

SECTORIAL REVIEW OF FRUIT CULTURE IN ERNP

BY

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**CONSULTANT (FRUIT TREE CULTURE)
ENVIRONMENTAL REHABILITATION IN NWFP
AND PUNJAB (ERNP)**

ISLAMABAD, PAKISTAN

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LIST OF ABBREVIATIONS

ADPB	Area Development Programme Balochistan
AEZ	Agro-Ecological Zone
ARI	Agricultural Research Institute
ARP	Agricultural Research Project
ARS	Agricultural Research Station
DFDC	Deciduous Fruit Development Centre
DKP	Dir Kohistan Project
EFS	Experimental Field Station
ERNP	Environmental Rehabilitation in NWFP and Punjab
FAO	Food and Agriculture Organization of the United Nations
FVDP	Fruit and Vegetable Development Board
IADP	Integrated Area Development Programme
IUCNP	The World Conservation Union, Pakistan
MAEZ	Micro-Agro-Ecological Zone
MKKS	Muree-Kahuta-Kotli-Sattian
NARC	National Agricultural Research Centre
NRCP	Natural Resource Conservation Project in Galiat
NGO	Non-Governmental Organizations
NRM	Natural Resource Management
NWFP	North West Frontier Province
PARC	Pakistan Agricultural Research Council
PFI	Pakistan Forest Institute
URDP	Upland Rehabilitation and Development Project

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FOREWORD

A consultancy on sector review of fruit production under Environmental Rehabilitation in NWFP and Punjab (ERNP) Project was fielded to look through and document existing knowledge and experiences in fruit culture in the mountainous areas of Pakistan, with specific reference to the three project areas; one in Murree-Kahuta-Kotli-Sattian (MKKS), second in Galiat (NRCP) and the third in Dir Kohistan (DKP) area. Although, climatically suitable, fruit production in the past has not been very successful in the project area because of no access and non-availability of the suitable planting material, haphazard plantation of the inferior stock with no or wrong training and pruning practices, no plant protection measures of the existing plantation and improper irrigation and nutrition of the orchards. The technical know-how about fruit production is obscure in the area. Usually land holdings are small and the growers need to get maximum benefit from the high value cash crops through introduction of high yielding and precocious cultivars with appropriate rootstocks and cultural practices.

The consultant visited the three project areas, held discussions with the staff and the growers who are the ultimate beneficiaries. Discussions were also held about the fruit production situation with professional of different institutions/organizations, highlighted in the itinerary, to whom the author is thankful for providing information and valuable suggestions.

Thanks are extended and enthusiasm acknowledged of the staff working in the three project areas with special reference to Mr. M.Iqbal Sial, Coordinator NRM, for taking care of the logistics during the consultancy.

EXECUTIVE SUMMARY

The theme of the ERNP Project is to promote conservation of natural resources, while improving the welfare and living standard of the people. It's fundamental approach hinges on full involvement of local population in the management of resources on which they depend. Agriculture, as one of the potential resources, is not only the occupation but also is a way of life in the rural communities of the project area. People observe an integrated farming system in which they are growing cereal crops, vegetable and fruits, rearing cattle, keeping poultry birds, and planting trees on farm land. Farming is practiced on small terraces that are cut out of the hill slopes.

Land holdings are small and becoming smaller due to traditional division among the family heirs. People are unable to meet their food requirements from their farms. Production of adequate amounts of food crops on small land holdings with ever declining farm productivity is impossible. Reports indicate that wherever cash crops farming has not been adopted, the importance of mountain agriculture, as a source of sustenance for people is rapidly sinking. The promotion of horticulture comprising high value cash crops, in the mountainous areas, in the past few decades, has brought a pleasant impact and the quality of life of these people has improved. This has not happened in the project areas because of lack of technical know-how and quality planting material.

Although some fruits are also rich in carbohydrates, proteins and fats etc, yet fruits are valued most for vitamins and minerals which have been considered indispensable for human health. Since fruits have been found to contain high amount of dietetic essential, the importance of producing enough fruits for feeding the masses as a protective food in the human diet, in rational manner, has now been fully realized. This is an established fact that fruits not only return much higher income to the growers but produce higher yields of nutritive food as compared to field crops.

The role of trees including fruits have beneficial effect on soil, soil nutrients, control erosion/conserves soil, add humus and favourably influence climate. In addition trees create aerodynamics roughness and assist in arresting dust particles.

Since deciduous fruit plant species have specific agroclimatic and soil requirements, thus nature have provided unique opportunities for mountain people to produce unprocessed, semi-processed and processed fresh and dry fruits as a native food as well as obtain fuel wood for cooking and heating in the severe cold weather where other options are not available, obscure or very expensive in the remote areas. This usual pruning practice to get higher yield and fuel wood as an extra, can control unlawful cuttings of forest trees and hence natural resource degradation.

For successful fruit production, good quality cultivars and rootstocks, proper layout, appropriate methods of training/pruning, adequate irrigation, proper nutrition, adoption of environment friendly plant protection practices, suitable post harvest techniques and marketing methods are necessary to get lucrative income per unit area.

Among apple cultivars Katja, Summer Red, Mondial Gala, Early Gold and Tydesman Early Worcester are the early ones which fetch a good price in the market. Katja is particularly a high income cultivar of Balochistan. MM111 rootstock is drought resistant and recommended for the project area particularly where there is a problem of irrigation water. Pajam 2 rootstock introduced by FAO/UNDP Fruit Development Project Balochistan is a dwarfing rootstock and is meant for high density orcharding. Spur type varieties like Dixi Red, Ultra Red, Ace Spur and Top Spur can be budded on the locally available crab apple rootstock for early cropping and to maintain/control the size of the tree. Among cherries, Early River, Local Black, Sun Burst, Stella, Noire de Meched etc. can be successfully grown in cold areas on Mazzard or Mahaleb. Colt rootstock, although dwarfing and easy to propagate, is susceptible to crown gall disease. Planting four or five cultivars together is recommended in order to overlap their flowering time for cross compatibility. Flordason, Early Grand and Florida King are the early varieties of peach. Manon, Red Heaven, Spring Crest, Sun Crest, Red Top, August Sun are some other promising cultivars. It is better to use common peach, GF 305 or GF677 as a rootstock for peaches. A problem of non-compatibility was observed in private peach orchards of Balochistan where apricot was used as a rootstock for peach by the private nurserymen.

Nectarine cultivars like May Belle, Nectared, Snow Queen, Red June, etc., budded on rootstocks

recommended for peaches can be planted in the orchards.

Apricot cultivars like Travett, Sardai, Narai, Swat Selection, Habi, Halman, Ali Shah Kakas, Shai, Shikanda, budded on Hari apricot rootstocks are recommended for plantation in the orchards. Northern Areas, Gilgit, is the home of apricots but care should be watched for crown gall disease.

Among plums, Fazal Manani (Santa Rosa), Stanley, Bluefre, President, etc., are recommended on plum, GF677 or GF8/1 rootstocks. Stanley, Bluefre and President are good for distant marketing.

Almond cultivars of overlapping blooming period should be planted to get a good crop. Cultivars like Non-Pareil, Neplusultra, Vesta, Jordonala, Patasa, Mung Phally, Farraster, Ferragnes, etc., are recommended on almond own rootstock. Grapes cultivars from hard wood cuttings of Early Cardinal, Kishmish, Italia, King Ruby, Regina, Ruby Seedless, Shandokhani, Haita, Sahibi, Flame Seedless, etc., are promising. Some of these varieties will be available at ARS Mingora, Swat and most of these can be obtained from EFS Pishin through DFDC Saria Balochistan.

Leconte, Keifer, Bartlett, Coscade, Parhawi, Khan Tangu, etc., of the pear cultivars on Batangi, Quince or OHF333 rootstocks are recommended for plantation.

Pecan cultivars like Mahan, Mohawk, Western, etc can be planted on border/marginal land.

Serr cultivars of walnut is comparatively precocious and not as tall as local varieties. Payne, Eureka, Midland and local selection are the other promising cultivars. Pecan and walnut can be included among the forest species for plantation in watershed areas. Seedless persimmon is the only commercial cultivar in NWFP. Plants of other cultivars including non-astringent are available in ARS Mingora, Swat. Turmanzai is a local selection in DKP area which need further propagation. Chalghoza, although slow growing, can be raised in the forest nurseries to be grown on the marginal land in DKP areas and the improved pomegranate should be introduced to MKKS area.

Strawberry is another small fruit which can be grown at home garden on small scale or intercropped in the orchards. Due to its early cropping and liking by foreigners, it will fetch a good price. Runners of different cultivars are available at ARS Mingora, Swat.

Among improved fig with big size fruit can be easily propagated from cuttings, the fruit of which can be sold fresh as well as dried.

In the warm temperate/subtropical areas of the project, Blood Red, Washington Navel, Valencia Late, Succari, Hamlin, Salustiana oranges can be planted in regular orchards but are to be protected from severe cold for few years. Recommended cultivars of grape fruit, lemon and litchi can also be grown in these areas. Litchi plants can be obtained from FVDB nurseries at Dargai and Haripur.

For nursery establishment on farmers land, rootstocks of apple, for example, should be provided free of cost but there should be an undertaking between the parties (the project and the grower) that on third year, the grower should return the same number of rootstock back to the project for giving it to another grower of the community group. This way stool beds of apple can be increased with many farmers. Progeny plants of promising cultivars, if from abroad, should be given to the growers on government fixed rates in Pakistan. If the planting material is local, it should be provided on 50% subsidized rates.

It is suggested that the planting material either inland or overseas should always be booked well in advance according to the requirements of the farming communities and/or research and development institutions.

The demonstration orchards plantation and the nursery established on growers land will need frequent visits for demonstrating different operations at appropriate timings as a full technical back stopping. It should be mandatory to take the leading growers to different institutions and to the demonstration orchards and nurseries on community land which are in good condition. There should be some incentives/prizes for the grower(s)/community whose performance is excellent.

1. INTRODUCTION

Two major challenges facing the world community today are to meet the demand of an increasing population and to reverse environmental degradation. Each depends on the other. For developing countries, agriculture is often the main source of economic growth and foreign exchange. It inevitably must play a key role in sustainable development programmes. Where agriculture has little room for expansion, much of the extra food needed to support population growth must come from intensifying production.

The European Union is funding a project entitled "Environmental Rehabilitation in NWFP and Punjab" (ERNP) in the upland areas of the two provinces. There are 3 sub-project areas; one in Muree Kahuta Kotli Sattian, second in Galiat and the third in Dir-Kohistan area. The project aims at halting and reversing the process of environmental degradation and improving the socioeconomic condition of the local people through integrated natural resource management.

The Natural Resource Management (NRM) Strategy for the Environmental Rehabilitation in ERNP Project is covering agriculture/horticulture, livestock and range lands, forests, wildlife, eco-tourism and fisheries.

Horticulture, particularly fruit trees play an important role in the upland agriculture. Fruits and nuts are grown as commercial food crops in all countries. In 1989, some 336 million tonnes of fruit were produced in the entire world.

Due to variations in altitude of the project areas, significant differences exist in the climate. The main variables are temperature and rainfall. Keeping in view these facts, the project areas have been divided into Micro Agro. Ecological Zone (MAEZ) in terms of altitude, rainfall, cropping intensity and vegetation in a strategy for natural resource management.

The land holdings in the project areas are very small and there are rarely properly laid out fruit orchards. In some parts of the MKKS, sporadic plantation of properly laid out orchards do exist. Most of the farmers, however, have scattered fruit plants on their farmlands in MKKS and Galiat.

Few properly laid out orchards are seen in DKP, however, extensive walnut plantation exist throughout the project area. Apple is the main fruit followed by walnut. Other fruit plants include plum, apricot, peach, guava, citrus, etc.

Mango also grows in the sub-mountainous areas of MKKS and DKP. The evergreen fruit like citrus, guava, etc., need to be protected from frost during winter even if planted at 3500 ft or somewhat lower elevation. Blood-red oranges in the frost free sub-mountainous areas of Dir district are famous through out Pakistan.

In lower Boi area of Galiat, with warm temperate/ sub-tropical climate, sweet oranges, grape fruit, lemon, guava, litchi, plum, persimmon, apricot, pear, almond and olives have already been planted as demonstration orchard as well as a source of budwood.

At Shringal (DKP), progeny plantation of apple, walnut, peach, pear, pomegranate, cherry, grapes and hazelnut have been established along with project nursery of MM111, MM106, M26, (apple rootstock) and BA-29 (pear rootstock). At the same time persimmon and peach seeds were sown to be used as rootstocks.

Four fruit plant nurseries and 16 demonstration orchards were established on farmers field by the project. It is interesting to note that the people of DKP area demand citrus, guava, pomegranate, mango and banana. Plantation of improved cultivars of pomegranate will be satisfactory in terms of climate and marketability, but plantation of citrus, guava, mango and banana in DKP will not be feasible except in the lower areas and protected places in the home gardens.

In a discussion with community group of Sari Salia (small, closed valley) in Galiat project area, it was disclosed by the farmers that the plantation of lemon and sweet orange dried in this area.

The horticulture, particularly fruit trees, play an important role in the upland agriculture. However, unplanned plantation of fruit trees in the past has not been very successful in the project area. This is due to obsolete fruit cultivars, the inappropriate rootstocks, lack of true-to-type fruit saplings and modern production technologies,

obscure training and pruning, plant protection problems, improper planting space and shortage of technical and skilled manpower.

