduced from Turkey is named after this region), Red Delicious, and Starking (see *Table 3* below showing number of varieties trees in order).

Table No. 3: Number of Surveyed Apple Trees Variety Wise

Variety	Total No. of Trees		
	Irrigated	Rain-fed	Total
Golden Delicious	778,218	5,746	783,964
Barwary Bala	718,074	3,445	721,519
Red Delicious	438,483	45	438,528
Starking	150,579	25	150,604
Callvile	58,632	0	58,632
Spartan	31,736	0	31,736
American	19,030	0	19,030
Khanek	1,360	15,010	16,370
Anna	14,600	0	14,600
Winter Banana	400	0	400
Star Krimson, VI & V2	250	0	250

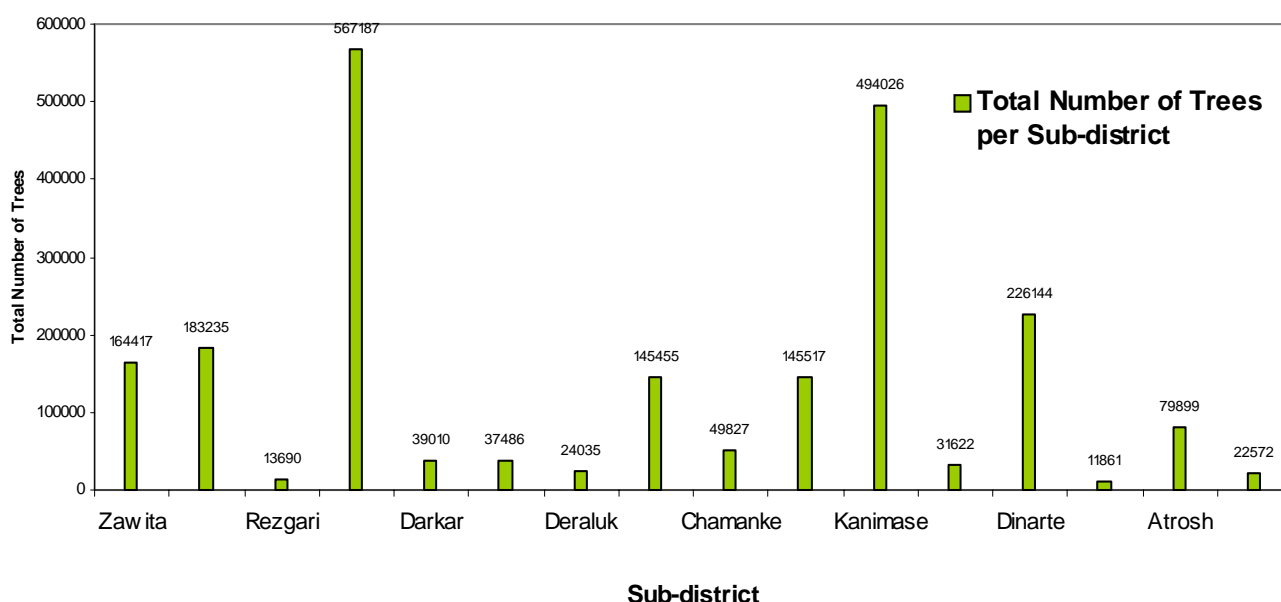
Variety	Total No. of Trees		
	Irrigated	Rain-fed	Total
on semi dwarf rootstocks			
Others	350	0	350
	2,211,712	24,271	2,235,983

See Annex 4 for more details

The surveyed orchards include about 2,235,983 apple trees of different varieties. Out of this figure, 99% are irrigated while only 1% are rain-fed. The largest percentage of apple trees is found in Batifa, which represents 25% of the total existing trees. Kanimase has the second largest share with 22%, followed by Dinarte (10%), Dosky (8%), Zawita (7%), Bamerne (6%) and Sarsenk (6%). (see Annex 4).

Diagram 3

Density of Apple Trees in Targeted Areas - Sub-district Wise



Apple producers in the region grow both summer and fall ripening varieties. Summer varieties ripen in July-August and include Callvile and Khanek. Fall varieties usually ripen in October. They include Starking, Spartan, Golden Delicious, Red Delicious, Winter Banana, Barwary Bala, American and Anna.

Most of the apple plants are propagated by seedlings or grafted/budded plantlets. All these varieties are mostly irrigated with a few trees as rain-fed such as Khanke variety. Irrigated varieties such as Starking and Golden Delicious are grown easily in some secured rain-fed areas such as Banke village in Bamerne Sub-district. This is mainly due to favorable weather conditions – adequate rain and snow fall, and high humidity.

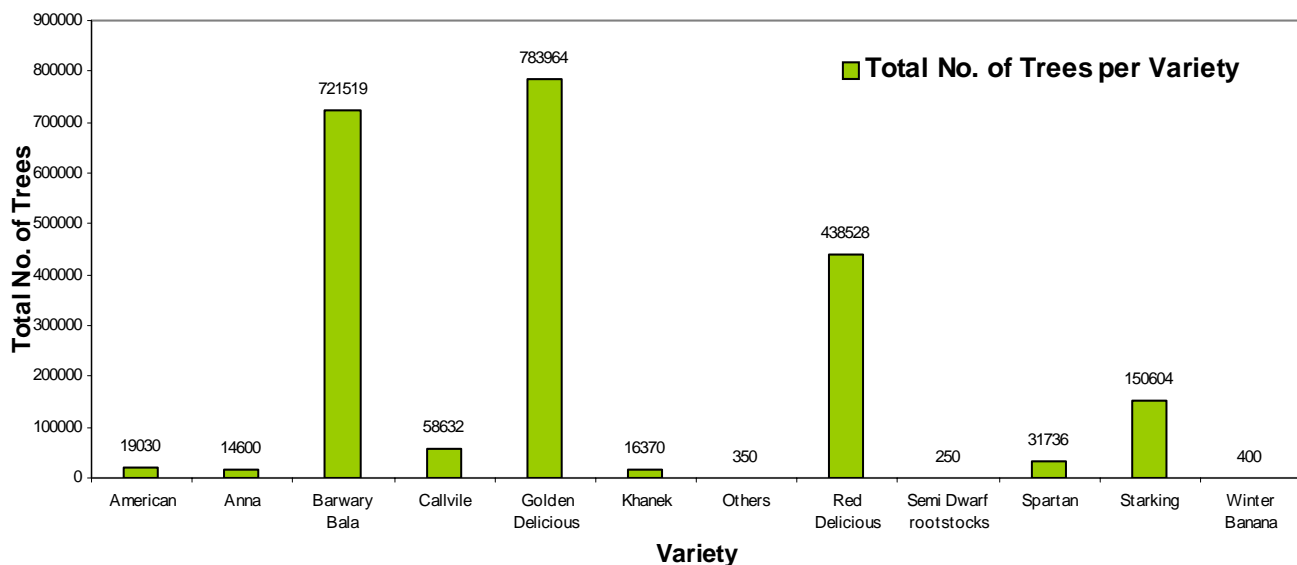
American varieties are available only in Kanimase and Batifa, Winter Banana in Dinarte and Chamanke, Khanek in Bamerne and Sarsenk, and semi-dwarf in Bamerne. Anna is highly available in Dosky and Rezgari; Barwary Bala in Kanimase and Batifa; Callvile in

Dinarte and Qasrok; Golden Delicious in Batifa, Dinarte and Kanimase; Red Delicious in Dosky and Zawita; Spartan in Bamerne and Sarsenk ; and Starking in Kanimase and Batifa. (See enclosed *Diagrams 4 a-k*).

Semi-dwarf MM106 rootstocks with varieties like Star Krimson, V1 and V2 are available only in one village – Enishke in Bamerne sub-district. They were introduced by the government in the past. Some unknown varieties were available but in a very small-scale – i.e. in a few orchards, but they could not be identified by the teams.

Khanke is a rain-fed variety that has existed in Barwary Bala area since 1960. It was first planted in Khanke town, in Semel District – a flat area without many apple orchards, and it was named after this area. Therefore, it is called *Seva Khanke*, which means *Khanke* apple. This variety is resistant to diseases, and it starts production after three years. Average production per tree is estimated at 150 kg, and the fruit is moderate in size.

Diagram 4
Density of Apple Trees in Targeted Areas - Variety Wise



The fruit color of most of these varieties is red , although some are yellow, yellow to red, and red to white. Barwary Bala is the best variety in the region. It has long shelf life under normal conditions, and a firm flesh with excellent eating qualities and is resistant to handling and transport. The fruit is aromatic. The American variety has the best productivity with an average of 59 kg per tree. Red Delicious variety is grown better than other existing varieties. Barwary Bala variety comes at first grade in quality, and followed by Starking and Golden Delicious.

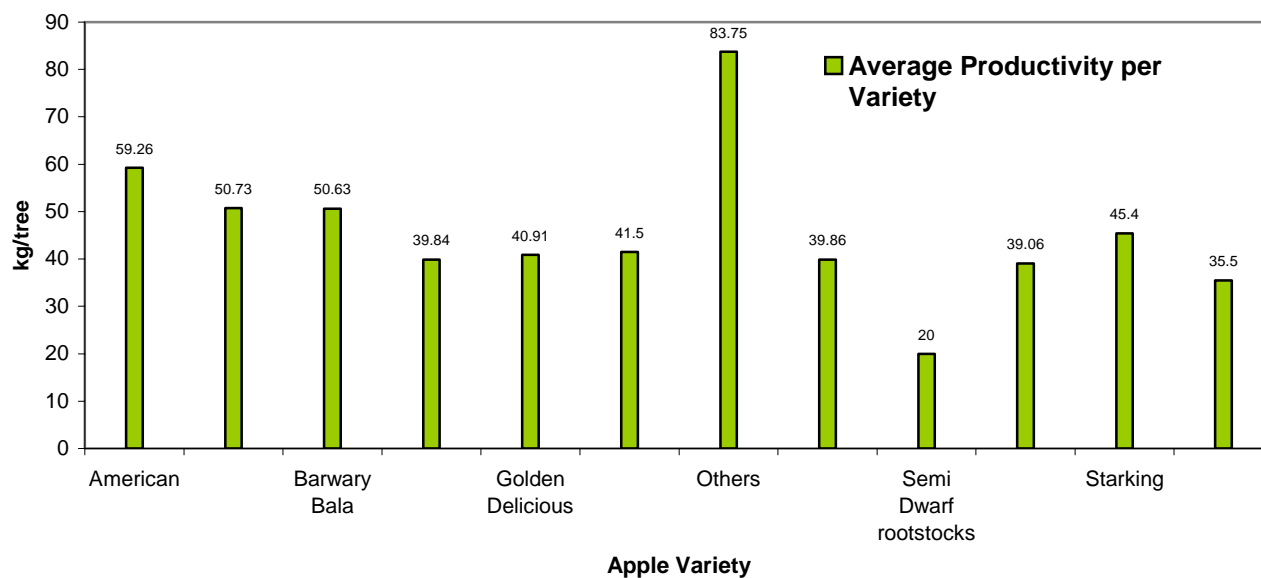
Table No. 4: Average Apple Productivity Variety Wise

Variety	Kg/Tree
American	59
Anna	51
Barwary Bala	51
Callvile	40
Golden Delicious	41
Khanek	42
Red Delicious	40
Star Krimson, V1 & V2 on semi dwarf rootstocks	20
Spartan	39
Starking	45
Winter Banana	36
Others	84

See Annex 4 for more details.

Diagram 5

Average Productivity of Apple Varieties



VI. Problems with Production as Expressed by the Farmers

The major problems stated by the farmers which impede apple production in the region are shown, in order of percentage of orchards affected, in Table 5 below.

Table No. 5: Major Problems in Apple Production

Order No.	Major Apple Problem	%* of Total Orchards
1	Poor post-harvest technology	58
2	Inefficient irrigation canal	52
3	Lack of pesticides	45
4	Lack of fertilizers	38
5	Lack of machinery	29
6	Bad access road to orchard	26
7	Lack of farm tools	25
8	Lack of water sources	24
9	Bad access road to village	14
10	Existence of pests/diseases	14
11	Dryness of water sources	5
12	Lack of transportation means	3
13	Lack of good rootstocks	2
14	Unfenced orchard	2
15	Lack of farmer knowledge in apple	2
16	Existence of rodents	1
17	Poor financial resources of farmers	1
18	Limited manpower capability of farmer	0.2
19	Frequent break out of fires	0.1
20	Environment (frost, hail, etc)	0.1

See Annex 5 for the degree of the problems in each area.

* % of orchard having such problem.

These problems are detailed as follows:

Lack of Farmers' Orchard Education and Awareness

Lack of adequate knowledge and skills of orchard cultivation techniques was observed among many farmers especially in remote areas with no access to the government agricultural extension and awareness services that are usually broadcast to the area via local media. Some farmers were found to be totally ignorant of proper horticultural practices associated with apple growing. Many farmers are not educated and not aware of all apple growing problems, and they do not know details of the problems that are related to production and quality.

For example, no farmer indicated that he ever used an input to prevent fall of tree flowers or to improve fruit quality, or foliar fertilizers. The farmers are not aware of the causes behind fall of tree flowers and fruits. Some farmers prune shortly before blossoming or foliation, which hampers production. Some farmers indicated that they prefer pruning before leaves begin to fall, and the majority of the farmers focused on orchard cleaning from dead or dried branches. However, pruning before blossoming or

foliation stimulates sapping and makes the cut parts vulnerable to a variety of diseases especially Black Rot or Black Stem.

Most farmers seek (at cost) the assistance of other farmers or individuals for pruning their apple orchards with the use of scissors for small trees/branches and saws for large or old trees/branches. Mostly, these individuals are not specialized or experienced in this field.

The government pays inadequate attention is to the capacity building of the government horticultural extension staff who can play a major role in farmers' extension and awareness. There is a shortage of technical staff who are specialized and mobilized in apple growing. Available staff are mostly restricted to office work, and their interaction with the farmers in the field (practical work) is limited. The agricultural instructors (guides) do not play an important role especially in the establishment of new orchards and improvement of horticulture. Farmers do not seek their consultation or technical advice in such matters.

The government also pays inadequate attention to the research centers or institutions that are specialized in the development of strategic crops including apples. There are no institutions specialized in the study or research in apple production. As a result, these entities lag behind counterparts in other countries in this field.

Poor Orchards Establishment Techniques

A high proportion of orchards have not been established according to proper technical and scientific methods, and they lack minimum requirements for a standard orchard. No consideration is given to the use of technical consultation or advice of specialists, study of the orchard soil, selection of the orchard location with respect to transportation means and its subject to winds that cause fall of fruits and tree branches, availability of wind breaks such as forest trees of pine and cypress around the orchards to protect apple trees from winds, etc. The high density planting obstructs performance of orchard services and decreases production.

Improper selection of appropriate varieties that are appropriate to the region's climate and environment, and more resistant to diseases is a fundamental problem. Some farmers obtain grafted/budded plantlets from unreliable sources – mainly private nurseries – and without having adequate knowledge of good varieties. Selection of plantlets needs to be made under the supervision of experienced specialists. The shortage of improved apple rootstocks and plantlets obliges the farmers especially with limited capability either to plant local unimproved varieties or procure improved varieties at high prices.

There is also a general absence of proper classification and care of new plantlets at the private nurseries. In addition, the workers at these nurseries are not knowledgeable about many plantlet varieties that they sell.

The presence of pollinator trees in apple orchards is not common, and is a matter of which almost all the farmers are not aware. While Golden Delicious is the best pollinator tree available in the region, many orchards do not have this variety. Therefore, bees and wind play a major role in the pollination of trees by carrying pollens from Golden

Delicious trees that are available in other orchards in the same area. Orchards that do not have pollinator trees have fruiting of low quantity and quality. Technically, each 3-4 lines of apple trees require another line of pollinator trees, a fact of which most farmers are not aware.

Table No. 6: Types of Pollinators Used in Apple Orchards

	Use of Pollinators		Types of Used Pollinators		
	Trees	Others	Bees	Wind	Others
	<i>In % of Total No. of Orchards</i>				
Total	37	63	40	57	3

See Annex 6 for more details.

Inter-cropping of apple with other fruit species (especially peach) in a single orchard can also be an obstacle to fruit production. Surveyors observed in some areas that large lands are planted to apple and peach trees, and since peach trees are of short life, they are cut before apple trees reach production age. Thus, single apple trees are left in the orchards. In some other areas, peach trees are grown adjacent to apple orchards, and since they are more susceptible to pests, infection spreads to the nearby apple trees. Peach trees produce many irregularly shaped branches, if not bred properly, which in turn affects adjacent apple trees. Other existing fruit tree species compete with apple trees for nutrition, which also reduces apple growth.



An apple orchard including other tree species

Surveyors also observed that poplar trees are grown in areas close to apple orchards. Since they are susceptible to pests and are usually not controlled effectively, adjacent apple trees are quickly infected with such pests and diseases. Inter-cropping of apple trees with other trees is not a sound agricultural practice since each tree species has its own characteristics and requires certain types of cultivation.

Poor Maintenance/Servicing of the Existing Orchards

There is a general status of negligence in all agricultural services associated with apple orchards. Farmers do not regularly perform practices such as tree training, pruning, fruit thinning, irrigation, soil cultivation, fertilization and pest/disease control in their orchards. This is mainly due to low interest and discouragement of the farmers to maintain their orchards because of low income generated from apple production. It was observed that many of the existing orchards, especially those with old ages, are totally or partially neglected.



A neglected apple orchard

The survey output indicates that about half of existing apple trees are young in age (up to 15 years). About 13% of the orchards are old (exceeding 20 years). As it is not economical to rehabilitate many of these orchards, the farmers are reluctant to make any improvement in their orchards. Older orchards are more susceptible to infection with pests and diseases, which furthers discourages improvements to increase production, especially because such intervention requires resources that the farmers can not afford. This lack of resources also impedes the establishment of new orchards. Another fact is that old-aged trees or large trees require more servicing – pruning, thinning, pest control, etc.

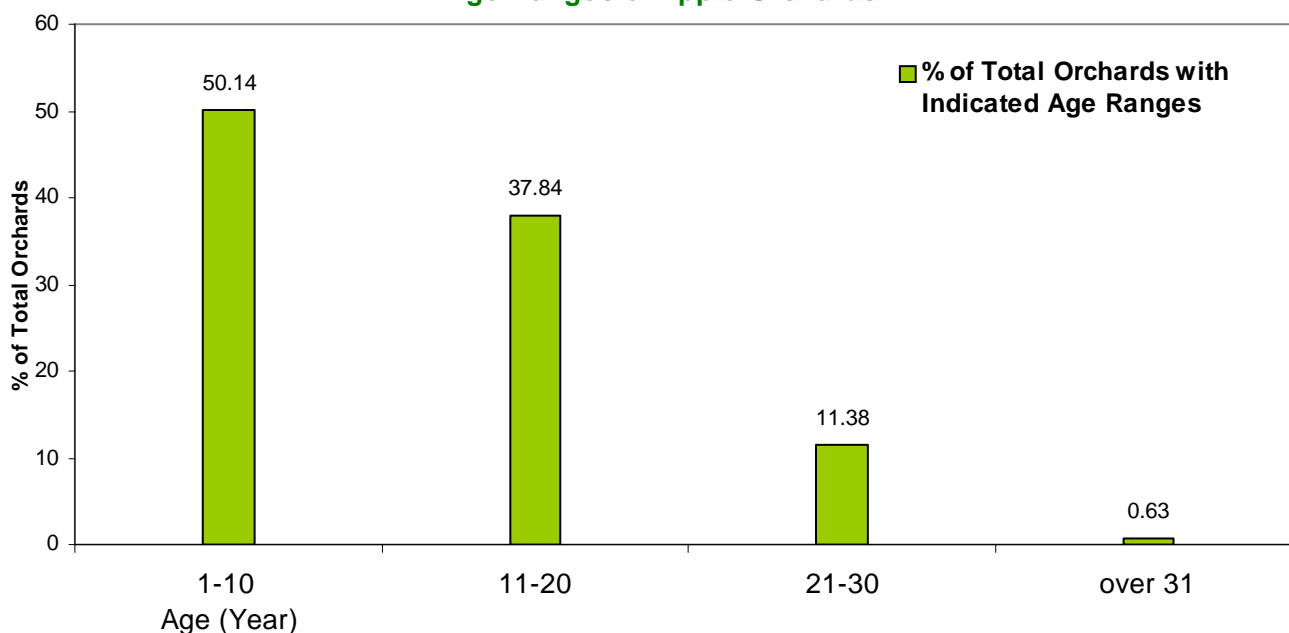
Table No. 7: Age Ranges of Apple Orchards

	Total No. of Orchards	% of Total No. within Following Age Ranges			
		1-10	11-20	21-30	Over 31
Total	16,289	50.14	37.84	11.38	0.63

See Annex 7 for more details.

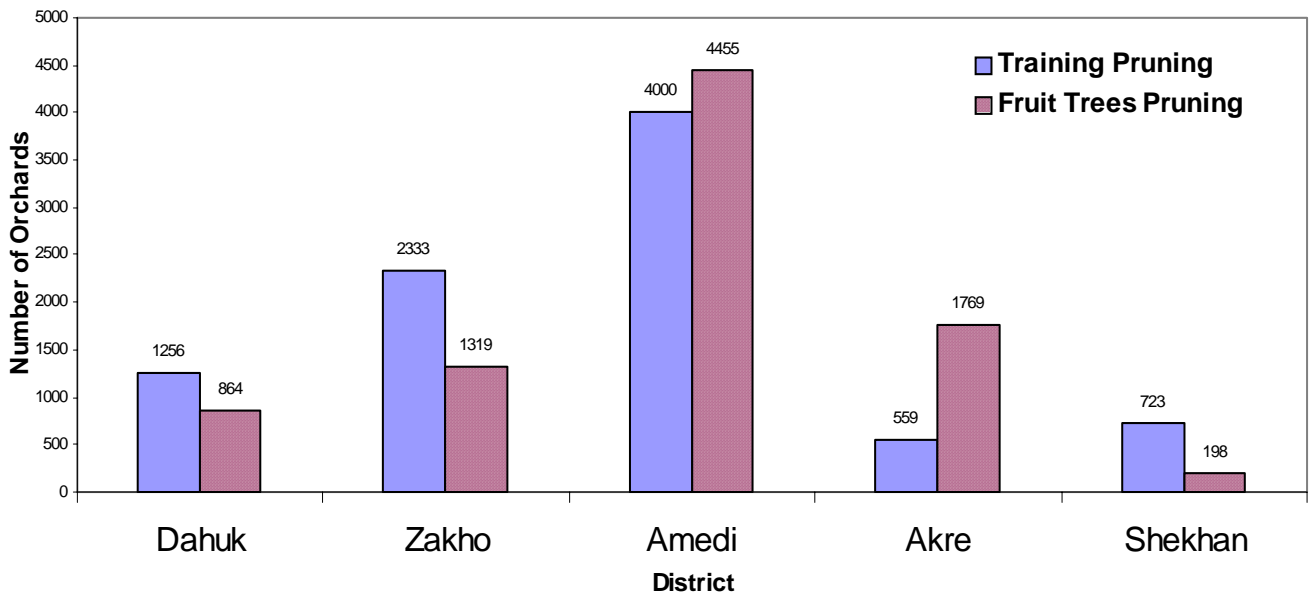
Diagram 6

Age Ranges of Apple Orchards



Training of apple trees is not done in a regular manner in many orchards. Tree pruning is done in 54% of total orchards, and fruit trees pruning in 53% of orchards. See Annex 6 for more details.

Diagram 7
Pruning Types in Apple Orchards



The shape of majority of apple trees is cuppy. This is followed by pivotal (central leader) and pyramidal. Pivotal shaping is the most preferable method of tree training because it acts as a support for the tree and prevents fractures due to heavy branch weight or effects of environmental factors such as snow. In contrast, the pyramidal shape gives the tree too much height, and the cuppy shape causes fracture of main branches.



An apple tree not trained in the proper manner

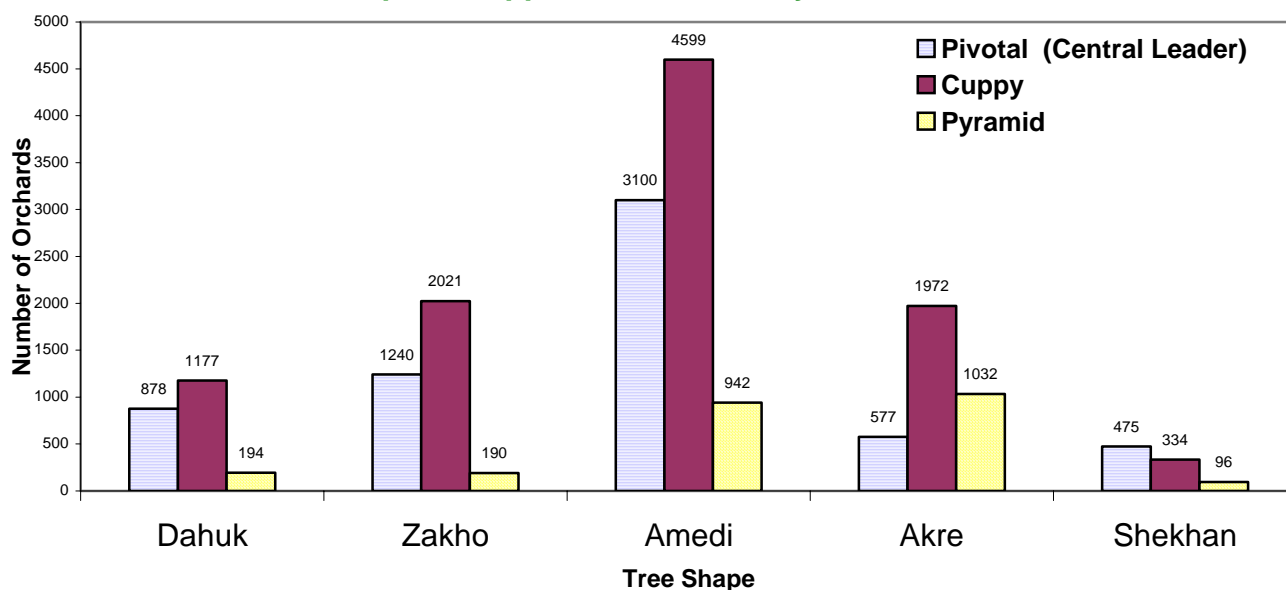
Table No. 8: Shape of Apple Trees in Surveyed Orchards

	Pivotal	Cuppy	Pyramid
In Total No. of Orchards			
Total	6,270	10,103	2,454

See Annex 8 for more details.