In order to identify the problems related to fruit production in the project areas and to ascertain the recommendations, the consultant adopted the project approach by reading project documents, discussion papers, technical reports of concerned research stations, and FAO/UNDP projects in Northern Areas Gilgit and Quetta Balochistan, conducting field surveys of all the three project areas, discussing problems related to fruit production with local staff and growers, exchanging views with research scientists of different institutions. The strategy to boost-up fruit production in the project area is elaborated in this report according to the job description in the terms of reference to review and document the existing knowledge and experiences in fruit culture in the mountainous areas of Pakistan, with specific reference to the three project areas and to establish linkages of the project with horticulture research stations and development projects working in similar climatic zones in the country.

1.1 The Economic Factor

An analysis of reports on inadequate food production by farm families in several poor areas in the mountains reveals that the production of adequate amounts of food crops on small land holdings, with ever declining farm productivity is impossible. Reports indicate that wherever cash crop farming has not been adopted, the importance of mountain agriculture, as a resource of sustenance for the people is rapidly sinking. The promotion of horticulture (high value cash crops) in the mountainous areas, in the past few decades, has brought a pleasant impact and the quality of life of these people to day is reflected by their very high level of income, consumption pattern, education, and other human social welfare services besides environmental conservation. As reported by Partap (1995), the marginal farmers (0.5-1ha of farmland) in the Hindukush-Himalayan Region, on the average, earned annual net returns of US \$1600 and for the small farmers (1-2 hectare farmland) maximum annual net earning were upto US\$ 4000.

A study on the economic viability and potential of increasing the income from the small and marginal farms revealed that subsistence farming, which focuses on cultivation of cereals, was no longer viable for marginal and small farm families. Generally, food grain production is around two tones per hectare under the climatic conditions of the Himalayan regions, but the yield of apple trees is ten times that of cereal grains from the same area. This establishes the fact that tree crops have potential to offer sustained high level of productivity on marginal and fragile lands where annual crops can not be grown profitably because the fertility is poor. The comments of the farmers of Ziarat valley in Balochistan can be quoted as an example, stating that Almighty God has not given them land but mountains, and that they were able to make land for quality apple production. The same is true for northern areas of Pakistan.

1.2 The Fodder Situation

The farmers of the ERNP project area grow cereals not only for food but as fodder and feed for their animals as well. The farmers of the northern areas of Pakistan with the help of FAO/UNDP projects were persuaded to grow fodder as intercrops in the orchards preferably leguminous crops like Lucern, etc., which will not only fulfill the fodder requirements but at the same time will increase soil fertility. Cereals are generally exhaustive crops but wheat can be intercropped in the orchard for few years, keeping the distance away by one meter on either side of the tree row. Anyhow maize is not recommended as an intercrop in the orchards because of over-shadowing the young trees and hampering the precocity.

1.3 The Fuel Wood Situation

Fruit trees, particularly deciduous fruits plant species need to be pruned regularly to get higher yield. The pruned wood is used as fuel for cooking and heating. In 1982, a fruit grower of Swat sold the pruned wood for Rs.8000 from sixty apple trees to an acre of about 15 years age. Since deciduous fruit plant species have specific agro-climatic and soil requirements, thus nature have provided unique opportunities for mountained people to produce unprocessed, semi processed and processed

fresh and dry fruits as a native food as well as obtain fuel wood for cooking and heating in the severe cold weather where options are not available, obscure or very expensive in the remote areas. This can control unlawful cuttings of forest trees and hence natural resource degradation.

1.4 The Evergreen Fruit Plant Species Plantation

Emphasis should be given to plantation of deciduous fruit tree orchards in the project area. Anyhow, evergreen fruit plants like citrus, guava, litchi and olive can be planted in the sub mountainous frost free areas at elevation of about 1000-1200 meters. The new plantation of evergreen is to be protected from frost injury any way. Plantation at household level in compound under shelter is appropriate. In warm temperature/subtropical areas of NRCP (Boi area) and MKKS, plantation of some evergreen fruit plant species have already been done by the project.

Although, economical comparison of olive with other fruit plant species is not known, marginal land could be planted with olives and the already existing plantation can be top-worked with the improved varieties. Small-scale facilities of olive pickle preparation and oil extraction will have to be introduced in the project area if economically feasible.

1.5 The Nutritional and Environmental Aspects of Fruit Tree Culture

For the normal function and development of human body we need proteins and calories in sufficient quantity. Calories are provided by the cereals, sugars, crops, starchy roots and some vegetables, whereas protein is obtained from meat and eggs while vitamins and minerals are contributed through fruits. Although some fruits are also rich in carbohydrates, proteins, fats etc; yet fruits are valued most for vitamins and minerals which have been considered indispensable for human health. Since the fruits have found to contain high amount of dietetic essentials, the importance of producing enough fruits for feeding the masses as a protective food and the human diet, in rational manner, has been now fully realized. This is an established fact that fruits not only return much higher income to the growers but produce higher yields of nutritive food as compared to other field crops.

The role of trees including fruit trees for making environment favourable can be elaborated as follow:

- CO₂ is dangerous for life if in excess.
- CO₂ is an important source of food for plant life.
- Trees not only absorb CO₂ from the atmosphere, but release O₂ in the atmosphere which is a must for life and this should be maintained at 21% for normal life activities.
- According to environmental research, on an average, trees to an acre (400-600 trees) will absorb 246 tons of carbon per annum.
- One ton of living trees biomass produces 1.47 tons of oxygen from the atmosphere.
- Trees on an acre of land consume CO₂ equivalent to CO₂ produced by a vehicle which has travelled 41600 kilometers.
- A healthy vigorously growing tree can produce O₂ for 32 children.
- Trees have beneficent effect on soil, soil nutrients, control erosion/conserves soil, add humus and favorably influence climate.
- In addition, forests, by acting as wind break, create aerodynamic roughness and assist in arresting dust particles.

In short, fruit trees will give mankind a high value food, aesthetic value, medicine, fuel wood, minimize global warming by working as carbon sink, provide shade, protect intercropped high value cash crops from physical wind damage, reduce soil erosion and help recycle nutrients.

2. FRUIT PRODUCTION, HANDLING AND MARKETING PROBLEMS AND POSSIBLE SOLUTIONS

Higher fruit production per unit area can be obtained, if proper planting material, irrigation, nutrition, plant protection measures, post harvest techniques and marketing methods are procured/adopted. Fruit production, handling and marketing problems and possible solutions are annotated as follow:

Planting Materials:

Problems:

- Improper planting materials
- Non certified
- Rootstocks and scion not known
- No or irregular training and pruning practices
- Pests and diseases.

Solution:

- Advance booking
- Purchase from certified and recognized nurseries
- Known characters of rootstocks and scion cultivars
- Proper training and pruning techniques
- Proper plant protection measures.

Irrigation:

Problems:

- Excessive irrigation and standing water problems
- Flooding and restricted aeration
- Scarcity of irrigation
- Lack of water-harvesting and water conservation.

Solution:

- Do not over irrigate
- separate irrigation for intercrops and orchards
- Shovel technique for irrigation requirement
- Drought resistant rootstocks and fruit plant species
- Bandat and mulching for water conservation and proper water harvesting.

Nutrition:

Problems:

- Usually no soil analysis
- No organic matter application
- No fertilizer or improper fertilizers application
- High costs of chemical fertilizers

Solution:

- Soil analysis in the district soil testing laboratories
- FYM application and green manuring
- Proper fertilization
- Compost making (making the environment clean and reducing the costs on chemical fertilizer).

Plant Protection:

Problems:

- No differentiation of insects and diseases by most of the growers.
- Grower do not keep track of their own experiences after heavy losses
- High chemical costs.

Solution:

- Frequent visits of the grower to research institutes and agriculture extension service for identification of the problem and control measures.
- The growers should keep track of their own experiences about insects diseases, weeds and resistant varieties.
- Use physical and biological control measures.(predators, Insect growth regulators, isomate, etc.)
- Use specific chemical e.g., perimoir for aphids, Oomite/plictran for mites to reduce costs.

Post-harvest Techniques:**Problems:**

- Maturity time
- Pulling fruit from connecting stalk
- Nail injury
- Throwing harvested fruit on the ground.
- No picking bags
- Making big heaps of fruits in the sun

Solutions:

- Proper maturity time
- Clipper or twist harvesting
- Cut the nail before harvesting
- Do not throw picked fruit on the ground
- Use picking bag
- Do not make big heaps, spread the fruit gently under shade, cover with straw (shali) and tarpaline.

Marketing:**Problems:**

- Lack of investment capital
- Lack of physical infrastructure
- No use of modern techniques
- Lack of cold storage facilities
- Small volume of the produce
- Lack of market information system
- Role of intermediaries

Solution:

- Credit facilities
- Farm to market roads, cold storages
- Production and marketing technology, proper methods of picking, on farm storage, grading, packing.
- Cold storage facilities at gross-root level
- Farmers' association
- Self and collective marketing through VOs

2.1 Planting Material Recommended for the Project Area

The following rootstocks and cultivars are recommended for the project areas which should be either ordered from overseas or procured from ARS Mingora, Swat, DFDC, Quetta, NARC, ARI Tarnab, Hill Fruit Station Sunny Bank Murree, Nursery at Charapani Murree or from some reliable private nursery growers in Swat and Quetta.

Table 1. Recommended Rootstocks and Cultivars of Fruit Plant Species

Fruit Plant Species	Rootstocks	Cultivars
Apple	Crab apple? MM106 MM111 Pajam 2	Kaja, Summer Red, Mondial Gala, Early Gold, Tydesman Early Worcester, Spartan, Smoothee Golden, Delbard Jubilee, Stark Crimson, Braeburn, Fuji, Red Chief, Dixi Red, Ultra Red, Ace Spur, Top Spur.
Cherry	Mahaleb Mazzard Colt?	Early Rivers, Chinnok, Local Black, Black Tartarian, Larien, Sunburst, Rainier, Bing, Lambert, Merchant, Badacsony, Stella, Noire de Meched, Moreou.
Peach	Apricot? Montclar GF 305-1 GF 677 Common Peach	Flordason, Earli Grand, Flordaking, May Crest, Spring Crest, Manon, Dixi Red, June Gold, Elberta, Red Top, Red Wing, Red Haven, August Sun, Prime Rose, Sun Crest, Michilini, Elberta Late, Red Cal.
Nectarine	As for Peach	May Belle, Snow Queen, Red June, Flavor Top, Sunlite, Red Gold, Honey Gold.
Apricot	Bitter (Hari) Apricot Mariana GF8/1 Peach?	Travett, Charmaghz, Cassel Brite, Orange Red, Gold Rich, Dan Gaetano, Buddaghur, Bergeran, Hargrand, Narai, Sardai, Shakkarpara, Swat Selection, Habi, Halman, Ali Shah Kakas, Marghulan, Shai, Shikanda.
Plum	Prunus myrobalana GF677 GF 8/1	Fazal Manani (Santa Rosa) , Plum 3, Plum 7, Shiro, Kelsey, Satsuma, Ozark Premier, Frier, Black Ambar, Stanley, Bluefre, President, Red Beaut.
Almond	Amygdalo persica (Almond x Peach) Bitter almond, FG677 Nemaguard, Hari Apricot?	Patasa, Kata, Mission, Mung Phally, Farraster, Ferragnes, DFDC Late, Non-Pareil, Ne plus Ultra, Vesta, Jordonala.
Grape	Hard Wood Cuttings	Early Cardinal, Kishmish, Shandokhani, Kings Ruby, Flame Seedless, Spin Lal, Italia, Regina, Ruby Seedless, Haita, Sahibi.
Pear	Batangi Quince A&C BA 29 OHF333	Leconte, Bartlett, Sensation, Shinsui, Hosui, Sekel, Kosui, Gosia, Packhams, Keifer, Winter- Nelis, Conference, Cascade, Parhawi, Khan Tangu.
Pecan	Seedling	Mahan, Stuart, Western Schley, Burket, Mohawk, Shawnee, Wichita, Caddo, Choctaw.
Walnut	Seedling	Serr, Payne, Eureka, Midland, Tehama, Hartley, Local Selection.
Persimmon	Seedling	Seedless, Saruga, Saijo, Shen, Local Selection(Turmanzai)
Strawberry	Runners	Corona, Tufts, Gorella, Tioga, Sequia, Red Gauntlet, Hamigent.
Fig	Cutting	Improved Bannuwal, Mardan Selection
Sweet Orange	Sour orange Rough lemon Troyer citrange Troyer trifoliata Heen naran, Citrus sunki swingle	Succari, Hamlen, Washington Navel, Salustiana, Valencia Late, Blood Red.
Grape Fruit	---do---	Marsh Seedless, Foster, Duncan, Daud Shah

Lemon	---do--/ cuttings	Eureka Lemon, China Lemon
Litchi	Air layering	Bedana, Bombay, Purbi, China, Serai

Rootstocks for stone fruits should preferably be of the same species or of known compatibility. Local crab apple rootstock should be budded/grafted with spur type cultivars for size control and precocity. MM111 rootstock of apple is drought resistant. Colt rootstock of cherry is dwarfing and easy to propagate but is highly susceptible to crown gall disease.

Selection from the local germplasm needs to be properly tapped and exploited. Pears like Parhawi, Khan Tangu, etc., in DKP area need to be compared with exotic germplasm for yield and quality.

Chalghoza is produced in high MAEZ of DKP area. This crop, however, is neither being managed nor its fruit being collected in the desired manner. It takes longer time to come into bearing. Anyway, it should be dealt with other forest species nursery raising for plantation on marginal land and watershed areas. If properly managed, chalghoza trees can greatly enhance the income of the growers.

Pomegranate can be easily propagated by hardwood cuttings. Promising strains of pomegranate in MKKS area need to be selected and further propagated. Cuttings/rooted plantlets of high yielding cultivars like Qandahari can be introduced to the area for performance and comparison.

2.1.1 Management of Fruit Orchards

It is not enough to plant the orchard and leave it to nature. Due attention is to be paid to management for maximum output.

2.1.2 Pruning and Training

Training and pruning of fruit trees is the foremost management practice for the maintenance of tree vigour and productivity. During discussion it was indicated that proper training and pruning is normally not carried out in the areas. Low yields and poor fruit quality may be attributed to less light penetration in the tree canopy. Alternate bearing, poor fruit colour development are also due to uncontrolled upright tree growth.

Training of fruit trees is an important management practice for obtaining the proper tree shape, which has a strong scaffold system to bear a heavy fruit crop load. It also brings the tree into early bearing. The grower must have the basic knowledge of the techniques and practical background in order to obtain the desired results of training and pruning.

There are two pruning phases in the life of fruit trees. The first involves pruning of young trees, upto about 3 to 4 years old, to provide a structurally strong frame work for supporting a maximum fruiting area easily accessible for management and harvesting operations. In the second phase, older trees are pruned to maintain, renew and evenly distribute fruit and wood throughout the tree.

2.1.3 Orchard Floor Management

Orchards are cultivated to:

- Reduce noxious weeds and plant competition for water and nutrients.
- Incorporate cover crops and fertilizer.
- Aid in aeration and the infiltration of water where orchard operation have caused compaction.

Cultivation should not be deeper or more frequent than is necessary to accomplish these various objectives and should never injure the root system of fruit trees.

Cultivation does not reduce water loss, except by killing weeds that use water. Unnecessary cultivation not only increases operating costs but it may also cause soil damage.

2.1.4 Cover Crops (Inter-crops)

This practice can be employed without disadvantage in the early years of an orchard's life.

The best intercrops are leguminous crops like peas, alfalfa, and other beans, which provide nitrogen to the soil. The nitrogen fixed in the nodules of leguminous crops becomes available to the fruit trees.

It is a common practice in Northern areas and Balochistan to grow alfalfa as well as vegetable cover crops in fruit orchards. The same is true and valid for ERNP project areas. Farmers have to take into consideration the different water and nutrient demand of fruit trees and cover crops, and irrigate/manure them accordingly.

2.1.5 Sod and Strip Weed Control

Sod culture can be used in fruit orchards and is frequently combined with herbicides for strip weed control along the tree row. Low growing grasses or legumes can be planted as sod in between the tree rows or the natural grasses and weeds can be allowed to grow.

A number of herbicides can be used in fruit orchards to provide weed-free strips down tree rows. The strips can vary in width depending on orchard conditions, but they are often about 6 feet wide. Sods have several advantages, including erosion control, regulation of nitrogen availability to the tree, easier orchard access following irrigation or rains (with potentially less soil damage), and possible improvement of water infiltration and of the climatic condition throughout the orchard. Therefore, using sod will ultimately result in better fruit coloration and reduced sunburn damage. Sod is moved or flailed regularly in order to prevent high water and nitrogen subtraction from the soil.

The sod cultivation system can be used successfully with the combination of drip irrigation method.

2.3 Fruit Thinning

Fruiting is an exhaustive process for the apple tree, especially if the crop is heavy. If we do not remove part of the fruit on the tree, the consequences are likely to be:

- reduced fruit size
- alternate bearing tendency

Hence, the chief goal of a good horticultural practice is to supply sufficient nutrients and carbohydrates for the remaining fruits on the tree and thus conserve them for the flower-bud formation of the next year's crop.

2.3.1 Objectives of fruit thinning:

Thinning increase fruit size. Experiments have shown that good size and quality can be obtained when fruits of most varieties are spaced to allow about 30 to 40 average size of healthy leaves in the vicinity of each fruit. If 50 or more leaves are left per fruit, there is little enlargement of fruit size.

The usual commercial practice of spacing the fruit from six to eight inches apart on the branch allows about 30 average-sized leaves per fruit.

Thinning increase fruit color and dessert quality. Thinning has a very important effect on apple varieties such as Red Delicious (Tor-Kulu), Fuji, and Gala, which need considerable red color for the market. When the fruit on an apple tree has adequate and efficient leaf surface it has high sugar content and tastes good.

Thinning reduces limb breakage. In heavily bearing apple trees which are not thinned, limb breakage is prevented by the use of stakes. This procedure is labour intensive and

expensive.

Thinning reduces alternate bearing. Most apple varieties have a tendency to bear heavily one year and lightly the next. This can be avoided by introducing the thinning practice.

However, we can use other corrective practices to induce the same objective as above. These include:

- Use of increased pruning before the expected heavy bloom season, to reduce flowering points, and
- Use of supplementary irrigation, when required (after harvesting if necessary), to help the flower-bud formation, and
- Application of more fertilizer, particularly nitrogen, before a heavy-crop year, to produce healthy large efficient green leaves and vegetative growth.

2.3.2 How to do thinning:

We need intensified thinning if

- the trees are older and the fruits small, or
- the ecological conditions are not good, e.g. drought, bad weather, insufficient nutrient supply etc, or
- the trees have weak vegetative growth or foliage injury caused by spraying, fungus or insects.

2.3.3 How to commence thinning

The chemical fruit thinning of apple fruits, by applying such chemicals as NAA, Etaphon, DNOC or Sevin sprays, has been a standard practice in commercial orchards around the world for many years. Taking into consideration the various climatic conditions and the farmers lack of knowledge, chemical thinning is not recommended for fruit growers of the project area at this time.

In apple orchard and other fruit orchards, the safest thinning is the removal of excess fruits mechanically by hand. Hand thinning can be carried out by hand or by using small scissors. With hand thinning, the grower should leave one or, at the most, two fruits in one cluster. The largest, healthiest, those most exposed to light, should be left.

2.3.4 When to do thinning

Thinning should be done 3-4 weeks after the petals fall; when the small fruits drop and we can see which fruits have set well.

2.3.5 Preharvest Drop

With some varieties, dropping of apples immediately preceding and during harvest may result in considerable loss. With most varieties, this drop may be substantially reduced with the use of 10-20ppm naphthalene acetic acid (NAA) spray. This chemical is usually applied 1 to 2 weeks before harvest, as dropping of apples becomes evident.

2.4 Replanting

Trees lost in a planting should be replaced but not before the cause of loss is determined and corrected. This may entail soil modification with a backhoe, fumigation of the tree site, or other procedure like change of soil, drainage of site etc.

Young replant trees should be given extra care because they are usually competing with older trees which have much larger root systems.

Young trees need to be watered more frequently than surrounding older trees. Weeds should be eliminated to prevent their competition for soil nutrients and moisture.

With this extra care, replanted trees frequently do reasonably well in existing orchards.

2.5 Early Cropping of Young Trees

Young plants of some cultivars, like Golden Delicious, tend to carry fruits too soon, even in the first season. The fruit which sets during the first season should therefore be removed. Each tree may be allowed to carry half-a-dozen fruits during the second season after planting and in the third season a fair crop may be obtained. Apple should be thinned by handpicking.

2.6 Cross-pollination

Most of the apple cultivars will not set fruit when planted alone because they are genetically “self-sterile”. It is important to match varieties in order that they may cross-fertilize each other. As a general statement, it is unwise to plant a single variety in a large plot. Plant two to four rows of a given variety and alternate with two to four rows of another variety having the same or an overlapping blossoming period. The pollinizer variety should not be farther away than two tree rows. It is not advisable to mix varieties in a row. The apple cross-pollination guide can be seen in Table 2.

Table 2 Apple cross-pollination guide

	Summer Red	Kashmiri	Mashadi	Delbard Jubile	Red delicious clones	Fuji	Gala	Golden delicious clones	Delbard Estivale	Apartan	Granny Smith	Tydesman's	Katy	Pollinizer apple
Summer red					◆			◆						
Kashmiri	◆		◆											
Mashdi	◆	◆												
Delbard Jubile					◆		◆	◆						◆
Red del.clones				◆			◆	◆			◆			◆
Fuji					◆		◆	◆			◆			◆
Gala					◆	◆		◆			◆			◆
Golden del. Clones					◆	◆	◆				◆			◆
Delbard Estivale					◆		◆	◆						
Spartan								◆						
					◆	◆	◆	◆						◆
Tydesman's	◆													
Granny Smith								◆						

- ◆ Recommended
□ Unsatisfactory or no reliable information

2.7 Planting distances

The proper distance for planting fruit trees has never been definitely settled. Distance of planting will depend upon the region, soil type, cultural care, tree training, pruning system and the scion/rootstock combination of trees to be planted. In northern areas, planting distance for apple was kept 15 feet between rows and 12 feet between plant for scion varieties on MM106 or MM111 rootstock. For apricots and plums it was 18-20 feet in a square and for walnuts 35-45 feet.

The number of plants required for a hectare may be determined by multiplying the distance they stand apart both ways and dividing the figure into the number of square feet in a hectare, as can be seen in Table 3 below:

Table 3 Recommended Planting Space of Apple Fruit Trees

Cultivar habit	Rootstock	Ft² (Area/tree)	M² (Area/tree)	Trees/ha
Super or semi spur	MM106	162.216	15.20	661
	MM111	216.260	20.25	500
	M 793	260.320	25.30	400
	Crab	260.320	25.30	400
Medium vigorous	Pajam 2	130.162	12.15	830
	MM 106	380.440	35.40	300
	MM 111	440.500	40.45	250
	M 793	500.650	50.60	200
	Crab	500.650	50.60	200
Vigorous	Pajam 2	162.220	15.20	660
	MM 106	440.540	40.50	250
	MM 111	540.650	50.60	200
	M793	650.860	60.80	160
	Crab	650.860	60.80	160

2.8 Training and pruning of young apple trees:

Training involves cutting and bending young tree shoots and branches in order to develop proper tree structure. It is carried out during the first 3 to 5 years of planting and completed before significant fruit set is allowed. Basically, two training systems are proposed for this region; the Modified Central Leader System and the Free Slender Spindle System.

Basic Rules for Training and Pruning Apple Trees:

Rule 1:

Limb orientation influences fruiting. Vertical, or upright vigorous growth habit, does not induce lateral branching. The result is that the trees either don't produce flower bud formations or the flower bud formations are delayed. Consequently, no fruit will be formed on such branches (Fig.1)

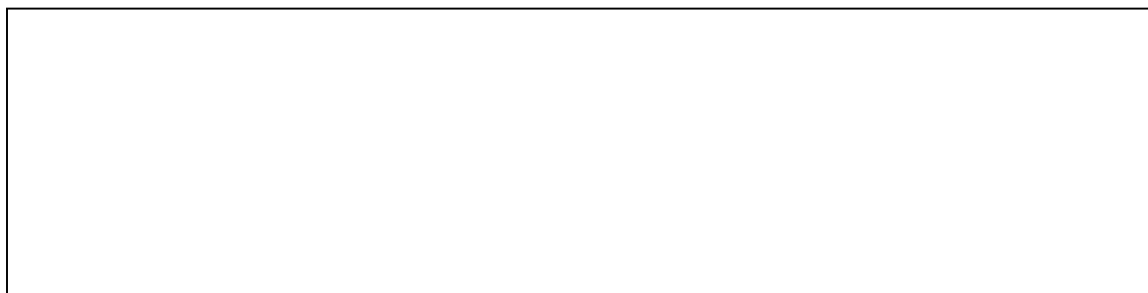


Fig.1 Upright branch growth without fruiting.

Limbs at 30 to 45 degrees develop not only laterals but some spurs that leads to early flower bud formation (Fig.2).

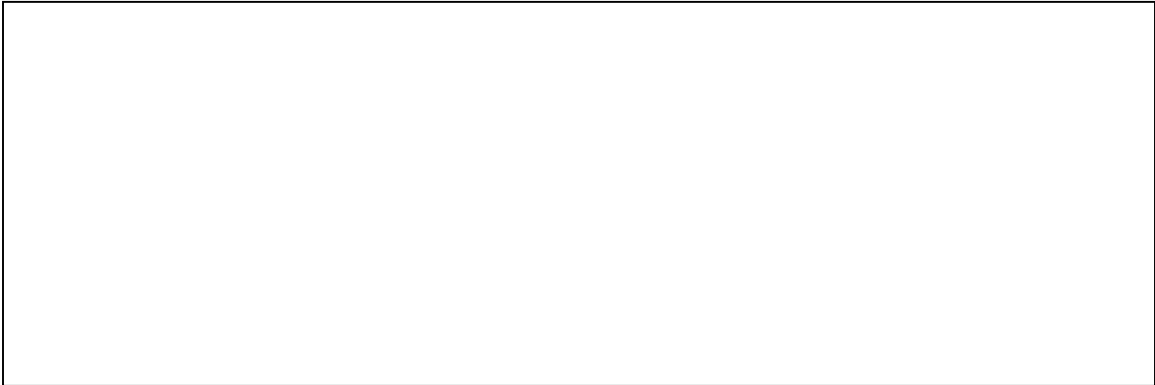


Fig.2 A branch oriented to 30 – 45 degrees angle with excellent fruit bearing.