Diagram 8

Shapes of Apple Trees in Surveyed Orchards



Central Leader-Shaped Apple Tree



Cuppy - Shaped Apple Tree



Pyramid - Shaped Apple Tree

Many farmers make their own plantlets by grafting and budding, but not with proper technical methods. The same is true for pruning. This is because of lack of adequate extension and knowledge, and lack of access to appropriate tools. The majority of the

farmers do winter pruning after the leaves fall. Fruit thinning is not practiced widely. Thinning by agrochemicals (growth regulators) is not also practiced. Technically, 5% of total blossoms in a tree are enough to give enough fruiting, and each fruit needs 30 leaves.

Table No. 9: Tree Services Observed in Apple Orchards

	Tree Pruning	Tree Thinning	Thinning Method	
			Manually	By Agro-Chemical
<i>Used in % of Total No. of Apple Orchards</i>				
Total	82	36	42	0

See Annex 6 for more details.



A Farmer Pruning his Apple Orchard but Not in a Correct Way



An Apple Orchard Not Pruned in a Correct Way



Branches of an Apple Tree Dangled with Heavy Fruiting



There exists an imbalance between vegetative and fruit thinning in production year, which usually starts at 4-5 years of tree age. Inadequate use of fertilizers and environmental factors such as frost and hail cause alternate (biennial) bearing, i.e. trees give much more fruit in one year and much less or none in the second year. Many farmers believe that this is a natural phenomenon.

Too many fruit on trees intensifies the biannual production or alternation of fruiting. Many farmers do not perform fruit thinning, and some simply use supports or trellising – usually wooden stakes (branches cut out of trees in same orchards) – for the branches with heavy fruiting to prevent fall of fruits or branches. However, these supports do not

afford heavy weight of fruits, and do not stand against heavy winds, which usually cause the fall of fruits and fracture of branches. In addition, these stakes or branches are sometimes infected with pests, which in turn affect the apple trees. Furthermore, heavily loaded tree branches, when dangled due to the weight, expose inner parts of the tree to extreme sunlight during summer, which causes the tree or fruit to become infected with pests such as Fire Blight.

Lack of access to improved machinery has also had a great impact on apple production. Mechanization is seldom used in the agricultural practices associated with apple growing, which results in poor land preparation and orchard maintenance, especially with regards to pest and disease control. For example, plowing or cultivation of the areas around tree stems especially to improve soil aeration. Technically, orchards need be plowed at a depth of 15-20 cm by tractors with three disc plows every three to four years. Surface plowing – cultivation with the use of rotivators can be done each year at a depth of ten cm.



Cleaning of orchard land from fallen leaves is not widely practiced. The fallen leaves in most orchards are not removed and kept intact. A few farmers, especially those who have adequate manpower, either burn the leaves or manually remove them with the use of hand tools on the belief that this procedure will prevent infection of trees with pests. In fact, existence of leaves in the orchard is a source of many pests. Some farmers indicated that cleaning their orchards from leaves improves production, prolongs trees age, improve vegetative growth and leaves color, and reduces infection with pests caused by insects and rodents, compared to the neighboring orchards that are not cleaned. Surface plowing of the orchard area at depth of 5-10 cm is a better method for cleaning the orchard area and overturning the leaves into soil, which can then be naturally converted into organic fertilizer.



Apple Orchards not Cleaned from Leaves

There is much inadequate or inefficient fertilization. Fertilizers are used in many orchards, depending on farmers' financial capabilities. Most common fertilizers used are Urea, Compound NPK and Compound NP. Animal manure is also widely used. Foliar fertilizer is seldom used in apple orchards.

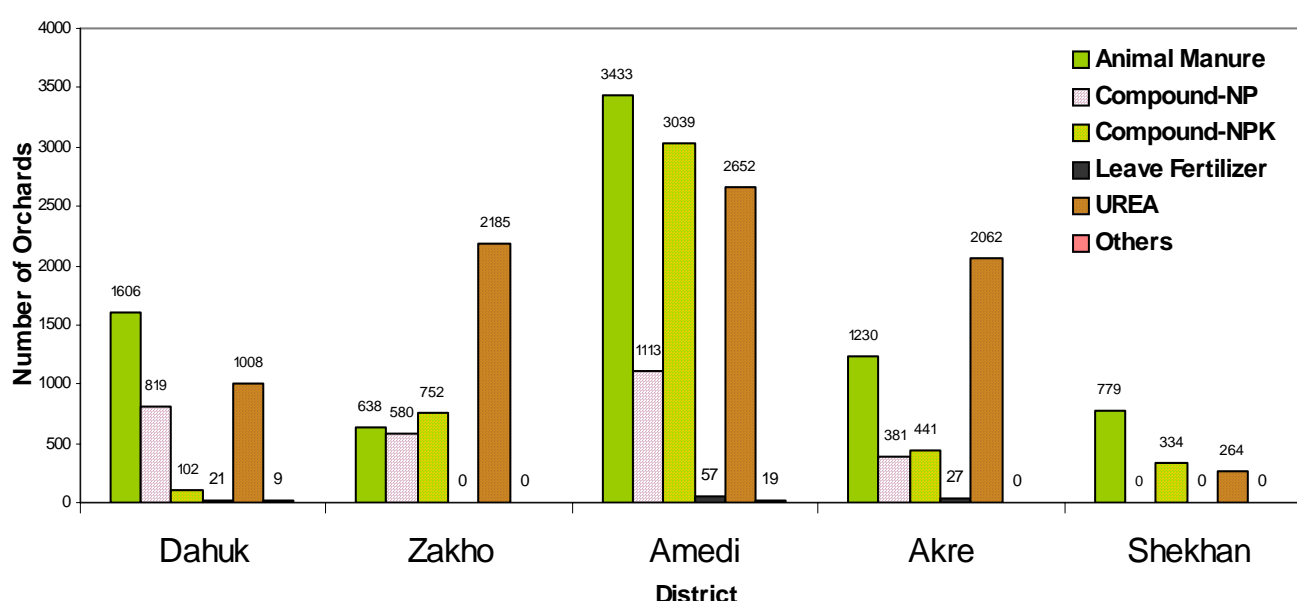
Table No. 10: Types of Fertilizers and Methods of Fertilization Used in Apple Orchards

Fertilizers are used	Following Types of Fertilizers are used				
	Animal Manure	Compound-NP	Compound-NPK	Leave	UREA
In % of Total No. of Orchards					
Total	94	47	18	29	50

See Annex 9 for more details.

Diagram 9

Types of Fertilizers Used in Apple Orchards



However, application of fertilizers is generally done improperly. No specific fertilizer is used for a particular tree variety. For example, farmers use the same fertilizer for wheat and for apple, and most farmers are not aware of the quantities and qualities of fertilizers required for each tree variety and age, or proper application periods and methods. A considerable portion of the fertilizers that farmers use is wasted due to improper use. Thus, the farmers are in need of practical training and education in application of the fertilizers.

Many farmers are reluctant to use animal manure, although it is widely available, due to concerns that they might cause the spread of insects. The majority of farmers refuse to use animal manure in their apple orchards, and those who use it allege that it causes spread of pests. Many of these farmers were simply spraying the orchard land with the manure before it has been transformed into compost. This does cause infection with pests and promotes growth of weeds since the manure contains microbes, insects as well as weed seeds. It is more proper to bury manure around tree stems to increase soil fertility, structure and warmth especially in winter season, and keep water for a longer duration in summer season. However, few farmers follow this method. Animal manure, once taken out of stables, should be stockpiled and covered to allow for a quick

decomposition that usually happens under warm conditions – in spring and summer seasons.

Apple Pests and Diseases

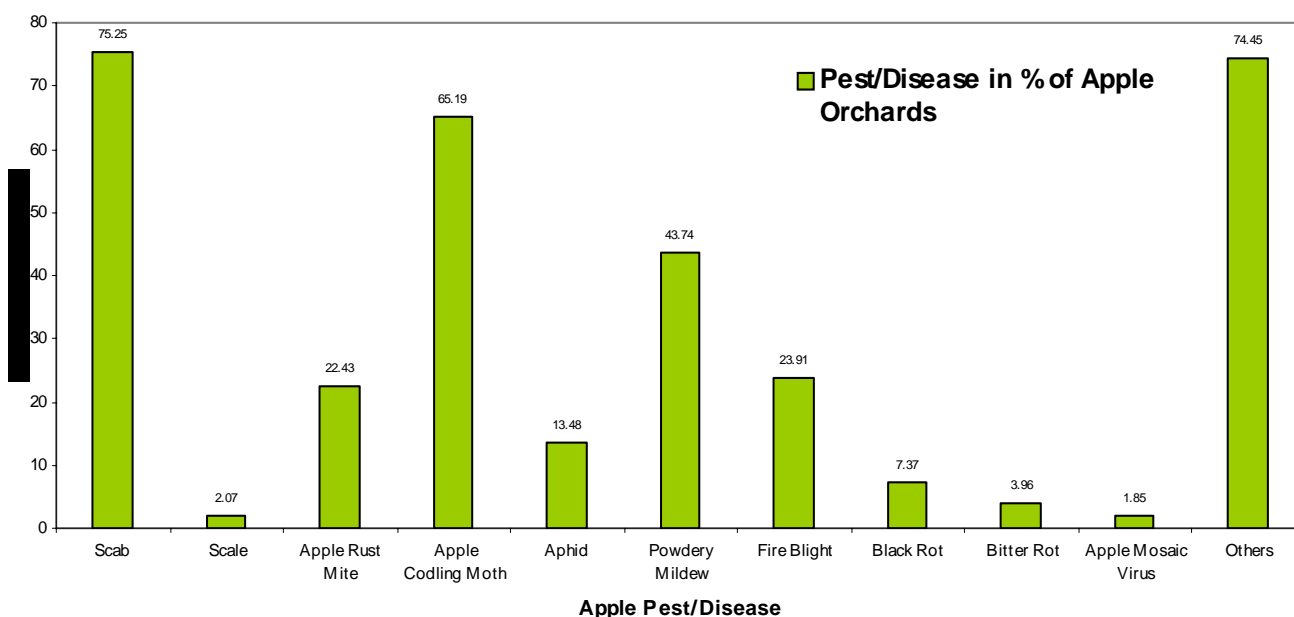
There is a high incidence or build-up of pests and diseases on apple trees and fruits. Common pests that infect apple trees in the region are as shown in Table 11 below.

Table No. 11: Common Existing Pests and Diseases in the Apple Orchards

Pest/Disease	In % of Total Apple Orchards
Scab	75
Scale	2
Apple Rust Mite	22
Apple Codling Moth	65
Aphid	13
Powdery Mildew	44
Fire Blight	24
Black Rot	7
Bitter Root	4
Apple Mosaic Virus	2
Other	74

See Annex 10 for more details.

Diagram 10
Common Existing Pests & Diseases in the Apple Orchards



**Common Apple Pests/Diseases
in the Region**



Apple Scab



Apple Codling Moth



Powdery Mildew on Apple Stem



Fire Blight

High incidence of weeds in many apple orchards weakens apple growth, since the weeds compete for absorption of nutrients from soil, decrease soil fertility and assist in the spread of pests and diseases.

**Apple Orchards
with High Density of Weeds**



Many farmers, especially in Batifa and Chamanke area, reported high incidences of rodents, especially mice. The existence of rodents affects apple trees to a large extent as they damage tree roots, cause dryness, and create holes in the orchards and irrigation canals, thus causing high loss of water. Yet the farmers have not given due attention or importance to rodent control. A farmer reported that he controls rodents and insects in his apple orchard by saturating it with water during the cold winter, until it freezes and kills all the animals.

Use of pesticides is the only common pest control method in the region. Pesticides are used in 74% of the orchards for the control of apple pests, diseases and herbs/weeds. However, they are not used in such a way to cover all of area of the orchard. Integrated Pest Management (IPM) techniques are not used for pest control, mainly because the farmers are not aware of such methods. Only one farmer in Dinarte reported that he used this method in his apple orchard. Pesticides such as Diathin, Kaptan, Bordeaux, Marlo, Sevin and Diazinon are applied commonly, with the use of knapsacks and wheelbarrow sprayers (see *Annex 11*). However, most of the farmers do not take adequate safety procedures and precautions while applying pesticides.