Limbs below horizontal orientation develop water shoots and produce poor quality fruit in low quantity (Fig.3).

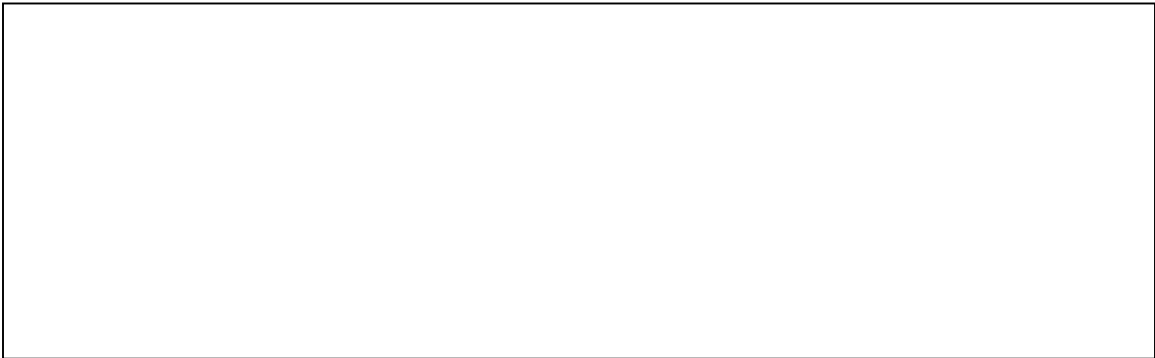


Fig.3 A drooping branch with poor fruits and water-shoots.

Rule 2:

Unpruned limbs do not develop proper laterals and spurs. The lower part of the limb also remain barren (Fig.4).



Fig.4 Low part of unpruned branch remains barren

Properly pruned limbs develop laterals. This is the ideal situation for fruiting (Fig.5).

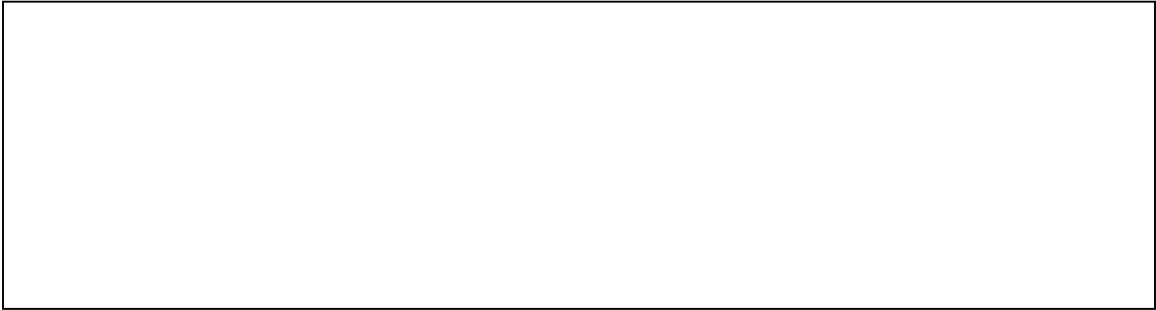


Fig.5 A properly pruned branch.

Severe pruning results in heavy re-growth that does not allow flower bud formation (Fig.6)

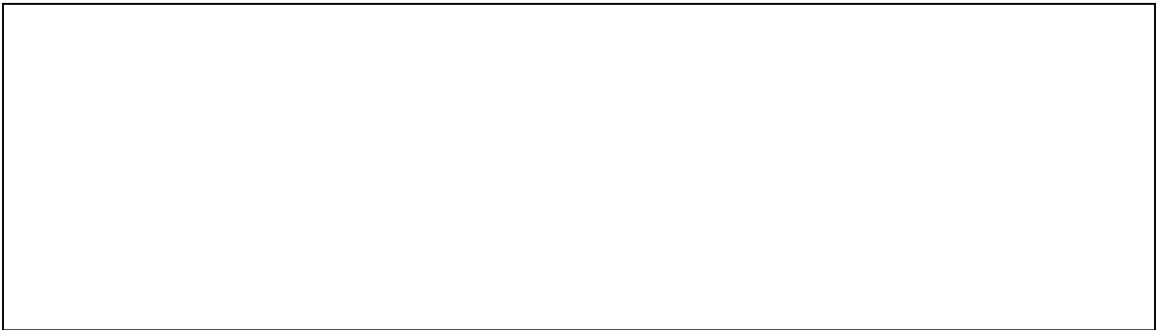


Fig.6 Severe pruning results in vigorous vegetative growth.

Rule 3:

Intensity of light spectrum is essential for fruit bud formation, it decreases drastically after it intercepts the tree periphery. Any inner tree part receiving less than 30 percent sunshine cannot develop flowering buds. Pruning must ensure light penetration in the interior of the tree canopy for fruit bud development, fruit setting, fruit growth and ultimately fruit colour development (Fig.7).



Fig.7 Decline in light penetration decreases flower bud formation in unpruned trees.

Rule 4:

The best time for bending of branches is when the growth is about to cease. In the cooler regions this can be carried out earlier in August. In relatively less cold areas this can be done later, in the first part of September.

2.8.1 Training Modified Central Leader System Trees:

This is an important and popular system common in most apple growing countries in the world. It is highly recommended for medium vigorous and vigorous varieties standing on standard and semi-dwarf rootstocks such as MM 106, MM 111, M 793 and Crab (local).

This system is particularly useful in areas where the trees have vigorous growing habits because the well developed central leader naturally passes the well selected secondary branches (limbs) to wide angle position, which helps in early flower-bud formation. If the limbs do not bend at 30 to 45 degrees they try to compete with each other and come to a vertical position. These trees will not produce a significant fruit crop earlier than 8 to 10 years. The steps involved in training a tree according to this system follow below.

2.8.1.1 First dormant season:

Head back newly planted apple trees by severing the trunk with one cut 80 –100 cm above ground just after planting (Fig.8).



Fig.8 Heading back of tree in the first dormant season.

2.8.1.2 First summer:

During growing season check trees at 4–6 week interval and make sure the uppermost limb is dominant. Pinch back any strongly competing limbs growing from the 2nd, 3rd or 4th bud below the heading cut. Use cloth pins for forcing wide angle branching. About 4 – 5 well-spaced limbs along the main stem can be selected as lateral branches of the first tier.

2.8.1.3 Second dormant season:

If training was not done during the summer, during the second dormant period select 4 to 5 wide-angled lateral scaffold branches and remove or bend all others growing upward. The number of scaffolds to be trained as first tier should not exceed 5. Head back the side scaffolds to half or 2/3 of their length. A bud immediately below the cut must orient outward (Fig.9). Central leader should have vertical orientation throughout the training process. Head back the central leader 60 –75 cm from the highest branch of the first tier.

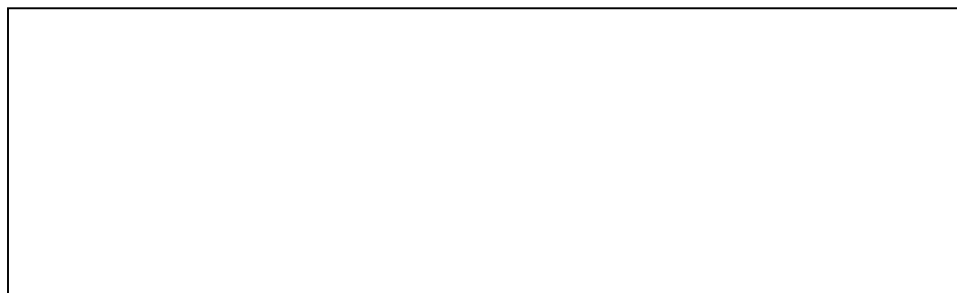


Fig.9 Heading back of tree in the second dormant season.

2.8.1.4 Third dormant season:

Select 3 to 4 branches to form the second tier. The first branch of the second tier should be 60 – 75 cm (90 cm for colored varieties) from the uppermost limb of the first tier at the central leader. Limbs in both the first and second tier should be cut back to $\frac{1}{2}$ or $\frac{2}{3}$ of length above the previous year's heading cut (first tier) or where they join the central leader (second tier). Cut back the central leader to a weak lateral which is then headed back. All the upright growing shoots are also removed as shown in Fig.10.

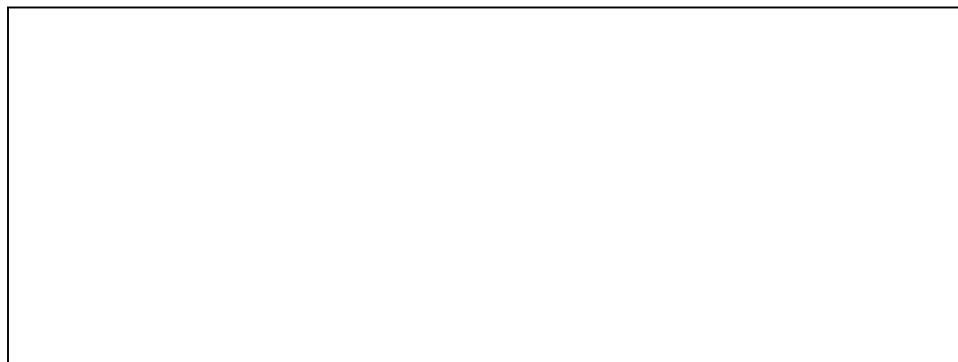


Fig.10 Bending, tying and pruning of tree during second summer and the following dormant season.

2.8.2 Training of Free Slender Spindles System Trees:

This training system involves the planting of spur or semispur varieties on MM 106 or MM 111, or medium vigorous varieties on Pajam 2 rootstocks.

This system has the following advantages:

- Routine operations, such as pruning, picking, and spraying, are easily carried out and therefore, expenses related to those operations are reduced.
- A high percentage of top quality fruit, of good size and colour, is produced.
- Heavy yields are obtained earlier than with the extensive systems.

However, this training system requires:

- More care, skill and work to carry out summer pruning and bending branches, and
- More capital expenditure on plants and materials in the early years, and
- In some instances, the trees will need staking during the first 3 – 4 years (such as the use of Pajam –2 dwarf rootstocks in a windy area and or light, sandy soil).

2.8.2.1 First dormant season:

Head back the newly planted apple trees at 70 – 90 cm after planting (Fig. 11).



Fig.11 A newly planted apple tree.

2.8.2.2 First summer season:

During growing season watch trees regularly and make sure the central leader is dominant. In early summer select primary limbs spaced about 20 – 30 cm from each other vertically and well distributed around the central leader. Use cloth pins for forcing wide angle branching. Use strings for bending when the limbs reach 40 – 60 cm. Shoots below 60 cm should also be removed.

2.8.2.3 Second dormant season:

The central leader is headed to $\frac{2}{3}$ – $\frac{1}{2}$ of its original length and the side shoots are left unpruned (Fig.12).

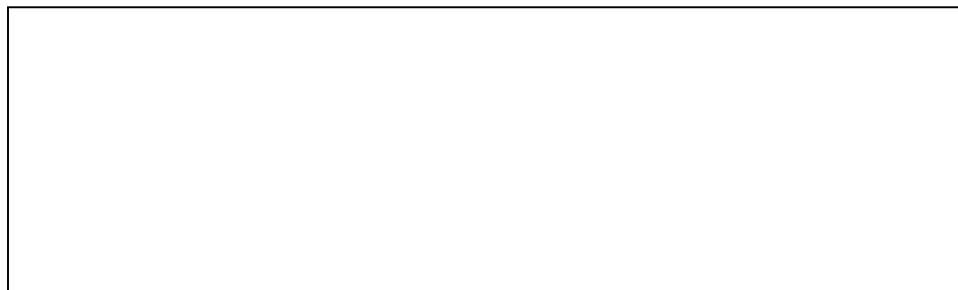


Fig.12 Heading back and training during second dormant season.

2.8.2.4 Second summer:

Bend the lateral shoots to 0-30 degrees in moderately growing trees (grafted onto dwarf rootstocks, Golden Delicious or spur types cultivars). Vigorously growing trees (varieties grafted onto semi-dwarf rootstocks, Red Delicious or standard varieties) should be bent to 30 – 40 degrees. Build up the upper limbs up to 2.5 to 3 meters as it was done during the first summer (Fig.13).

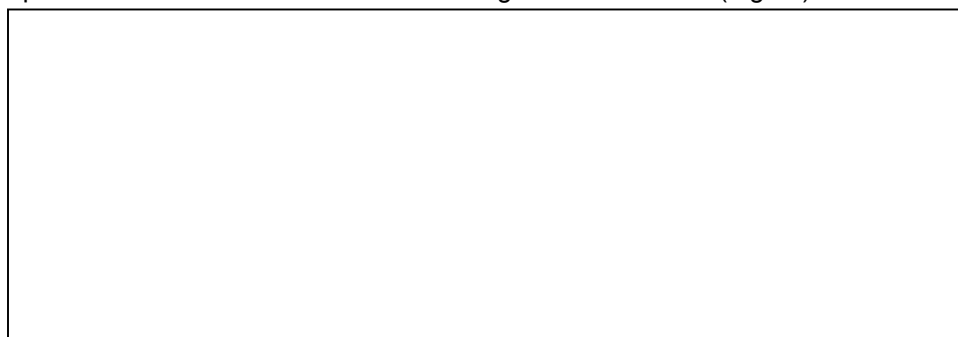


Fig.13 Bending and tying of tree in the second summer season.

2.8.2.5 Third dormant season:

Remove or cut back any upright or unwanted shoots originating from either central leader or any other limbs. Head back central leader if the central leader attained a height of 2.5 to 3 meters (Fig.14).

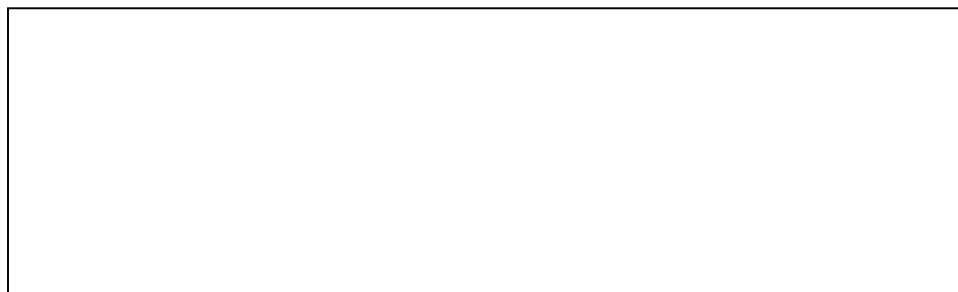


Fig.14 A well trained 3-years old free slender spindle tree.

2.8.3 Pruning of bearing apple trees:

Apple trees normally produce most of their fruit terminally on spurs located on wood 2 years old and older. Spurs are usually productive from 5 to 8 years. Some varieties such as Golden Delicious and Summer Red produce additional fruit on the tips of last year's shoots.

The primary consideration in pruning bearing trees is to maintain a proper balance between vegetative growth and fruit production. Excessive growth by young bearing trees is usually at the expense of fruit production; over bearing is accompanied by loss of vigor. On the ideal mature tree, shoots average at least 1–1½ Ft of new terminal growth per shoot per year. With most regularly pruned trees there is little necessity for more than a light thinning out of limbs and cutting back of upper branches to laterals. This will prevent the tree from becoming too high for economical cultural operations. Central leader trees can be kept from becoming too high by cutting the central leader back to a short lateral branch. Branches, especially weak and unproductive ones, should be thinned out to allow sunlight throughout the tree.

2.8.3.1 Renovation of old unpruned trees:

Most of the apple trees in the orchards, especially those grown at low altitudes (under 1200 – 1500 m), exhibit upright shoot growth. These are practically unproductive due to lack of fruiting spurs or bud on the branches (Fig.15). The lower parts of the tree canopy are under shade and hence do not set fruit. If the trees are getting old and do not produce new shoots/spurs, they will benefit from relatively heavy pruning to stimulate new shoots and fruit wood development. Old, long spurs become weak and unproductive. Such neglected orchards can be brought back into production by doing the following.

Large limbs should not be removed unless it is essential because of the danger of large cuts becoming infected with wood fungi and borer insects. However, when they must be made, the limb should be removed completely by a flush cut at the point where it originates.

Thin out the remaining branches for light penetration in the tree canopy and for more carbohydrate assimilation. The result will be more intensive flower bud differentiation. Thinning out also ensures better nutrient supply from the soil as it is diverted only to the remaining useful tree parts.

Cut back the downwardly drooping branches to horizontal or nearly horizontal position. If the branch does not have a polarity effect it will be short of proper water

and nutrient supply and, consequently, will produce poor quality fruit. It will also dry up much earlier (Fig.16).

Water sprouts on the main limbs must be thinned, bent or pruned back to $\frac{2}{3}$ to $\frac{3}{4}$ of their original length in order to initiate flower bud formation as early as possible. These operations should continue for 2 to 3 subsequent years.

One year old shoots not longer than 15 – 20 cm should be left unpruned. These will initiate spurs and flower buds in the subsequent years.

Removing the upper branches can be carried out only when the trees have experienced vigorous growth 2 – 3 years successively. Elimination of all the upright branches altogether in the first year can trigger more intensive upright water-shoots.

Shoot growth can be invigorated by shortening them to the last good growing point (bud) close to the limb with which they are attached. This can be done with a few older spurs each year, thus maintaining young vigorous fruiting wood that can produce good quality and large sized fruit. If spurs are entirely removed they may not regrow. Extensive spur renovation is best done following light crop years when the tree is ordinarily expected to come back with a heavy bloom and large potential fruit set. This practice can also help reduce alternate bearing tendencies.

An unpruned and pruned tree is shown below:



Fig.15 Old apple tree before and after pruning.



A drooping branch before pruning



A drooping branch after pruning.

Fig.16 Drooping old branch before and after pruning.

2.9 Training and Pruning of Peach Trees

Pruning has at least four major functions in the peach orchards:

- training the trees to a strong frame work thereby preventing undue losses from breakage of limbs, and
- shaping the tree to a reasonable size for convenient harvesting and other orchard operations, and
- training the crops (as flower-buds) thereby influencing the size of the fruits and regular yields, and
- helping to maintain adequate shoot growth on mature trees.

2.9.1 Basic Rules of Training and Pruning of Peach Trees

Rule 1:

Pruning of peach trees is required every year. Trees which have grown for several years without pruning become tall and dense, with weak crotches, surplus scaffolds, branches, and many suckers and watersprouts

Rule 2:

Peach trees should be pruned all throughout the year. This is the reason why the peach tree is the most recommended fruit species for summer pruning.

Rule 3:

One year old shoots must be pruned extensively to enable them to renew. All stone fruit species develop flowering buds on branches grown the previous year. During the trees productive phase these old shoots must be pruned extensively.

Rule 4:

Peach trees should be trained to an open center system. In order to stop their heavy upright growing habit, and thus put the power into wide-angled scaffolds where the fruiting-shoot-growth balance can be maintained easily (Fig.17).



Fig.17 Properly balanced scaffold of peach tree.

Recommended open Center Training System for Peach trees is as follow:

At planning time: The trees are headed back to a height ranging from 60-80 cm from the ground level. Usually, three to four well spread laterals are selected as the future scaffold limbs. They are headed back to two to four healthy buds each (Fig.18).

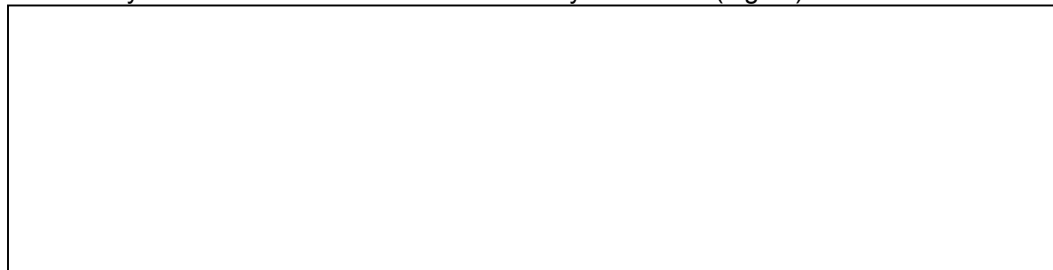


Fig.18 Pruning of peach tree at planting.

First Summer

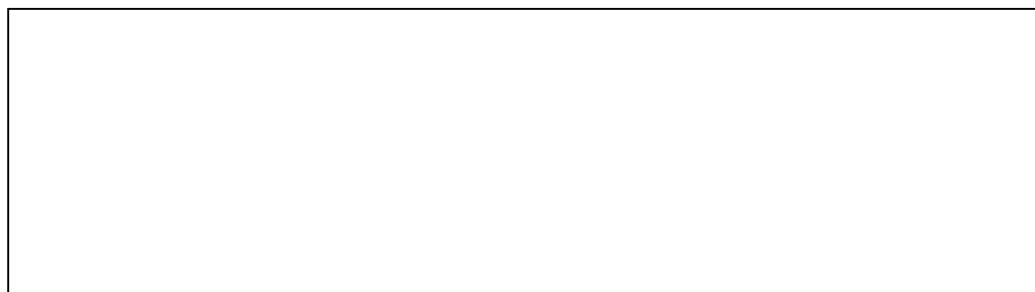
During growing season, check trees regularly and cut back upright growing branches and water sprouts. This will help in developing 3 to 4 strong scaffolds with, ideally, 50-70 cm long fruiting branches.

Second dormant season

During the second dormant period, with the assistance of pruning, we should strive to:

- keep balance among scaffolds
- keep them at 30-40 degree orientation
- keeping balance between fruiting and shoot growing

The second dormant pruning can be seen in Fig.19.



Peach trees before pruning.

Peach tree after pruning.

Fig.19 Pruning peach tree at second dormant season.

Second Summer

During the second season, the upper most dominant shoots, the water sprouts and the suckers should be cut back.

Third dormant season

After the third dormant season a significant yield can be expected if the trees have been managed well. During the third dormant season and successive years, the main task of pruning is to keep a proper balance between fruiting and shoot growth (Fig.20).



Peach trees before pruning.

Peach tree after pruning.

Fig.20 Pruning peach tree at third dormant season.

2.9.2 Renovation of unpruned peach trees

As it was noted earlier, most of the peach trees are neither trained nor pruned. Consequently, the fruit production is concentrated extensively in the higher branches while

the lower ones become barren.

In this case the only solution is to renovate these trees by drastically cutting back their scaffolds, as can be seen on Fig.21.



Fig.21 Cutting back scaffolds in order to renovate peach trees.

This can be done easily because the peach tree is able to develop many new shoots from its latent buds after it has been revitalized.

As all growing power is now concentrated in the new shoots, they need to be selected and headed back to secondary shoots during summer time. This will help in the development of new, strong, well placed scaffolds (Fig.22). If the renovation is well managed, the result will be a significant crop yield of good quality fruit the following year.



Fig.22 Summer pruning after renovation of peach trees.

2.9.3 Top-working

Top-working is usually done for rejuvenating old unproductive orchards, decrease in market for certain varieties i.e. loss of commercial value, varieties planted earlier may not be cross pollinating properly or trees in the orchard growing too large. Top-working has a significant dwarfing effect. Apple cultivars in general can be inter-grafted successfully with each other, but it is wise to use cultivars of about equal inherent vigour. Peach cultivars are compatible with one another. Top-working is usually done on the younger trees which have an abundance of small pencil size branches close to the centre of the tree and fairly close to the ground. These branches may be top-worked by budding in late summer and cut back the following spring. The older trees can be dehorned during winter and 4-5 resprouts selected and budded late summer leaving the buds dormant and cutting it back the following spring before leafing out. The top-worked trees of apple, peaches, plum and cherries etc will start bearing fruit within 2-3 years.

3. IRRIGATION

The irrigation water source in DKP area is Panjkora River and its major tributaries are perennial and receive water mainly through snow melt. The tract also has numerous springs that are spread all over the subproject area.

In Galiat the main sources of water for the streams are snow, springs and rains. The flow in the streams is maximum during June and July. Perennial streams of Haro, Harno and Salol have good water supply throughout the year. They flow at low levels within steep banks. Restricted flanks offer fewer chances for gravity channels.

Spring and streams are the main source of water supply for domestic use in MKKS. There is little possibility of irrigation because the rivers flow in deep gorges and the banks are generally very steep. Most of the rain water is rapidly drained as surface run off because of the steep slopes.

The predominant watering method, where irrigation water is available, followed by the growers is surface irrigation which in common term can be called as flood irrigation. This method is simple, cheap and requires little maintenance, yet it is very inefficient and wastes a lot of precious water during conveyance from source to the field and also during application in the field. The modern localized irrigation systems like trickle and bubbler require much more initial capital investment and is not in the reach of the growers with small land holdings. It is, therefore, imperative to fully utilize this precious commodity in a way to avoid losses as well as soil erosion. The plots or terraces should be well levelled and water in the channels should run alternately in opposite directions if on slope. These should be horizontal and not perpendicular to the slope. The water should enter in a channel irrigating a row of trees in one direction and then turn back in the opposite direction in another channel irrigating second row of trees to avoid soil erosion. The channel can be made between two rows of trees taking water to individual tree with a sub channel to basin around the tree, but then intercropping is not possible.

The frequency/interval of irrigation is dependent on weather condition and soil type and usually the farmers over-irrigate their orchards with a view that excessive irrigation will improve the vegetative and productive capacity of the tree. This concept is wrong. Excessive irrigation not only cause erosion and leaching of nutrients but is detrimental to trees. A simple way to determine whether to irrigate or not is a shovel technique. In this method a shovel is forced deep into the soil (10-12 inches) and the soil is turned upside down. The bottom soil is taken in the hand and pressed in the palm. If a ball is made of the soil and the hand get moist, there is no need to irrigate the orchard. If cracks develop in the soil ball with moist palm, irrigation is required after two days and if the soil particle do not stick together and stay apart then there is a need of immediate irrigation. This simple technique can be followed by the growers for efficient utilization of water. In areas of water scarcity, apple scion varieties of MM111, apricots, grapes, almond and pistachio should be preferred. Anyhow, supplemental irrigation water is required during vital growth period.