A Farmer Spraying his Apple Orchard against Pests using Knapsack Sprayer



Farmers Mowing an Apple Orchard with the Use of Hand Scythes

Lack of efficient pesticides, misuse, and inappropriate and untimely application of pesticides is also a major problem affecting apple production. Inadequate or inefficient application of pesticides affects the production especially because some of the agrochemicals used by farmers cause the fruits to fall from trees before ripening, and decay or deform the ripened fruit shape, which impacts its market quality and makes it undesirable for the consumer. A number of problems with pesticide availability, including uncontrolled or uncensored sale of pesticides in the local markets, lack of affordable pesticides, sale of expired pesticides, sale of pesticides without giving proper instructions to the farmers, and lack of specialized technical staff to provide the farmers with proper instructions for pesticide use have all contributed to the spread of plant diseases and pests, causing high losses in production.

Absence of an effective control system for pests, including mass control of apple pests and diseases, is a major problem in apple production. As indicated above, pesticides are generally used alone, and not in conjunction with IPM techniques. Random spraying does not always effectively control pests, since the sprayed apple trees soon become infected from neighboring orchards that are not also sprayed within the same timeframe. This necessitates spraying of all apple orchards in same village at one time in order to completely remove pests. The failure of farmers to take this type of unified action is

mainly attributed to the financial incapability of the farmers, and their low interest or motives to spray their orchards, and lack of effective/affordable pesticides and spraying equipment.

Lack of Irrigation Water Sources and Systems

A shortage of irrigation water has been observed in many of the targeted villages. Constant shortage of water resources portends an imminent problem with dryness in many areas, a matter that will promote abandoning irrigated cultivation and the expansion of rain-fed cultivation, especially on lands that were irrigated in the past. Several years of the drought (1999-2002) that affected the region, and subsequent shortage of water resources, have caused many apple orchards to dry. It has also affected and weakened many orchards.

Water resources in some other orchards/villages are as follows, in order of prominence: springs, canals, rivers surface wells, and deep wells. However, water resources and irrigation facilities, especially springs, wells and basins in some villages, are deteriorated and require rehabilitation.

Table No. 12: Types of Water Sources of the Apple Orchards

Type of Water Source	Percentage of Total No. of Apple Orchards
Spring	51
Surface well	13
Deep well	3
Canal	25
River	25
Others	0.18
Total	

See Annex 12 for more details.



Khabor River – an Irrigation Source for Many Apple Orchards in Batifa, Rezgari & Dosky Sub-districts

Most of the existing canals (about 52%) are traditional dirt canals that are in a very deteriorated condition, with high water losses and leakage due to the existence of silt/sedimentation, cracks, holes, weeds and plants that obstruct flow of water, debris,

etc. This makes water conveyance less efficient and causes high losses of water due to leakage, existence of silt, weeds etc that obstruct flow of water and cause loss of water of about 50% in some areas. These canals should be lined with concrete to increase water conveyance efficiency and bring more area under irrigation. This is highly essential but it requires adequate study, planning and follow-up.



Traditional Irrigation Canals Used for Irrigation of Apple Orchards

The irrigation methods used in many areas are not economical also promote growth of weeds and build-up of pests. Surface irrigation is the most common irrigation method, used in almost all surveyed orchards (99%). Surface irrigation leads to the loss of large quantities of water and spread of fungus. Drip irrigation systems are rarely used in 0.04% of apple orchards. Only 7 orchards with drip system were found: 6 in Amedi district and one in Dahuk district.

In addition, the farmers usually release water to their apple orchards to get saturation for several hours, without opening outlets for drainage of this water. This causes a number of tree and fruit pests such as powdery mildew, aphid and scab. Saturation causes lack of oxygen (asphyxia) of the plant roots.

Drought and subsequent shortage of water supplies have also contributed to the increase in drilling of deep and shallow wells for agricultural and human consumption purposes. This has decreased the water level in rivers and streams, and consequently contributed to decrease in ground water level. Therefore, many of the shallow wells that were dug during the drought period have become less efficient or even dried up since, in many areas, these wells were dug with short distances between each and other, or in the course/on the bank of streams, rivers and other water resources.

Many farmers, especially in drought-stricken areas, reported that they pay high costs to supply water to their orchards and maintain their existing water sources each year. For example, the farmers are obliged to buy water through hired tankers or tractors for the irrigation of their orchards. However, not all of them can afford trucking water to their orchards. In addition, non-lined shallow wells require constant rehabilitation each year since they are subject to land sliding, cracking, sedimentation, growth of weeds, etc, which affect the efficiency and capacity of these sources. The same thing applies to canals, especially for the traditional irrigation canals.

Moreover, operational and maintenance costs of the irrigation pumps used for pumping water from the wells, rivers and other sources are increases, in accordance with the

increase of cost of other materials in the local market, such as fuel, oil, replacement of spare parts, frequent repairs, etc.

This, compounded by lack of water storage facilities (concrete basins for springs and karezes) and deteriorated irrigation canals and other water resources have limited the orchard areas and decreased apple quality. Much of the irrigation water is lost during non-use time, such as night, due to the lack of storage facilities or high existence of holes, cracks etc in the canals.

Lack of water causes apple fruit to fall before ripening, decreases it or shrinks it, makes it with less sap, more susceptible to pests such as fungi and insects, and less desirable to the consumer.

Poor Harvest and Post-Harvest Technology

Poor Harvesting Services

Primitive methods are used in apple fruit picking, and many farmers follow improper picking methods. Farmers pick or pull off the fruits strongly, in such a way that separates them from the bearers. This causes wounds in the fruit flesh with a high possibility of infection from such pests as rot. In addition, farmers do not use gloves while picking and pressing apples by hand, which affects the apples' skin and makes them brown in color and shortening shelf life. Some farmers are accustomed to shaking the trees (especially those with high branches) to cause the fruits fall on the ground or beat branches bearing fruits with wooden sticks so that they fall on the ground for easy collection. This contributes to deterioration in the apple quality. Once the fruit collides with an object or pressed or squeezed, it is bruised and subsequently infected with various pests, which makes it quickly perishable. All of these practices affect the fruit shape and consequently decreases its demand in the local markets and decreases its economical value.

In addition, beating trees also breaks fruiting ends (bud places), which causes the tree to give fewer fruits in the following year. Another phenomenon observed is that the farmers climb to tree branches to pick the fruits. Because of over-weighting, this causes fracture of some branches, which could imbalance or deform the tree structure and decrease its fruiting. This is due to lack of ladders, which are very useful in fruit picking especially from high trees. Only a small number of farmers possess ladders.

Improper or primitive methods are used in apple post-harvest handling (sorting, grading, packaging, marketing, storing). Farmers' inadequate knowledge and awareness of proper harvest techniques is a major cause behind the fall in market prices offered for their produce. Most of the farmers pack harvested fruits in plastic boxes without paying any due attention to their proper package requirements – for example, separating boxes with fruits through papers or cardboards. Most of the farmers do not sort and package fruits by grades. They pack all fruits – small sized, large-sized, sound, infected, nicely shaped or poorly shaped into one box. They put good shaped and large-sized fruits at the top layers of the box to attract attention of the customers, and believe that by doing so they will get high prices for their fruits. However, the wholesale market traders know well about these tricks and simply empty the contents of one box to see what is put at the bottom. When they find apple fruits of different grades in one box, they offer lower

prices than what they really deserve if they are graded properly. It would be better for the farmers to sort out and grade the fruits, and pack them in different boxes as per their grading. This will bring higher prices for them. Moreover, many farmers use grass and weeds that are mostly infected with pests to cover the fruit boxes when marketing so as to protect fruits from sunlight and dryness. This also leads to the infection of the fruits with pests.

Improper Apple Fruits Packaging Practice



Poor Post-Harvesting Services

There is a complete absence of fruit processing factories for canning, making juice and other products, etc as well as post-harvest technology facilities such as cleaning, disinfection, polishing and waxing.

There is a complete absence of cold storage facilities for agricultural products, especially apple fruits. As a result, a large percentage of apple fruits are damaged. Absence of improved storage facilities that could be used to keep the fruits for a long duration pushes the farmers to flush the markets with their apple produce immediately after fruit ripening, thus causing a sharp drop in prices, or to use primitive, improper and non-hygienic storage means.

Lack of fruit storage facilities: Some farmers keep apple fruits that ripen in the fall for some time, until there is a good marketing outlet. The fruits are sometimes stockpiled in piles, either covered with straw in rooms within their houses or covered with straw and/or polyethylene in open yards in the orchards. The storage duration of apple fruits depends on the varieties, and it extends up to two months. However, these primitive methods motivate growth of fungi due to humidity and infection with pests that can easily spread from an infected fruit to other sound fruits in same piles or places.

Primitive Storage Methods of Apple Fruits Followed by Many Farmers



The survey results indicate that the storage capability of most of the grown apple varieties is low, for many reasons. Therefore, these varieties could perish quickly within a short period, if not marketed quickly. This makes the farmers either market their produce at prices much lower than expected or abandon the fruit; that is, leave the fruits in the orchards to decay in the course of time or use it as fodder for animals. However, even the varieties with longer storage durability can not exist for a long period due to absence of cold storage facilities that could assist in keeping the fruits for a long duration until good marketing outlets or prices are offered.

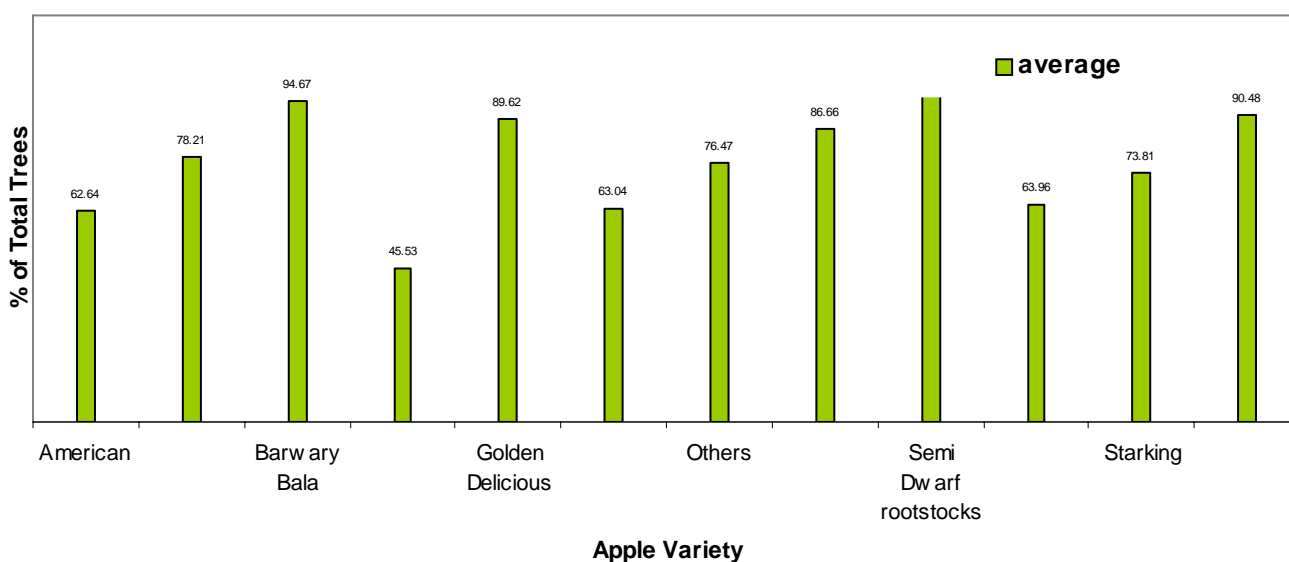
Table No. 13: Average Storage Capability of the Existing Apple Varieties

Variety	High	Medium	Low
	In % of Total Apple Orchards		
American	25	0	75
Anna	22	45	33
Barwary Bala	48	44	8
Callvile	4	14	82
Golden Delicious	30	55	16
Khanek	41	4	55
Others	0	53	47
Red Delicious	16	64	20
Star Krimson, V1 & V2 on semi dwarf rootstocks	100	0	0
Spartan	31	15	54
Starking	4	57	39
Winter Banana	86	0	14

See Annex 4 for more details.

Diagram 11

Storage Capability of Existing Apple Varieties





Apple Fruits Left in Orchard Ground

Poor Marketing Outlets

Absence of balance between production and income together with an absence of effective marketing policy geared at supporting the farmers is a major obstacle in apple production. This obstacle was reported for 53% of the surveyed orchards.

Import of apples from neighboring countries at lower prices, especially during the ripening season of local varieties, has greatly affected local production, especially with respect to the prices. Flushing local markets with such competitive foreign production that is of better quality and at lower prices has decreased the prices offered for local production, a matter which has discouraged the farmers and decreased interest in apple growing, since the income generated from sale of apple fruits does not even cover the transportation costs of the produce to the marketing centers. Therefore, many farmers have abandoned orchards and engaged in other professions to gain higher incomes.

The price of good quality of varieties such as Golden Delicious and Barwary Bala in the local market in last season was estimated at NID 10,000 – 22,000 (an equivalent to US\$ 7-15) per box of 22-25 kg, while that of lower quality at NID 1,000-3,000 (US\$ 0.66-2.00). Thus, low prices are offered for local apples mainly due to their low quality as compared to that of the imports.

It was noticed that about half of the farmers' produce is left in the orchards after the fruits fall from the trees. The farmers had no willingness to market them, due to meager or nil income generated from their sale. In other villages and orchards the farmers stockpiled apple fruits in orchard spaces or household rooms, awaiting favorable market prices that often do not materialize.



*Apple Produce
Left on the Ground in an Orchard*



*Apple Produce
Stockpiled in an Orchard*

The majority of the apple-producing villages are located in the mountainous areas that are far from the major fruits/vegetables wholesale markets. Most of the roads to these villages are rugged and difficult. Therefore, the transportation cost of one box of apple fruit from the producing villages such as Kanimase, which has the biggest apple area in the region, to the wholesale market in Dahuk was I.D 1000 (US\$ 1). This, compounded by farmers' lack of transportation means – vehicles, and high prices of fuel and vehicle repairs and spare parts replacement – have all led to the high increase in the marketing cost.

Absence of fruit and vegetables wholesale markets, particularly in the areas with large apple production, is another marketing obstacle. There is one large market in Dahuk city and a few smaller markets in other districts (Zakho, Akre). The farmers, especially those in remote villages, have to pay high costs for transportation of their agricultural produces to these markets.

There is an absolute lack of processing factories that could be used to absorb and process the local apples into different products throughout the year. There is also an absence of a reliable and fair market for receiving and marketing of the produce in a proper and technical manner, which contributes to the downgrade in the prices offered for local apples. The only beneficiaries from apple production are in this case are wholesale marketers and retail vendors/shop owners. The growers do not benefit a lot from this profession.

As a result of all these challenges to apple production, it was observed in many areas (especially Dinarte, which is well-known for apple production and has a high percentage of apple trees) that the farmers cut out apple trees to replant the orchards with other fruits, especially peach trees, as they have quicker yield and better market prices, since peaches are highly perishable and can not be easily imported from outside the country.



A Farmer Cutting Out Apple Trees in his Orchard Area



Apple Trees Cut Out in an Orchard



A Destroyed Apple Orchard

Others

Lack of access roads to villages and farmers' orchards is another obstacle in 20% of the surveyed orchards. Many apple orchards are inaccessible, with difficult/rugged roads, or they are situated far from main and sub-roads. This affects apple growing and marketing, and causes difficulty in transportation especially of machinery and most importantly the farmers' apple product to the local markets. This, compounded by long distances between apple growing orchards and marketing centers in Dahuk city and other towns have negatively impacted the production in an unprecedented way. In addition, dirt roads that pass nearby orchards and movements of vehicles especially in dry seasons create dust, which assists in the appearance of pests such as Rust Mite on apple trees.

Lack of financial and human resources is a major burden and an obstacle to production. As indicated earlier, many farmers who practice agriculture in general are over forty years old. Some of them live in the villages to practice agriculture according to their capabilities, and some others stay in the villages only during cropping season. They leave the villages in winter and fall seasons. The percentage of young individuals who are engaged in agriculture is decreasing, since most of them immigrate to urban areas and/or practice other professions. When the farmers intend to do something for the improvement of their production, they usually encounter a financial and manpower burden –resources that are needed to carry out improvements. The majority of the apple farmers are poor with low income, and depend mainly on farming as major source of income.

Table No. 14: Age Ranges of Apple Farmers in the Region

	Total No. of Farmers	% of Total Farmers with Following Age Ranges								
		Below 20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Total	6,391	4.04	13.22	22.23	22.31	21.92	10.69	4.99	0.50	0.09

See Annex 13 for more details.

Diagram 12
Age Ranges of Apple Farmers in the Region

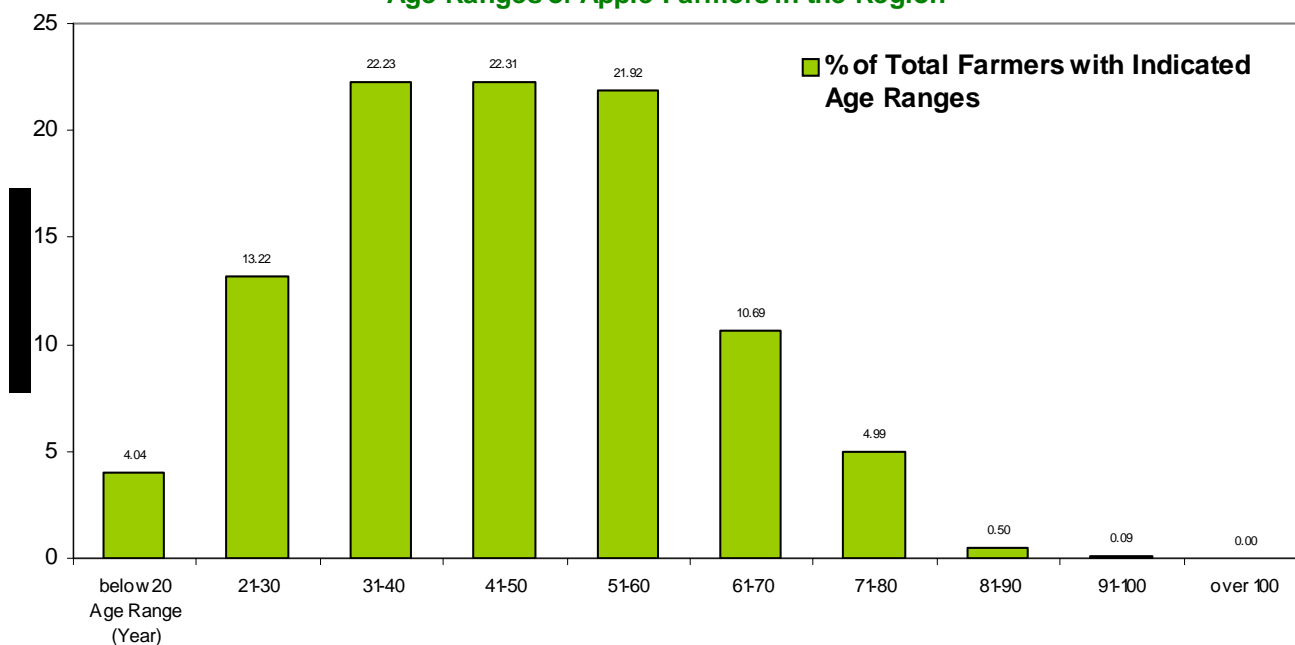


Table No. 15: Income Sources and Average Income of Apple Farmers in the Region

	Total No. of Farmers	% of Total Farmers with:												
		Present Source of Income						Average Income (US\$)						
		Farming	Gov. Employees	Private	Retired	Animal Production	Others	below 100	100-200	200-300	300-400	400-500	500-666	Over 666
Total	6,391	78	27	2	0.23	5	31	37	3	1	4	2	15	37

See Annex 14 for more details.

The immigration of farmers to urban areas to seek better work opportunities has also contributed to an extent to the downgrade in production. Many farmers in the targeted areas do not inhabit in the villages where they grow apples, thus leading to complete negligence of their apple orchards. It was observed that mostly elder people or part of the family live in the villages and many of them stay there only during spring and summer season and they abandon the villages in winter.

Internal conflicts and insecurity in some areas like Chamanke and Kanimase had caused many people to abandon their villages and orchards and settle in urban areas. Because many villages have been uninhabited, many apple orchards have been neglected. It was observed that many orchards in these areas have been newly established – since last three years - following stabilization of the region. Although many villages are still not reconstructed or inhabited, some original villagers are attempting to rehabilitate their existing orchards in spring and summer seasons.

Absence of fencing was reported for 2% of the apple orchards. A lack of fencing enables animals to graze on apple fruits and plants/grafted/budded plantlets, and damage the fruits and small plants. In addition, most orchards in the region are fenced with hedges of thorny plants especially blackberries and of dried branches of trees, which is a major source of pests, since cut tree branches are easily infected. Moreover, hedges, mainly dry ones, are piled which creates an easy source of fires especially in summer.



An Apple Orchard with a Plant Hedge



An Apple Orchard with a Barbed Wire Fence



A Cow Grazing on an Unfenced Apple Orchard

VII. Current Methods of Apple Production

Apple production is largely concentrated in the mountainous areas of Dahuk-Ninewa Governorate because of favorable weather and ecological conditions. Barwary Bala (what is administratively called Kanimase sub-district) comes at number one terms of production of apple. This area is famous for the high production and good quality of apples. The people of this area depend on apple production as main source of income.

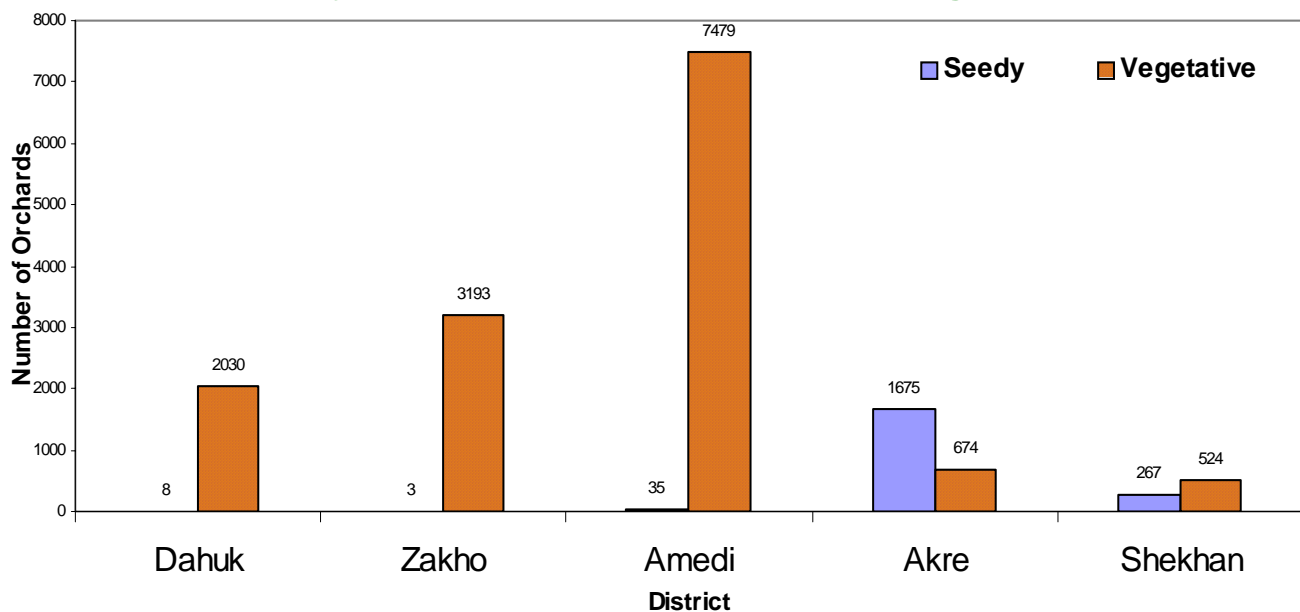
Apple growing is currently improved from past production. However, there is no remarkable comparison between the methods followed in apple growing in the past; currently many farmers follow the same traditional methods that were previously used. The following results were observed in the surveyed apple orchards:

Rootstocks

The source of most apple plants is grafted/budded plantlets and seedlings that are obtained locally from private nurseries and a few government nurseries. Types of apple rootstocks in many orchards are seedy in 13% of total apple orchards and vegetative in 87% orchards. Vegetative rootstocks are obtained mostly by cuttings and some by suckers (see Annex 8 for more details). The disadvantage of seedy rootstocks is that the trees rise to a height exceeding two meters. It is also known that wide differences exist among individual plants originated by seeds, and that these plants have very vigorous growth, which delays full bearing of the orchard.

Diagram 13

Types of Apple Tree Rootstocks in the Region



Cultivation Methods

The growing methods observed in the targeted areas is generally traditional and outdated with rare indicators on the improvement in all practices associated with apple production – land preparation, selection of varieties, types of planted varieties, growing methods, pest/diseases control, fruit picking, etc.

Many orchards were not designed in a proper technical way, without taking into consideration minimum requirements for a standard orchard. For example, many orchards lack windbreaks that could protect the trees from wind and other environmental factors.

No consideration is given by farmers to the importance of proper spacing between apple trees in individual orchards. Method of apple trees plantation is mostly regular; 78% of the orchards are regular while 22% are irregular. High density is observed in many orchards as the spacing between trees is 4*4 m and in some orchards is less than that, which is below the standard spacing (5*5m) for some varieties. However, spacing depends on the variety of the rootstock and applied machinery. Many orchards are planted with middle-high density (from 150 to 160 plants per donum). Adoption of standard spacing in newly established orchards has been improved due to the great role of farmers' agricultural extension especially in the past several years (see table below).