4. NUTRITION

The fertilizer recommendations are those of the FAO/UNDP project for Northern Areas which have about the same conditions as the project area. Anyhow, the area of scientific interest that requires clarification is the aspect of soil fertility. This project area need full soil mapping, and the generation of fine tuned fertilizer recommendations utilizing foliar analysis for fruit trees needs to be undertaken with some priority, to allow confident recommendations for establishing commercial fruit planting from the early stage of development of the fruit industry in this area.

4.1 Fertilization of Orchard

4.1.1 During plantation: After site selection and layout

1. Dig 2x2x2 feet pit, 3x3x3 feet is preferable with the help of planting board if available.
2. - Put 5-10 kg well rotten farm yard manure near each pit.
- Add one kg single super phosphate to the FYM and mix it
- Add 2-3 shovels of top soil to the FYM + SSP mixture and thoroughly mix it again.
- Add 50 gm each of Zinc and Iron sulphate.
3. - Put the mixture in the pit and gently press it.
- Put a reasonable thick layer of top soil over the mixture in the pit and gently press it again. The top soil layer is meant for avoiding direct contact of roots with FYM + SSP.
4. - Put the plant into the pit with the bud/graft union at least 3 inches up above the surface (help of planting board is again required if available).
5. - Pour the top soil first to the pit and bottom soil later on around the plant and press the soil and irrigate.
6. - Burry the cracks (if it happens to be so) with sand or available soil.
7. - It is preferable to apply about 20gm of urea per plant (away from the stem around the plant) per month starting from May to September. This will take care of your plants during the first year.

4.1.2 Subsequent years

If the orchard is planted at 12x15 feet spacing (like apple scion cultivars on MM 106 rootstock), recommendation for fertilization of orchard are as follow.

FYM :	About one maund per tree per year during winter
SSP :	500 g per tree per year. 2 weeks before leafing out/flowering
SOP:	400g per tree per year. 2 weeks before leafing out/flowering
Urea:	200gx2. First dose with SSP and SOP and 2 nd dose, 6 weeks after the first application

If the spacing is more, fertilizers should be applies as follow:

FYM:	1.5–2 maunds
SSP:	1000 g (Kg)
SOP:	700 g
Urea:	300x2g (two split applications as above)

4.2 Fertilization of nurseries

4.2.1 Stool bed:

Stools are sprouts that arise from the base of the plant below ground and become rooted. They are used for vegetative propagation.

November/December:

FYM 2kg/sq meter = 1MT/kanal

January/February:

SOP 17.5g/sq meter = 8.75kg/Kanal

SSP 35g/sq meter = 17.5kg/kanal

Urea 17.5g/sq meter = 8.75kg/kanal

May/July

Urea 17.5g/sq meter = with every or alternate irrigation

Iron chelate 1g/litre spray form May-June (particularly in apples) if iron deficiency is visible.

Note:

Spray of Greenzit or soil application of Zarzamin should be done for micronutrients deficiencies.

Timings can be adjusted to local conditions and altitude.

4.2.2 Fertilization of production nurseries:**November/December:**

Soil preparation and FYM 2kg/sq meter = 1MT/kanal

January/February :

SOP 17.5g/sq meter = 8.75kg/kanal

SSP 35g/sq meter = 17.5 kg/kanal

February/March:

Urea 17.5g/sq meter = 8.75kg/kanal

May/July:

Urea 17.5g/sq meter = 8.75kg/kanal (with every or alternate irrigation)

Iron chelate 1g/litre spray

Greenzit or Zaramin for micronutrients deficiency

In the second year, these rates can be repeated, or only nitrogen and iron chelate can be applied, depending on growth performance in the first year.

4.3 Compost Making and Environment

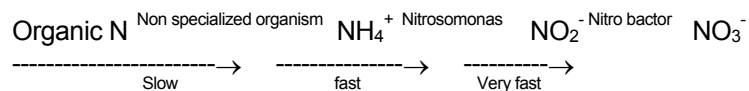
- Pit size according to requirements but generally 8x5x5 feet.
- Put fresh farm yard manure, leftover (unusable) straw, left over fodder (maize, lucern, barseem etc), leaves, small pruned branches, ash and other swept material except plastic (nondegradable) in the pit.

Moisten it with water and add the following:

1. Urea 1-2 kg per tractor load
2. Phosphatic fertilizer 1-2 kg per tractor load
3. Zinc Sulphate 1-2kg per tractor load
4. Iron Sulphate 1-2 kg per tractor load

Cover it (each time) with thin layer of soil and/or plastic sheet

- Beside clean environment, this will make a very fine compost within 4-8 months depending upon the temperature and microbial activities.
- Be sure that the organic matter is well rottend. It can be checked from the particles and smell.
- If the organic matter is well degraded into fine particles and there is no smell of ammonia, the organic matter has turned into a good soil conditioner as well as a nutrient supplier.
- Iron and zinc deficiency can be controlled through application of compost to the high value cash crops.
- Application of fresh FYM can end up with termites problem in hot areas and white grubs problem in cooler areas.
- Microbial process.



5. PLANT PROTECTION

Emphasis should be given to biological control, use of pheromone, isomates, and insect growth regulators. Indiscriminate use of chemicals should be avoided. Exact timings and specific chemicals should be used if unavoidable. These chemicals were recommended for use in the Northern Areas Gilgit, and equally good for the project area. Suitable environment friendly chemical substitute should be preferred.

5.1 Suitable chemicals for pest and disease control

Pest	Chemical
Aphid	Primoir Perfekthion Karate
Codling moth	Cymbush/Ripcord Karate Lebycid Plictran Oomite Perfekthion Dicofol Kelthane
Leaf Minor	Lebycid Perfekthion
Disease	
Powdery mildew	Nimrod Kumulus Benlate Saprol
Peach leaf curl	Cobox Cupravit Copper Oxy Chloride Benlate

5.2 Orchard Plant Protection Programme

Pest to be controlled	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Winter oil (To spray)		-----										-----
Aphids			-----			-----			-----			
Codling moths				-----				-----				
Mites					-----							-----
Powdery mildew			-----					Pruning				-----
Peach leaf curl			-----									-----

Exact timing of sprays is highly dependent on altitude with earlier spraying being necessary in lower altitudes and later application at higher altitudes.

6. POST-HARVEST TECHNIQUES

According to some estimates 20-30% of the fruits are wasted from orchard to the consumer which is a tremendous loss and if minimized, will have not only economic impact on the growers but will help to improve the nutritional status of the growing population. These losses are attributed to lack of technical 'know-how' of fruit maturity and harvesting, poor basic infrastructure of orchard to market roads, inadequate facilities of modern handling, storage, and transport, etc.

It is worthwhile to mention that harvesting should be done at proper maturity with clipper or twist harvesting, nails cut before harvesting and use picking bags. The picked fruit should not be thrown on the ground and big heap should not be made, rather picked fruit should be gently spread under shade, covered with straw/shali and tarpaline before packing. Packing should be in appropriate boxes/crates with suitable lining material.

The main causes of post-harvest spoilage are as under:

- Loss of moisture through surface evaporation, transpiration, and respiration resulting in shrivellage and low price.
- Faster rate of respiration in higher environmental temperature resulting in the early onset of senescence/aging and loss.
- Interruption in the normal metabolic activities when the produce is exposed to abrupt changes in storage temperature or fruit not stored at optimum temperature resulting in physiological disorders like superficial scald in apple and pear
- Attack of micro-organisms like fungi and bacteria which are attracted to injured or aged fruit cause great losses.

7. MARKETING

The term "marketing" means the entire process of directing the flow of goods and services from producer to consumer. For fruit, the physical distribution include all the handling and movement features of harvest, loading and unloading, grading, packaging and storage, and subsequent dispersal through the markets to the consumers. In addition, auxiliary functions may be included as preharvest considerations; production and dissemination of market information, market finances and administration; marketing intermediaries; provision of marketing training, extension and research services.

At its simplest, the marketing of fruit may involve only the sale of produce by the farmer directly to an immediate neighbour for his own consumption. However, if the distance between the producer and consumer increases, then the marketing process become complex, since more handling, transport and trading operation will be involved. Lack of physical infrastructure, invest capital, cold storages, small volume of the produce, no market information system, no use of modern technology and the role of intermediaries may be the problems in marketing of fruit produce. These problems can be overcome if credit facilities and cold storage facilities are made available, farm to market roads improved, farmers association made, self and collective marketing through VOs employed and proper on farm handling and storage practices followed.

8. NURSERY PRODUCTION

Nursery plant propagation is either through seeds or vegetative means. To be used as a rootstock, it is advisable to collect seed from seed production mother plantation. The seeds should be stratified and taken care of against pest and disease to give a uniform stand for budding with quality scion varieties.

Vegetative propagation is either through cuttings which gives true to type scion cultivar or rootstock. Propagation of pome fruit is mainly done through stooling to increase number of off-shoots and then bud these rootstock with promising cultivars. In production nursery, off shoots are obtained from the stool bed and bud wood from the progeny plantation which make a good union resulting in maiden trees for plantation in orchard.

8.1 Production schedule from stoolbed established with 1000 plants

<u>Year</u>	<u>Stool #</u>	<u>Action</u>	<u>Rootstock production</u>
2000	1000	Planting and cuttings 3buds above ground Growth and earthing up	
2001	1000	First harvest	2000-3000 to nursery
2002	1000	Second harvest	3000-4000 to nursery
2003	1000	Third harvest	6000 to nursery
2004	1000	Fourth harvest	6000 to nursery
	And so on For 15-20 years.		

8.2 Pictorial representation of nursery production schedule

<u>Year</u>	<u>Stool beds</u>	<u>Production nursery</u>	<u>Progeny block</u>
Feb. March 2001	Rootstock	Growth of rootstock in nursery	
Aug/Sept. 2001		Budding	Bud wood
March 2002		Force bud into Growth Growth of maiden tree	
Nov. 2002 or Feb. March 2003		Sale	

8.3 Nursery Rotation Programme

Care should be taken not-to-plant off-shoots or seeds of the same fruit plant species repeatedly on the same plot. An eight-year rotation programme should be followed as under:

YEAR ONE	POME FRUIT ROOTSTOCK GROWTH	(PR)	
YEAR TWO	POME FRUIT MAIDEN TREE GROWTH		(PM)
YEAR THREE	BREAK CROP	(BC)	
YEAR FOUR	GREEN MANURE	(GM)	
YEAR FIVE	OTHER FRUIT ROOTSTOCK GROWTH		(OR)
YEAR SIX	OTHER FRUIT MAIDEN TREE GROWTH	(OM)	
YEAR SEVEN	BREAK CROP	(BC)	
YEAR EIGHT	GREEN MANURE	(GM)	

8.4 Nursery Raising of Stone Fruits

The seeds of stone fruit are sown in fall or stratified and planted in spring. Seedling grows during the spring and continue developing through the summer. Budding is done in late July or early September as dormant budding. Seedlings are cut-back above the bud before growth starts in the coming spring. New top develops from the bud of the scion variety and will give a maiden tree with in 1½-2 years, ready for plantation in fall or in spring.

9. CALENDAR OF OPERATION

January:

- Application of well rotten farmyard manure at about 1ton/kanal (5445 sq. feet) to the land meant for orchard plantation or fruit plant nursery raising.
- Apply well rotten farmyard manure @ 10-40 kg per tree atleast 1 foot away from the trunk.
- Proper training/pruning of deciduous fruits like peach, nectarine, plum, almond, apricot, pear, cherry, persimmon, walnut, pecan
- Grafting apple, pear, and walnut.
- Spray of winter oil , supracide or follidol for scale control.
- Protection of evergreen fruit plant species in nursery and young plants in orchards from frost.

February:

- Application of FYM to land and orchard if not done in January
- Winter oil, supracide, or follidol spray from scale control if not done in January
- Proper training/pruning operations
- White wash the trunks of the trees with the following ingredients.

Lime	1-1.5 kg
BHC	50g
Cupravit	50g
Water	5 liters
- Preparation of land, sketch of planting plan, digging of pits and filling pits with mixture of 5-10 kg well rotten FYM, 1kg single- superphosphate, 50gram each of zinc and iron sulphate with few shovels of top soil, making a thin layer of top soil above the mixture, gently pressing it, then planting the tree with bud union at least 3 inches above soil surface, pouring top soil first and then the remaining bottom soil last, pressing it and then immediate irrigation.
- Harvesting off-shoots from the stool and planting in lines in production nursery site.
- Apply 500g of single super phosphate, 400 grams of potassium sulphate with 200 grams of urea per tree, 1 foot away from the trunk under the canopy of the tree with some hoeing to mix up the fertilizer with soil and then irrigate.
- Cuttings of pomegranate, fig, grapes, local plum and where feasible in warm temperature and subtropical climates cuttings of lemon, sweetlime be planted in the nursery rows.
- Land preparation for sowing of local persimmon seeds, sour orange and guava (warm temperature and subtropical condition).
- Sowing of already stratified seeds of peach.
- Spray against aphids on citrus (warm temperature/subtropical conditions) with primoir(aphicide not killing the predator of aphids , Lady bird beetle) or Timaran for aphids and leaf minor.