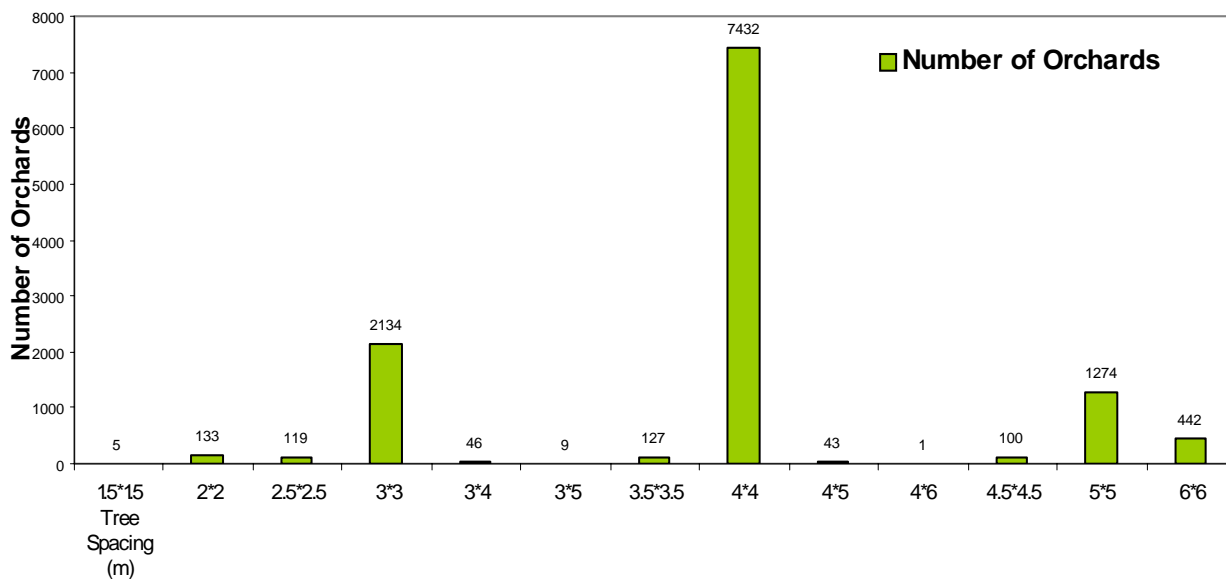
Table No. 16: Apple Trees Plantation Methods and Spacing

Plantation Method		Spacing between Trees (m)													
Regular	Irregular	1.5*1.5	2*2	2.5*2.5	3*3	3*4	3*5	3.5*3.5	4*4	4*5	4*6	4.5*4.5	5*5	6*6	
In % of Total No. of Orchards															
Total	78	22	0	1.1	1.0	18	0.4	0.1	1.1	63	0.4	0	0.8	11	3.7

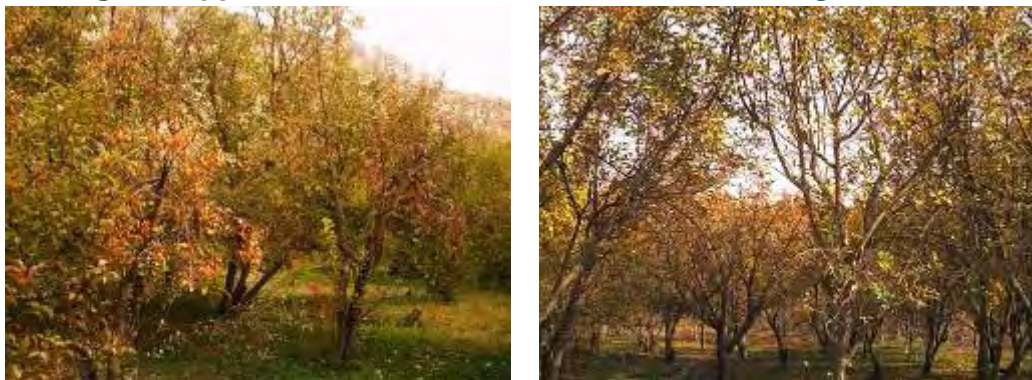
See Annex 15 for more details.

Diagram 14

Spacing between Apple Trees in Surveyed Orchards



Irregular Apple Orchards – Trees Not Planted in a Regular Method



Regular Apple Orchards – Trees Planted in a Regular Method





A High Density Apple Orchard



An Apple Orchard with Standard Spacing

Inter-cropping was observed in 77% of the total surveyed orchards. A total of 12,628 apple orchards include other fruit species, and the percentage of apple trees to other tree species is shown district wise in Table 17 below.

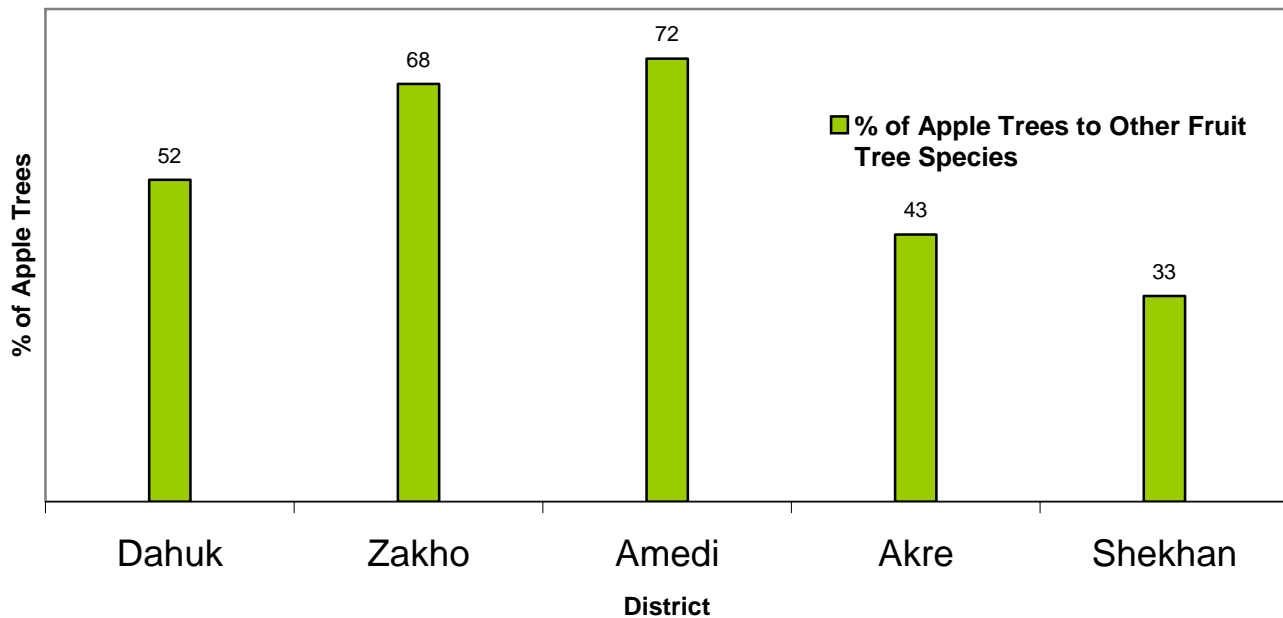
Table No. 17: Mixture of Apple Trees with Other Fruit Species

District	% of Total Orchards Including Other Fruit Species	% of Apple Trees to Other Fruit Species
Dahuk	10	52
Zakho	17	68
Amedi	35	72
Akre	11	43
Shekhan	5	33



Fruit Orchards with Mixture of Tree Species

Existence of Other Fruit Tree Species in Apple Orchards



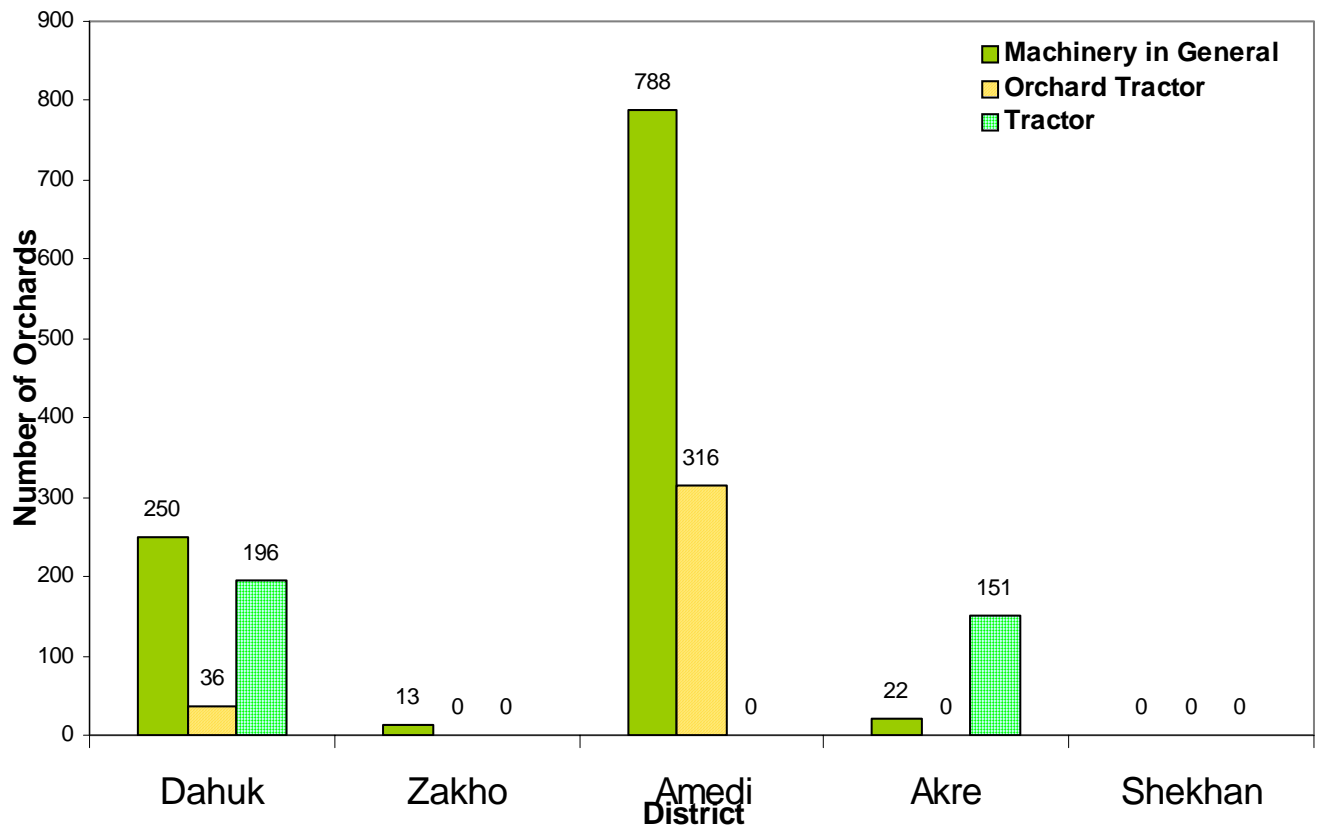
Orchard Services

Mechanized agricultural practices associated with apple growing are generally not mechanized. Lands in many orchards are plowed or cultivated by the farmers themselves or/and with the assistance of colleague villagers and relatives since this work requires huge efforts and human resources. This practice is common in some villages where it is made alternatively in all farmers' orchards. A few farmers hire laborers for plowing of their orchards, a matter which is costly and can not be afforded by many farmers. Plowing or cultivation of apple orchards is made every three years or more, depending on the farmers' financial and manpower resources.

Orchard mechanization depends on availability of machinery and farmers' financial capabilities. The farmers rarely use small tractors for plowing/cultivation of their orchards. Plantation of the grafted/budded plantlets is made after digging pits with the use of hand tools. Diggers are rarely used. However, agricultural machinery, particularly tractors, are used in 7% of the total apple orchards. Small orchard tractors are used in about 2% of the orchards. (See *Annex 9* for more details).

Other services like IPM control and post-harvest technology that are very important for apple production are non-existent.

Diagram 16
Application of Agricultural Machinery in Apple Orchards



Women

Women assist or share with men responsibility for many agricultural practices associated with apple growing, especially weed control and harvesting. 1.14% of the surveyed farmers are female (see *Annex 2*).



A Female Farmer Mowing Grass in Her Apple Orchard



A Female Farmer Pruning Apple Trees in Her Apple Orchard



Females Assisting in Apple Picking

VIII. Economic Importance of Apple Production in the Area

Nutritional Value

Apple fruit contains valuable nutritional elements and is an important source of vitamins and minerals that are very important for the human body. It is consumed as a fresh fruit or processed into jam, juice, vinegar, cider, alcohol, etc. Apple vinegar has various advantages for the human body especially in health and medical aspects. It contains a low percentage of water, which makes it less perishable, has more storage durability (for about 2-3 months under normal conditions and up to 8 months in cold storage). Another advantage of apple growing is that apple tree has a longer life than most of other fruit trees, reaching over 30 years.

Production Levels

Apple productivity depends on the rootstocks and varieties planted, orchard establishment and maintenance methods and services. All these elements affect the production levels in quantity and quality. Apple is a major fruit that is always in demand in the markets of Iraq. Its production had been an important income source for many farmers especially in Kanimase, Batifa and Dinarte areas. Due to its longer shelf life and high prices, apple had surpassed other fruits in importance. Apple production had reached its peak and flourished in the region especially in the 1980s due to the large income generated from this agricultural profession. The local produce reached its highest levels meeting almost all local demands. As a result, apple was exported even to center and south of Iraq.

Improvement of apple production will provide a good capital and work opportunities as it will engage people in production, transportation and marketing. In addition, it will promote adequate utilization of land and water resources.

Self-sufficiency in apple production can be achieved in Iraq if the production levels are improved, better varieties are introduced, the farmers are supported and encouraged to keep up production, and essential services including cold storages are made available. Surplus production can be achieved if all arable lands are cultivated to improved varieties, and this surplus can be processed into some other products such as jam and juice, depending on the market demand on fresh fruit.

Prices

Previously, despite relatively small production levels due to the use of traditional cultivation methods, the prices offered for apple fruits were high to an extent that the generated income covered production costs. This generated considerable income for the farmers. As a result, the living conditions of apple growers were good, and they were richest among all farmers in the region. This encouraged other farmers to start growing apple trees and introduced improved varieties such as Callvile, which are more adaptable to the region's climate. However, the income generated from the sales of local

apple has regressed due to low prices offered because of apple imports and unimproved local quality.

Competition by imports has lowered market prices of local produce to an extent that the sale price of one fruit box does not cover the cost of its transportation from the producing village to the fruit markets in Dahuk or major towns in the region. This question is always asked by the apple growers: "Why we should import apple from neighboring countries as long as we have plenty of local produce?"

Many apple growing villages are located in areas far from the marketing centers especially in Dahuk city and towns such as Akre and Zakho. Because of their inability to market their produce, or because it is uneconomical to market their produce, the farmers (especially those from remote areas) process some of their apple produce into jam, and use some others as fodder for animals. The income generated from sales of apple, especially in last season, did not cover the costs incurred in production especially pesticides and fuel for operation of generators.

Currently, local production is available in adequate quantities and it can meet demand, but it needs improvement in both quality and quantity to compete the foreign imported varieties. This can be achieved only by improving the growing methods and techniques, marketing outlets as well as post-harvest handling methods.

Marketing

At this moment there is no reliable market for apple although the demand on this produce is related to the income of the consumers. This means that if the incomes rise, the quality demanded from consumers increases proportionally, because the people have more money to spend. With this scenario, the apple production needs to improve to satisfy demand in terms of quantity and quality. Part of the apple fruit is imported from the neighbor countries during winter although the region has the potential to produce them.

IX. Problems or Obstacles Noted by the Surveyors

Village Inhabitation

Immigration of the farmers to the urban areas during hibernation season of apple growing was a major obstacle encountered by the survey teams. Many of the target villages were found uninhabited or partially inhabited, and the teams had to look for the original villagers in other locations, a matter which took a lot of effort, resources and time.

Survey Period

Survey timing was not appropriate and the survey could have yielded more adequate results if it had been conducted in summer or spring when the villagers are available in their localities. It was observed that in many villages especially in Zawita and Atrosh sub-districts, the villagers had left their homes in late fall and returned to the urban areas mainly to practice other kinds of works. They only stayed in the villages during spring and summer seasons. Therefore, the survey teams found many villages desolate, uninhabited or partially inhabited.

Farmers' Reaction with Survey Teams

A general lack of confidence by the farmers was noticed in many surveyed villages. Despite the fact that the farmers face many obstacles in apple growing (especially lack of inputs and low marketing prices, which have made them less interested in apple production), they nevertheless showed willingness to explain their problems and requirements in a very simple and transparent manner. Their only concern was the lack of confidence, which is attributed to the failure of many organizations/entities, in the past, in getting required support for them despite frequent visits and promises made to the village communities. This made the villagers to lose confidence in the work of organizations and also not believe in the survey work. They did not trust in the work of the teams as well as results of the survey, and some farmers especially in Dosky area refused to receive the teams. For this reason, the apple farmers in a few villages were not interested in the survey work to an extent that some did not cooperate with the teams and did not provide them with required information despite their possession of apple orchards.

However, the farmers' cooperation with the survey teams was positive in many other target areas. The villagers received the teams warmly, provided them with required information, and were eager to cooperate.

Others

Most farmers did not know the exact areas of their apple orchards. It was difficult and time-consuming to measure the orchard areas very accurately, especially because of the

lack of required surveying equipment. However, the experiences of the survey teams as well as of some farmers have assisted in overcoming this obstacle. The number of the apple orchards surveyed in most of the target villages exceeded the planned figures. Therefore, the survey teams spent more time to cover all villages' orchards. As a result, the team could not sometimes cover 2-3 villages a day or even one village a day. In addition, the number of filled forms also increased, which required increasing the number of working days for the data entries to computerize the survey output in the designed database.

X. Recommendations for Apple Production Improvement in Dahuk-Ninewa Governorate

Apple production needs particular attention because it is the most popular fruit specie in irrigated areas in northern Iraq. In this case, a short, medium and longer term integrated approach needs be taken to improve production in a sustained way. Improvement of apple production be carried out by introducing improved cultivation practices (pruning, fertilization, pest control, etc), spreading technical advice (learning-by-doing), and rehabilitation of the existing apple orchards. Establishment of new orchards can lead to the improvement of commercial production technology.

The recommended essential requirements of the farmers' apple orchards show the lack of apple production knowledge as the farmers are interested in getting input support but not in the technical services. These requirements were outlined by the farmers and the surveyors as well. They are as shown in Table 18 below.

Table No. 18: Essential Requirements Recommended for Improvement of Apple Production in the Region

Order	Recommended Requirement	for % of Total Orchards
1	Lining of water canal	66
2	Provision of pesticides	52
3	Improvement of marketing	48
4	Provision of fertilizers	41
5	Provision of farm tools	23
6	Provision of machinery	20
7	Establishment of apple processing factory	13
8	Improvement of access road to orchard	13
9	Drilling of deep well	12
10	Pests and diseases control	12
11	Construction of spring water basin	9
12	Improvement of access road to village	6
13	Provision of good rootstocks	4
14	Provision of orchard tractors	4
15	Rodent control	3
16	Fencing of orchards	2
17	Improvement of transportation means	2
18	Establishment of new orchard	2
19	Improvement of farmer knowledge in apple	1
20	Improvement of orchard	0.5
21	Provision of apple transportation means	0.1
22	Establishment of apple plantlets	0.1
23	Trellises of apple trees	0.1

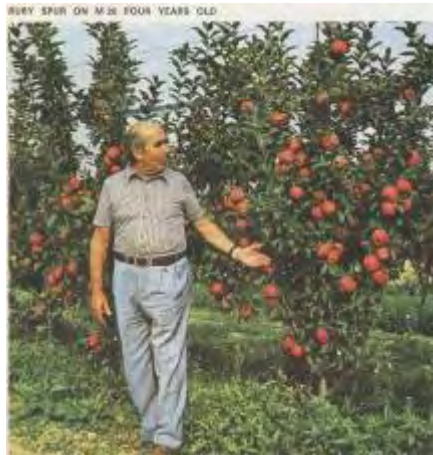
See Annex 16 for more details.

Principal recommendations for the improvement of apple production in the region are as follows:

Improvement of Local Apple Germplasm

Provision of improved apple grafted/budded plantlets with high productivity, more resistance to pests/diseases and more adaptability to the region's climate can contribute to the improvement of apple production in quantity and quality.

To achieve this, it is important to establish modern nurseries for production of improved apple rootstocks, especially M106 and grafted/budded plantlets. Foreign improved varieties such as Ruby Spur, Cooper 1, 4, 6 (4-7) and Starspur Golden Delicious grafted on rootstocks of dwarf and semi dwarf (EM, MM) that fruit in a shorter period (in 2-3 years of tree age), compared to plants of seedy rootstocks, which yield in 5-7 years, need to be introduced and propagated for further planting and reproduction. Such nurseries should be established with a proper technical and scientific basis, with the main objective of providing the farmers with reliable grafted/budded plantlets so as to contribute to the improvement of production and decrease in the cost of production.



*Dwarf Apple (EM 26) Rootstock
(Photo from Outside Country)*



*Semi-Dwarf (MM 106) Apple
(Photo from Outside Country)*

Rehabilitation and support of the private nurseries can lead to the improvement of the grafted/budded plantlets production. Use of this technical expertise can greatly contribute to the improvement of the work of these nurseries.

Experiments or field demonstrations/commercial orchards need be conducted on varieties such as dwarf or semi-dwarf. This will introduce and encourage the farmers to grow such improved plants, and will enhance their education and awareness of the benefits of using these varieties.

A study on the possibility of establishing rain-fed orchards needs to be carried out with the introduction of rain-fed and drought resistant rootstocks and varieties. Such varieties can be cultivated especially in the areas with (very) low apple density such as Semel district. They can increase the area under apple production and will certainly improve production and farmers' income.

It is important to carry out a comprehensive study on the identification and selection of all apple varieties that are available in the region. Such study can include the importance of diversification of each variety, identification of the varieties with high productivity and resistance to environmental conditions and pests/diseases. The output of the study will determine which variety will be more adaptable to the region's climate and more economical in view of existing production obstacles, and adequate study of the region weather and climatic conditions.

Improvement of Harvest and Post-Harvest Handling Techniques

It is necessary to improve farmers' education and awareness of proper picking and handling of apple fruits. Provision of inputs such as ladders could be of a great advantage since ladder is very essential in picking apple fruits.

Construction of integrated centers provided with necessary facilities and equipment for performing the chain of post harvest activities such as receiving, sorting out, grading, cleaning, polishing, packaging, storing and marketing can contribute to the increase in apple prices.

Establishment of cold storage for keeping farmers' produce of apple for longer periods is an essential requirement, especially in the areas with high production. These services could assist in the preservation of fruits and keep them for a period up to 7-8 months, since cold conditions will reduce biological activities of the fruits and prevent them reaching full ripeness. This will enable the farmers to market their produce when favorable prices are offered and not at lower prices. In addition, cold storages could preserve farmers' fruits from October to June, thus local produce will meet the domestic demand without depending on imports.

Establishment of an apple processing factory with multiple production lines (juice, jam, alcohol, vinegar, etc) can absorb much of the local produce especially those with low quality.

Improvement of Marketing Outlets

Improvement of apple production will be less effective if the marketing issue of the local produce is not handled. A study needs to be conducted on all the causes and factors behind this as well as recommended solutions. This study can cover issues such as marketing problems, self-sufficiency in local production, processing of varieties that are not desired or with low demand in the local markets, into products such as vinegar, juice, jam, etc.

Improving marketing outlets for local apple produce by linking the farmers with outside markets and exporting produce abroad after achieving a qualitative improvement in production. The government can adopt a policy similar to that was followed for wheat – procurement of farmers' produce in the past years. This will encourage the farmers to improve their apple production.

In such cases, provision of post-harvest facilities is necessary especially in the areas with high production so as to provide an outlet for farmers' produce, particularly for produce that is of lower quality and has lower market demand and prices.

A reliable and fair market for receiving and marketing of local apple produce in a more proper and technical manner will maintain the farmers' ability to gain favorable prices offered for their produce.

Attempts should be made to expand apple marketing to reach all the areas in the center and south of Iraq as well as Kuwait and Arabia.

Local Capacity Building

Local capacity building of the apple growers as well as agricultural staff is a prerequisite for any intervention in the improvement of apple production, as it is important to keep pace with the modern agricultural progress in the developed countries, application of improved agricultural methods and elimination of traditional methods.

Efforts should be made to enhance information and knowledge of the horticultural staff about the economy and modern technologies and methods followed world-wide in apple production, and other essential topics such as establishment of apple orchards, application of modern irrigation methods, and effective pest control. Such training programs will be more effective if they are conducted outside country since they will introduce the farmers to the practicality of these topics. These staff, once trained and mobilized, can play a great role in conveying what they acquired of modern knowledge and information to the region farmers practically in every practice associated with apple growing and production. Such mobilized staff can be deployed to the rural areas so as to train the farmers, provide them with adequate extension and awareness, and convey to them the up-to-date information and techniques that they learn.

Training and extension activities with farmers is an important tool in the improvement of apple production. Therefore, it is necessary to enhance farmers' education and awareness in apple horticulture and provide them with adequate extension and training requirements including field days, learning-by-doing approach, publications such as posters, leaflets and color materials (charts, pictures, etc), audio/visual materials like CDs and tapes, etc on all agricultural operations associated with apple growing and production.