March:

- Continue training/pruning of deciduous fruit trees.
- Complete plantation of evergreen in lower areas and apple, almond, walnut and other deciduous fruit plants in the high mountainous areas.
- Sowing of seeds of guava, sour orange and persimmon
- Transfer citrus and other evergreen fruit plants from nursery plots to maiden production nursery rows.
- Hoe in nurseries and light plough in orchards.

April:

- Second application of urea 200g 6 weeks after the first application when fruit is of berry size.
- Remove sour orange sprouts from the budded citrus plants
- If aerial layering is required in guava, litchi and loquat, it should be done in this month.
- Spray against aphids with Primoir (aphicide) or Timaran or Anthio. It will also control leaf minor.
- Spray Plictron, Oomite, Morocide or Kelthane against mites.
- Spray against fruit fly on peach, plum, nectarine and apricot after monitoring with Methyl Eugenol

- traps. Spray of Diptrex or Lebycid chemicals against fruit fly.
- Plant strawberry runners if not done in March.
- Drenching of Heptachlor in the areas where white ants is a problem.

May:

- Continue training of young trees.
- Proper attention should be paid to hoeing, weeding and irrigation of nurseries and orchards.
- Whit wash the trunk of the trees as recommended in the month of February.
- Where ever the land is not fertile and the FYM not available, sow berseem and lucern for green manuring.
- Bud citrus rootstocks with desirable scion varieties.
- Spray thiodan or timaran or larsban against flat headed peach borer on mid and late season varieties of peach, plum, nectarine and apricot. The varieties maturing this month should be sprayed after harvest.
- Spray Supracide or Larsban or Follidol against scales if attack is observed. It will take care of hairy caterpillar as well if spray done late in the month.
- Spray Diptrex or Lebycid against fruit fly second time on late maturing varieties of peaches.
- Spray Trimeltox or Cupravit for withertip problems of citrus.
- Spray Thiodan or Larsban or Gosathian or Zolon against coddling moth of apple after monitoring with Pheromones traps.
- Earthing up stool beds.

June:

- Continue summer pruning of water sprouts and bending of branches.
- Proper care of hoeing, weeding and irrigation of nurseries and orchards.
- June budding in citrus and deciduous fruits plant nurseries.
- Spray Diptrex or Lebycid against fruit fly on late maturing varieties of guava, pear, peach, and apples at high altitude during first week of this month. Traps are quite helpful in monitoring and control.
- Spray Thiodan or Timaran against flat headed peach borer on peach, nectrine, apricot and plum varieties, fruit of which have already been harvested.
- Spray of Plictran or Oomite or Morocide or Kelthane if there is attack of mites.
- Earthing up stoolbeds.

July:

- Continue summer pruning and bending of branches.
- Proper care of hoeing, weeding and irrigation (if no rainfall) of nurseries and orchards).
- Continue budding citrus and deciduous fruits.
- Spray supracide or Follidol or Larsban if attack of scale is observed.
- Spray Plictran or Oomites for Kelthane against mites if present.
- Earthing up stool beds.

August:

- Continue summer pruning and bending of branches .
- Dormant budding in deciduous fruit trees is preferred.
- Final spray for flat headed peach borer
- Spray of fungicide against withertip of citrus. These sprays will take care of scab as well.
- Sowing of green manuring crops.
- Earthing up stool bed should be continued.

September:

- Dormant budding in deciduous fruit trees preferred.
- Budding citrus rootstock with desirable scion varieties.
- Plant strawberry runners.
- Sowing of green manuring crops.
- Spray against scales if any.
- Earthing up stool beds should be continued.

October:

- Complete earthing up stool beds.
- Continue and complete dormant budding (chip budding) in the first week of this month.

- Prepare land for peach stone sowing.
- Transfer citrus and other evergreen fruit plants from nursery to production rows.

November:

- Sowing of local peach stones, hari apricot and bitter almond after stratification.
- Collect Batangi offshoots and plant as a rootstock for pear varieties.
- Protect citrus, litchi and other evergreen fruit plant species from frost.

December:

- Application of FYM to orchards and nurseries.
- Start early training/ pruning.
- Continue to protect evergreen fruit plant nurseries and young orchards from frost.

10. SUMMARY

The consultant's report is based on his field survey after three project areas, revising technical reports/discussion paper related to the project areas, exchanging ideas with professional to learn from the experiences of research and development projects and personal working experience in different ecological zones of temperate regions. Being high value cash crops, fruit production in mountainous areas is the most appropriate choice. Unfortunately, development in this sub-sector of agriculture in such areas is lagging behind because of lack of appropriate planting material and technical know-how.

As the development of fruit industry can take 20 years or more, a proper strategy is to be drawn at the beginning to identify constraints, formulate solutions and assign priority areas of activity. Fruit production in the project area is in its infancy, therefore, a structured development programme on nursery production for production of high quality planting material, orchard establishment, tree training, preliminary fertilizer application, pest and disease control techniques, orchard maintenance, encouragement of early cropping, tree pruning, harvesting and fruit handling skills, fruit processing options and marketing activities should be planned distinctly. If necessary, preliminary surveys should be conducted and adaptive trials necessary to solve the perceived problems should be initiated.

11. CONCLUSIONS

Work on fruit production in all the three areas has been started by the ERNP project initially by providing planting material for orchards and nursery establishment from the local sources. Further establishment of demonstration orchards and nurseries is underway. Demonstration orchards and private nursery require extension but on small scale to be managed in a better way. These should be on the market line i.e. road so that other farmers can see and adopt. The private nurseries, if conventionally possible, should be located close to the already established nurseries of the government departments at present where skill is available for plant propagation.

The already existing orchards of inferior varieties can be replaced gradually through top-working with good quality scion cultivars. The existing rootstock of crab apple can be budded with spur type cultivars to control the size and induce early cropping.

One of the primary constraints to develop a fruit industry is the availability of superior quality planting material. It is preferred to order quality planting material with phytosanitary certificate from overseas. Anyhow, this is dependent on budgetary position of the project available for this purpose. However, to ensure the development of an economically viable fruit production, continued technical training of the local population in the scientific culture of fruit crops needs to be under taken. It is desirable to have enough bud wood from the progeny plantation to meet the demands of the nursery for budding/ grafting. This is particularly important to identify suitable cultivars that are acceptable to the local palate, extend the production season, are of suitable shipping quality, and are desired by the market in the major consumption centres. Apricot cultivars can be introduced/brought from Northern Areas, Gilgit but should be watched for crown gall disease.

Beside overcoming the provision of superior quality planting material, there is a need to address other constraints. These consist largely of lack of knowledge within the farming community, fruit production as currently practiced is technically unsophisticated, due to lack of basic horticultural knowledge and subsequent poor orchard management, hence low productivity and inferior fruit quality. There is a need to provide advice to farmers on correct orchard establishment, maintenance and cropping; to do this effectively will also require initiation of on-farm adoptive research to fine-tune recommendations or evolve new techniques suited to local conditions.

12. RECOMMENDATIONS

- Superior quality planting material, which is a foundation stone for successful fruit production, should be provided to the community groups on manageable small scale.
- A fully integrated approach should be adopted, tackling both the integration of fruit production in the farming system and the vertical integration of fruit production industry itself.
- Timely supply of inputs like farm yard manure and balanced fertilizers, horticultural tools/equipments, adequate irrigation, proper plant protection chemical should be insured to be available at the community centres.
- Full scientific surveys of pest and disease incidence and plant nutrition should be undertaken as a matter of priority to produce base line data of the growing environment of the project area and resulting recommendation should be fully communicated to the farming community.
- Continued technical training of the local population is necessary to be imparted in nursery production, orchard establishment, tree training, orchard maintenance, encouragement of early cropping, tree pruning, harvesting and fruit handling skills, preliminary fertilizer application, pest and disease control techniques, fruit processing options and marketing.
- Awareness should be created among the farming communities about the techniques and benefit of fruit production through leaflets in Urdu, field days, farm walk, demonstrations, workshops, seminars, newspapers and technical talks on radio and television.
- Efforts should be made to bring more experienced persons specialized in fruit production from the government institutions with incentives from the project, on deputation for a longer period to closely monitor the project activities and impart training to the farmers on different aspects of fruit production.
- Close linkages need to be developed with research and development institutions/departments/organizations, NGOs, etc., working on fruit production under similar conditions, take benefit of their research findings and also save time and resources in doing similar work for the project area. The ERNP project may assist such helping institutions. Local consultant can play a keyrole in assisting the project.
- Due consideration should be given to the indigenous knowledge tailored with the modern techniques. Selection from the local germplasm like walnuts, persimmons, pears, apricots, pomegranate etc., has already given good results and this enormous genetic resource needs to be properly tapped and exploited. Chalghoza is produced in high MAEZ of Dir Kohistan project area. It takes longer time to come into bearing and should be dealt with other forest species nursery raising.

13. IMPLICATIONS

The establishment of demonstration orchards and nurseries of superior quality, management regimes, and permanent progeny plantation for budwood production will enhance yield levels and hence increase income and living standard of the growers of the project area. Fruits not only return much higher income to the growers but also produce higher yields of nutritive food as compared to field crops.

A grower in Mastung district of Balochistan harvested 9000 kg apples by using MM 106 rootstock from 180 trees of 7 years age to an acre as compared to 50 trees, 13-14 years old of the same variety but on crab apple stock giving him 6000 kg fruit. An increase of 3000 kg per acre was obtained simply by using plants on improved rootstock. If all the new techniques are followed, the growers can double their yields per unit area.

All these facts and figures encompasses the ERNP Project objectives whether wide or immediate.

Since deciduous fruit plant species require regular pruning which provides unique opportunity to obtain fuel wood for cooking and heating in the severe cold weather. A well known grower of Swat who was not in favour of pruning was persuaded to do pruning after selling pruned wood from 60 trees for Rs.8000 in 1982. Beside getting higher yields through proper pruning, unlawful cuttings of forest trees can be controlled by using pruned wood for cooking and heating, and helps in control of natural resource degradation. Fruit plant species can be planted on slopes in water shed areas with zigzag irrigation method. Thus trees, including fruit trees, have beneficial effect on soil, soil nutrients, control erosion/conserves soil, add humus and favourably influence climate.

14. ANNEXURES

Annex - 1

14.1 Itinerary/Inception Report

Date	Departure	Arrival	Person(s) contacted	Area visited/work done/remarks
1.04.99	Peshawar	Islamabad	Dr. Iqbal Sial Coordinator NRM Mr. M. Akhtar Cheema, Coordinator Training Dr. Banaras Raja, Consultant (vegetables) Director Horticulture NARC Dr. Marchette, CTA ERNP	IUCN office Discussion about the consultancy Contract signed
02.04.99	Islamabad	URDP office at Company Bagh Gorha Galli, Govt. High School Murree Arukass Nursery back to Islamabad	Mr. Abid Riaz Agril. Officer Mr. Shamim Forester Haji. Mazhar Forester Raja Waheed SDFO	Project Office, Murree Area, High School Murree for forest tree plantation, Arukass fruit tree/forest nursery visit
02.04.99	Islamabad	Abbottabad	Mr. Ijaz Razvi Programme Manager Mr. Mushtaq Ahmad Wazir DFO, Siran Forest division Mansehra Dr. Banaras Raja, Consultant (Veg)	NRCP Galiat office meeting, discussion about futis and vegetable production.
03.04.99	Abbotabad	IUCN office	Mr. Gul Muhammad Project Director NRCP Dr. Banaras Raja, Consultant (Veg) Dr. Rober Barducci PTA NRCP Mr. Ijaz Rizvi Prog. Manager NRCP Mr. Hameed Mrwat Expert NRCP Mr. Muhammad Iqbal Asstt. Director Agriculture.	Meeting, discussion about fruit and vegetables Production.
03.04.99	IUCN Office	Nawashahr Galaga, (Jogan) Nimli Mera and back to Abbottabad	Mr. Muhammad Iqbal District Director Accompanied Mr. Imarn president VO Dr. Banaras Raja, Consultant (Veg)	Fruit plant nursery at Jogan Training and pruning at Glaga, apple at Nimli Mera, No regular plantation but walnut, persimmon (wild), peaches, plum and apricot seen
03.04.99	Abbottabad	Kalas Chatri Bala, Tandiani and back to Abbottabad	MR. Muhammad Iqbal accompanied the consultants	Tandiani area, no regular orchards, intercrops, peas as off season vegetable.
04.04.99	Abbottabad	Garhi Habibullah, Boi area, Chattar class, AJK, Berut	Mr. Muhammad Iqbal is accompanied the consultants	Boi area demonstration and progeny plantation of grape fruit, guava, litchi, plum, pear, persimmon, apricot, almond, olives, visited Water shortage problem. Chattarclass AJK

				vegetable Farm visited Sari Salia community group. Apple, walnut, apricot, plum, some cherry in the area. Problems about fruit production discussed. Walnut borer codling moth in apple and alternate bearing problem, lemon and sweet orange planted some dried Progeny Plantation (186 apple cvs) stool at Charpani (not visited) only 600 budded apple this year
05.04.99	Peshawar local		Mr. Iftikharul Haq Project Director (Rtd)	Discussion about MKKS project
06.04.99	Peshawar local		Mr. Sultan Aman Shah Agril. Officer Northern area Gilgit (student of M.Sc)	Discussion about fruit development in Northern areas Gilgit.
08.04.99	Peshawar	Swat	Mr. Muhammad Ibrahim, Mr. Khalil-ur-Rahman and Mr. Abdul Bari, Research Officers	Swat, Discussion about agril. research in general and fruit development in particular.
09.04.99	Swat	ARSN Mingora	Syed Fazal Ahad, Horticulturist Mr. Jamshed, Horticulturist Dr. Badshah Wahid, Food Technologist Mr. Muhammad Amin, Director Mr. Muhammad Ilyas, Research Officer Mr. Abdul Majeed, vegetable Botanist	Discussion about fruit research and development
09.04.99	Mingora	Shringal	Mr. M.Akhtar Cheema, Coord(Trg) Mr. M.Yousaf, Project Manager DKP Mr. A.Khurshed, Expert, NRM Mr. Gohar Ayub Agril. Officer (Hort) Mr. Waqar Ahmad, Social Scientist Mr. Mohd. Pacha Field Eng. Mr. Mohd. Riaz Social Organizer Mr. Ali Bacha computer operator	Visited Shringal Field Station plantation of apple, cherry, peach, pear, plum, and grape, pomegranate, walnut, Hazelnut and Project nursery.
10.04.99	Shringal	Dad Baurh Biarh East (Birkot) Shringal and back to Peshawar	Mr. Gohar Ayub and Mr. Waqar Ahmad Accompanied	Cherry orchards and fruit plant nursery at private farmers field visited
12.04.99	Peshawar local		Contacted Research Officers at ARI Tarnab	Discussion about fruits and nursery at Tarnab
13.04.99	Peshawar local		Agril. University Staff	Discussion about orchards and nursery situation in Malakandher farm NWFP Agril. Uni. Peshawar