Extensive training programs, including theoretical and practical activities involving improved growing methods and horticultural practices associated with apple production need to be conducted for the apple farmers. Such activities can be more effective if they are implemented within integrated projects aimed to improve apple production.

Implementation of field activities associated with practical orchard works for the improvement of existing orchards or establishment of new orchards is the most important activity to be undertaking to increase farmers' extension and training. This issue was highlighted by many farmers in the survey; these farmers showed considerable lack of horticultural skills and requested that they be trained in practical horticultural practices such as pruning and grafting under direct supervision and guidance of technical specialists.

Establishment of some small demonstration/commercial orchards, scattered among the most traditional apple producing zones is very useful; however it is only part of the solution to improve apple production because utilization of some technical practices (i.e. correct density planting, pruning, IPM application, fertilization, thinning, efficient irrigation, etc) need continued application and experience. Training for agricultural college graduates in production techniques is important because they can spread useful information directly to the farmers.



A Farmer Properly Fertilizing his Apple Trees



Farmers Packaging Apple Fruits

The role of the agricultural instructor should be strengthened, together with the reactivation of the agricultural extension services and dissemination of relevant publications.

Participation in regional and international agricultural exhibitions can give the farmers and the national staff the opportunity to display local products, meet counter-parts, exchange experiences, gain new information and knowledge, etc.

Establishment of New Apple Orchards

Establishment of new orchards following improved agricultural practices with the provision of technical package – inputs (superior plantlets, tools, irrigation systems, etc), and basic training and extension in orchard establishment and maintenance is necessary.

Establishment of new orchards in accordance with standard methods or improved techniques is an essential requirement for the improvement of production. Improved technologies such as use of modern irrigation methods (drip systems) need to be introduced in such orchards in order to increase the orchard production area. This intervention also depends on the reconstruction of the villages, and will encourage the farmers to return and resettle in their own villages.

A total of 2,753 apple farmers requested establishment of new apple orchards. They have adequate land and manpower resource to assist them in the orchard establishment and maintenance (see *Table 19* below).

Table No. 19: Number of Apple Farmers Interested in Establishment of New Orchards

District	No. of Farmers	Area (Donum)
Dahuk	243	563
Zakho	145	446
Amedi	967	6223
Akre	1005	2319
Shekhan	393	897
	2753	10448

Another 1,241 farmers with no existing apple orchards showed interest in the establishment of apple orchards. Most of them have adequate land and manpower resources to assist them in this regard.

Table No. 20: Number of Farmers Interested in Establishment of New Orchards

District	No. of Farmers	Area (Donum)
Dahuk	443	951
Zakho	61	581
Amedi	313	1511
Akre	78	176
Shekhan	346	919
	1241	4138

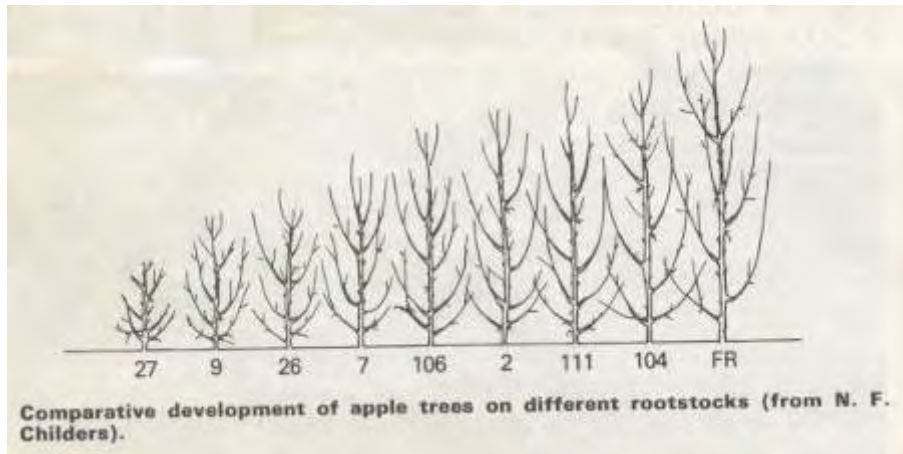
A separate database including all necessary information about these farmers is also attached. It also includes information such as farmers' possession of land and whether farmers live in the villages and availability of manpower to assist them in future agricultural practices associated with orchards establishment and maintenance.

Establishment of new orchards necessitates the following:

- **Proper selection of the orchard land** taking into consideration all necessary requirements – good soil, topography of land, humidity, etc. This can only be done with the assistance with technical specialists.
- **Use of apple plantlets of good qualities** and new varieties, as well as rootstocks of varieties like dwarf and semi dwarf: EM (East Malling) – 7, 9 and 27 and MM (Malling Merton) -106 and 111 for grafting with improved varieties and propagation purposes. New international varieties with high storage capability, color, taste, and flavor that

are desirable in the local and international markets and with qualities required for processing need also be imported, propagated and made available to the farmers.

EM and MM rootstocks have the following common characters: very or semi dwarf, (very) vigorous, plants grafted on them come very early in full bearing (give fruiting in third year), are resistant or not susceptible or with limited susceptibility to pests such as root asphyxia and woolly aphid, and some are resistant to drought.



Comparative Development of Apple Trees on Different Rootstocks
Dwarf & Semi-Dwarf Rootstocks (trees from 27 to 104) & Seedy Rootstock Plant (FR)

- Better land preparation through improvement of orchard mechanization by providing machinery required for establishment as well as improvement of apple orchards. This machinery includes shovels, excavators, tractors and orchard tractors with accessories, pest control equipment like sprayers, etc.
- Proper designing and inter-spacing between the rows and trees is necessary. Spacing between the orchard rows and plants should depend mainly on the tree variety.
- Wire training of trees with dwarf rootstocks (EM 7, 9, 27) should be introduced and expanded to contribute to increased productivity and acceleration of production. It is necessary to establish a factory for making concrete stakes (columns) that can also be used in fencing of the orchards. The aim is to provide the farmers with such input at subsidized prices. Growing apples on trellises yields much higher production, facilitates orchard services like plowing, pruning, pest control and picking. It does not cause fruit damage since the tree height will not exceed 150 cm. In addition, 416 dwarf plants can be grown in one donum with trellises while 100 plants of other varieties can be grown in one donum with ordinary training.



*Dwarf Rootstocks
(Photo from Outside Country)*



*Apple Dwarf Trellises
(Photo from Outside Country)*



*Starking on M 9 Three Years Old Granny Smith on M 9 Four Years Old
Apple Dwarf Trellises
(Photo from Outside Country)*

Since some of the surveyed apple orchards are old (over 20 years), it would be more economical and feasible to remove them especially if they are in poor condition, and establish new ones following improved or proper methods rather than rehabilitating them.

It is necessary to create a foundation for establishment of new orchards in a sound technical and modern way. Such entity should have adequate resources like capital, technical cadre, machinery and equipment that could be used for this purpose.

Rehabilitation of Existing Apple Orchards

The poor condition of the existing orchards necessitates urgent action of rehabilitation by the introduction of cultural practices, which until now have not been utilized in a suitable way. Management of the trees (pruning, soil maintenance, fertilization, pest control, etc) requires immediate action. Any intervention in the improvement of existing orchards should be based on an accurate classification of trees ages and conditions. It is not worth improving trees with more than 20 years especially if they are in poor condition, since they will shortly reach end age. Trees with less than 20 years should be improved.

Improvement of the horticultural practices of the farmers through provision of essential farm tools that the farmers cannot obtain on their own.

Establishment of small-scale apiaries beside apple orchards is important in apple orchards since bees play a vital role in the trees' pollination and could contribute to the improvement of production in view of absence of pollinator trees in many orchards. It is necessary to provide some farmers who have existing apple orchards with beekeeping requirements so as to encourage beekeeping and enhance production.

Fencing of the existing orchards can prevent grazing by animals, reduce apple pests, and prevent fire breakouts in orchards. However, this requires a feasibility study on the basis of which an intervention decision can to be made.

Enhancement of Orchard Irrigation Supply

It is important to enhance irrigation sources for the apple orchards in the region, especially in drought-stricken areas. Any approach in this regard should be based on an accurate study that takes into consideration all necessary requirements to secure efficiency and adequacy of such intervention. The following approaches can be taken to improve apple orchard irrigation supply:

- **Concrete lining of traditional irrigation canals** especially in the areas with high apple density. Although such works are rather expensive, the farmers' contribution should be involved especially in non-skilled labor works. This will reduce construction costs. Lining of canals will reduce water loss and leakage, enhance water conveyance efficiency, and bring more area under irrigation.
- **Provision of water storage facilities** – Concrete basins for irrigation of fruit orchards, especially apple, in 9% of surveyed villages. This will also contribute to the decrease in water losses and improvement of the water supply of the orchards, and will increase the area planted to apple trees.
- **Establishment of farms irrigation ponds** – Rainfall catchments in the villages that have suffered from lack of water for several years in the past. These ponds can provide adequate irrigation water especially in dry summer seasons, and are a more practical and technically sound option for exploitation of water in areas with a shortage of irrigation resources.
- **Drilling of deep and shallow wells** on the basis of an accurate study. Although this approach is not encouraged, especially in case of excessive and improper drilling activities and over-exploitation of groundwater, it can be used particularly if it is necessary.
- **Improvement of the orchard irrigation systems** can contribute remarkably to the improvement of production. Introduction of drip systems, especially in newly established orchards, can enhance irrigation efficiency, reduce water losses and supply costs, reduce weeds, reduce infection from pests, and allow for application of fertilizers mixed with water. In addition, the farmers can easily control irrigation with the use of drip system, which is of utmost advantage.

Improvement of Orchard Mechanization

Provision of small orchard tractors (35-45 hp) with accessories like plows, cultivators, rotivators and ditchers, and other machinery can assist in the improvement of existing orchards and establishment of new orchards by improving essential horticultural practices such as land preparation and cultivation. This will provide the farmers with access to use this input for cultivation of their orchards frequently, which will contribute to the improvement of the orchards and subsequently increase in production in quantity and quality.

Effective and Economical Control of Apple Pests/Diseases

- It is important to have a wide-scale approach in control of apple pests in the areas with high infection. Preventive spraying or control should be made after adequate study of major pests in every area together with the causes, periods and degree of appearance of every pest.
- Deployment of control teams, each comprised of two agricultural specialists, to approach and assist the farmers in the control operations is necessary, as it is not possible for each farmer to spray his own apple orchard without having adequate extension and awareness in control procedures.
- Leaving some apple orchards not sprayed in a village could cause the pests to re-infect the sprayed apple orchards. It is necessary to have an integrated or comprehensive plan for application of pesticides for the control of apple pests. Apple trees in all the areas should be sprayed at one time.
- Although many farmers supported intensive control of apple pests and diseases through the provision of agrochemicals, application of agrochemicals should be the last option. Other alternatives, especially IPM should be introduced on a large scale. Such interventions can be feasible and more applicable if they are integrated under future apple production related projects.

Establishment of Apple Cooperatives (Co-Op) and Associations

It is necessary to establish association(s) for apple growing, especially in the areas with high density of apple production. This action has already been initiated by the farmers but in a different and smaller-scale way. It was found in Narmky village in Batufa sub-district, Dahuk that the village apple farmers have been divided into groups. The first group includes 15 farmers having a total of 3,400 apple trees and the second group includes 30 farmers with 6,000 trees. Each of these groups performs all required horticultural practices and produces marketing in a collective manner.

An entity for marketing fruits or apple products should be established, similar to the one which existed in the past. It can be an establishment, agency or association, and it will be a valuable asset in better marketing of local apple. Such entity should have broad links to national, regional and international markets and should have adequate

capabilities and resources to undertake its tasks effectively and in a transparent manner. It should have necessary requirements such as capital, trucks for transportation of fruits, qualified marketing staff, etc.

Others

Long-term strategic research needs to be conducted officially to come out with results that could service apple growing, especially with regards to selection and improvement of the trees.

Specific surveys for the improvement of apple orchards need to be conducted periodically – for example every three years. Such surveys can cover issues like major apple pests that infect apple trees, irrigation and fertilization methods followed in apple orchards, etc. An assessment study on soil fertility is an important tool in the identification of proper types and quantities of fertilizers required for each specific area.

Introduction of an agricultural crediting system can assist many vulnerable and poor farmers to maintain apple production. Small loans need to be provided to the farmers to enable them to pay for essential requirements and services for their apple orchards. Such funding can be a motive to encourage to pay more attention to and improve their orchards and production.

Improvement of access roads to the villages and agricultural areas including apple orchards is also necessary so as to facilitate marketing of agricultural inputs.

Any future project for the improvement of apple production should take into consideration the following:

- Improvement of the farmers' horticultural practices, knowledge and skills in orchard establishment and management.
- Without improvement of apple production, people will stop apple production altogether. As noted earlier, many villages are either not reconstructed, uninhabited or partially inhabited. Many of the rural people will leave the villages if they are able to provide for renting residences in the cities and towns. It is expected that majority of the villagers will leave for urban areas after two years, if the current situation continues as it is.