14.04.99	Peshawar local		NWFP Fruits and vegetable Dev. Board Staff.	Collection of information about Fruit and Vegetable Development Board activities.
15.04.99	Peshawar local		Mr. M.Ilyas, Research Officer	Collection of informations about Kalam Intigrated Development Project (KIDP).
16.04.99	Peshawar local		Mr. M. Ilyas Research Officer Mr. Khalil-ur-Rehman Research Officer	Collection of information about Dir District Development Project (DDDP).
17.04.99	Peshawar local		FAO/ENDP publications	Gathering information about nursery production and making abstract.
19.04.99	Peshawar local		FAO/ENDP publications	Gathering information about plant nutrition and making abstract
20.04.99	Peshawar local		Dr. Hanif Qazi D.G Research Mr. Mohibullah D.G Tarnab Along with Dr. Banaras Raja	Discussion about Agri. Research and development activities at ARI, Tarnab, ARSMingora and different projects at Dir and Chitral.
21.04.99	Peshawar local		FAO/ENDP publications	Gathering information about plant protection and making abstract.
22.04.99	Peshawar local		Station Directors NWFP Research Stations	Contacted Station Directors of ARS Mingora, Swat, Cereal Crops Research Institute Nawshera (Pir Sabak), Potato Research Center A.Abad, Horticulture Tarnab, ARI Dhodial, ARSS Seri Naurang Bannu, ARI D.I. Khan and others in a meeting with Director General Research NWFP at his office in Agril. University Peshawar.
23.04.99	Peshawar local		FAO/ENDP publications	Gathering information about rootstocks of fruits plant species and making abstract.
24.04.99	Peshawar local		FAO/ENDP publications	Gathering information about promising cultivars of fruit plant species and making abstracts.
26.04.99	Peshawar local			Gathering information about compost making and role of trees in environmental and making abstracts.
27.04.99	Peshawar	Islamabad		Contact/discuss/brief the

				expatriate fruit specialist about consultancy for IUCN (ERNP) project.
28.04.99	Islamabad Local		Dr. M. Iqbal Coordinator NRM, Dr. Giancarlo Curzal Expatriate Fruit specialist. Dr. Marco Marchetti, CTA, Mr. Giuliano Masini PTA, Mr. Roberto Barducci PTA.	Discussion about the existing situation of fruit production in the project areas and recommendations for improvement.
29.04.99	Islamabad	Peshawar		Travel and gathering informations and discussion with Fruit and Vegetable Development Board personnel about fruit and vegetable development activities.
30.04.99	Peshawar local		Mr. Zakir Ali Shah Incharge Agriculture SCARP	Discussion about the activities of the Agricultural Development Corporation Unit of SCARP, particularly fruit development activities.
01-05-99	Peshawar local	PFI Peshawar	Mr. Safdar Khan	Farm Forestry, Pine raising.
11.05.99	Peshawar local		D.G Agricultural Research, Horticulturist Tarnab and Mingora, Staff of IUCN	Debriefing meeting of local and expatriate Consultants on fruit production in ERNP.

Annex-2

14.2 Sources of planting material

14.2.1 Local

1. Agricultural Research Station (North) Mingora, Swat
2. Reliable private Nurseries established by the Pak/Swat and Vegetable Dev. Project.
3. Deciduous Fruit Development Centre, Sariab, Quetta
4. Reliable Private Nurseries established by the FAO/UNDP Project "Transfer of Fruit Technology in Balochistan".
5. Agricultural Research Institute Tarnab, Peshawar
6. Agriculture Department Northern Areas Gilgit (Apricots)
7. Sunny Bank Hill Fruit Station Murree
8. Nursery at Charapani, Murree.
9. Directorate of Horticulture, NARC , Chak Shahzad, Islamabad.

14.2.2 Over seas

1. M/S Delbard International, Malicorne 03600 Cemetery, France, Fax # (003-7064-5861
2. Manager Star / Export Fax # (0033)490-408267, Mondragon, France Fax # (0033)490-408267
3. Manager Frank P.Mathews LTD, England Fax # (0044)-811830

Annex-3**14.3 Pheromone Traps**
(Codling moth, Sanjose scale etc.)

International Coordinator
Customer Service Department
Tree Incorporated
Salinas, ca 93912
Fax # (001-408)-758-2625

Insect Growth Regulators, Mating disruption Dispensers (Isomates plus)

Shine.Etsu Chemical Co.Ltd.
Fine chemicals Department
2-6-1 Ohtemachi, chiyoda-Ku, Tokyo, Japan
Fax # 81-3-3246-5371

Horticultural Chemicals

Hortichem Ltd
14 Edison Road
Churchfields Industrial Estate
Salisbury, Wiltshire SP2 7NU, England
Fax # (01722) 326799

Sigma Chemical. CO. P.O.Box 14508 St. Louis, Mo 63178 USA
Fax # (001)-314-771-5757.

Horticultural kit

1. Sandvik International
S. 81181 Sandviken, Sweden 4626-262600
2. Carlo A. Manaresi
40026 IMOLA (Bo) Italia
Fax # (0542)641603
3. Naegeli AG. Postfach, CH-8594 Guttingen Switzerland
Fax # (071)6945011

Soluble Powder Fertilizer

National Fertilizer Company Ltd (NAFCO)
P.O. Voz 1239 Riyadh 11431 K.S.A
Fax # 498-3767

Shade House etc.

- Tildenet Ltd
- Hartcliffe Way, Bristol, UK
Hartcliffe Way, Bristol, UK
Fax # 44(0) 117 9231251

Hot Bins. Soil Heating, Trace Heating etc.

Brooks Partners Ltd
The Paddocks, Honey Hill, Woldngham, Barkshire
Telephone 01344772456
Facsimile 01344776733

Annex-4**TERMS OF REFERENCE****Job Description**

Main task of the consultant will be to review and document existing knowledge and experiences in fruit culture in the mountainous areas of Pakistan, with specific reference to the three Project areas.

He will also link with horticulture research stations and development projects working in similar climatic zones in the country, including Agriculture Research Station North, Mingora Swat, Malakand Fruit Development Project (MFDP), Kalam Integrated Development Project (KIDP), Agricultural Research Institution Tarnab, NWFP Agricultural University, Horticulture Research Institution at NARC Islamabad, Murree Hill Research Station of Sunny Bank, Dir District Development Programme, Fruit and Vegetable Development Board, Peshawar, Agha Khan Rural Support Programme Chitral/Gilgit, and Deciduous Fruit Development Centre, Quetta.

During last one week of his assignment, out of a total of one work month, he will actively collaborate with the expatriate specialist to share his findings with the latter. To ensure this, he may have to split his assignment in such a way that three weeks are spent for field work and review in the three project areas and one week to be utilized on final report writing and discussion and briefing the expatriate specialist, after his commissioning.

At the onset of his mission, the local consultant will submit an inception report followed by a final report and debriefing at Resource Unit, Islamabad.

Duration

One work month for all the three sub-project, commencing on March 1, 1999.

Reporting

The consultant will report to the coordinator, NRM, Resource Unit, ERNP, Islamabad.

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15. REFERENCES

- Abi-Samra, S.E. 1995. Traditional Surface Irrigation Methods for Deciduous Fruit Orchards. Extension Circular. FAO/UNDP-Pak/89/014, Quetta.
- deGroot, I.J.M. and M.K. Shahwani. 1996. Pest and Diseases of Deciduous Fruits and their Control. Field Guide No.7. FAO/UNDP-Pak/89/014, Quetta.
- Doolan, D.W. 1992. Terminal Report. Production of Seeds and Planting Materials in Northern Areas Gilgit. FAO/UNDP-Pak/86/001, Gilgit.
- ERNP. 1991. Strategy for Natural Resources Management, Resource Unit, IUCN, Islamabad.
- ERNP. 1998. Diagnostic Survey Report. IUCN, Islamabad.
- FAO. 1991. Trees for Life. Rome, Italy.
- Farooqi, W.A. 1996. Post-harvest Technology of Major Fruits in Balochistan. Field Guide No.8. FAO/UNDP-Pak/89/014, Quetta.
- Iqbal, M. 1997. Marketing of Deciduous Fruits in Balochistan. Field Guide No.10. FAO/UNDP-Pak/89/014, Quetta.
- Kalam Integrated Development Project. 1996. Highlights 1993-95. Pak-Swiss KIDP, Saidu Sharif, Swat.
- Maree, A Manan, F.K. Wazir and I.Gergely. 1997. Propagation and Production of Deciduous Fruit Trees in Balochistan. Field Guide No.9 FAO/UNDP-Pak/89/014, Quetta.
- Partap, S. 1995. High Value Cash Crops in Mountain Farming-Mountain Development Processes and Opportunities. ICIMOD Discussion Paper No.MFS95/1, Kathmendu, Nepal.
- Shah, S.H. 1995. Fertilization of Fruit Plants. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.
- Shah, S.H. 1995. Fertilization of Fruit Plants Nurseries. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.
- Sharma, H.R. 1996. Mountain Agricultural Development Processes and Sustainability. Micro Level Evidence from Hamarchal Pradesh, Indian Hamalayas. ICIMOD Discussion Paper No.MFS 96/2, Kathmandu, Nepal.
- Technical Report. 1993. Horticultural Research Overview. OPC Australia and NESPAK Lahore,
- Technical Report and Annual Work Plan. 1998-99. Project for Horticulture Promotion. ARS Mingora, Swat.
- Technical Report. 1998. Highlights of Fruit Research. NARC Directorate of Horticulture, Islamabad.
- Wazir, F.K. 1987. Present Status and Future Scope of Fruit Culture in NWFP Department of Horticulture, NWFP Agricultural University Peshawar.
- Wazir, F.K. 1989-93. Semi Annual and Annual Technical Reports. FAO/UNDP-Pak/86/001, Gilgit.
- Wazir, F.K. 1990. Useful Informations About Orchards Plantation in Northern Areas of Pakistan (Urdu). FAO/UNDP-Pak/86/001, Gilgit.

Wazir, F.K. 1990. Destructive Insects of Fruit Plants in Northern Areas of Pakistan and their Control (Urdu). FAO/UNDP-Pak/86/001, Gilgit.

Wazir, F.K. 1990. Important Diseases of Fruit Plants in Northern Areas of Pakistan and their Control (Urdu). FAO/UNDP-Pak/86/001, Gilgit.

Wazir, F.K. 1992. Economical Importance of Fruits in Pakistan and its Northern Areas (Urdu). FAO/UNDP-Pak/86/001, Gilgit.

Wazir, F.K. 1993. End of Assignment Report. FAO/UNDP-Pak/86/001, Gilgit.

Wazir, F.K. 1996. Rootstocks for Fruit Trees. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1996. Top-Working of Fruit Trees. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1996. Thinning of Apple Trees. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1996. Hardwood Cuttings Propagation of Fruit Trees Rootstocks. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1996. New Apple Cultivars. Extension Leaflet (Urdu). FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1996. Report on Proceedings of Fruit Growers Planning Conference. Occasional Paper No.32. FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1997. Report on Assessment of Technology Transfer. Occasional Paper No.34. FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1997. Final Report - Outreach Activities of the Deciduous Fruit Development Project in Balochistan. FAO/UNDP-Pak/89/014, Quetta.

Wazir, F.K. 1998. Final Report - IADPB Activities. UNDP-Pak/96/006, Quetta.

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