NEPAL:
FruitDevelopment Project

Volume 1: Final Main Report

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Nepal Horticulture Promotion Centre

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Acronyms

ADS	Agriculture Development Strategy
AEC	Agro Enterprise Centre
BS	Bikram Sambat
CDCP	Citrus Development Center Palpa
CHCK	Central Horticulture Center Kirtipur
DADO	District Agriculture Development Office
DFDCS	Dry Fruits Development Center Satbanjha
DOA	Department of Agriculture
FDD	Fruit Development Directorate
FGD	Focus Group Discussion
FNCCI	Federation of Nepalese Chambers of Commerce and Industries
FNCSI	Federation of Nepalese Cottage and Small Industries
FY	Fiscal Year
Ha	Hectare
HCPS	Horticulture Center Phaplu Solukhumbu
HOPROC	Nepal Horticulture Promotion Centre
HRCRJ	Horticulture Research Center Rajikot Jumla
HVAP	High Value Agriculture Project in Hills and Mountain Areas
KIS	Key Informant Survey
MOAD	Ministry of Agricultural Development
MOF	Ministry of Finance
MT	Metric Ton
NARC	Nepal Agriculture Research Council
NCC	Nepal Chamber of Commerce
NCRPP	National Citrus Research Program Paripatle
NPC	National Planning Commission
PACT	Project for Agriculture Commercialization and Trade
RJKIP	Rani Jamara Kularia Irrigation Project
RISM-FP	Raising Incomes of Small and Medium Farmers Project
RMA	Rapid Market Appraisal
TEPC	Trade and Export Promotion
TOR	Term of Reference
TRHCM	Temperate Region Horticulture Center Marpha
TRHCN	Tropical Region Horticulture Center Nawalpur
TRHNDCJ	Tropical Region Horticulture Nursery Development Center Janakpur
TVDCS	Tuber Vegetable Development Center Sindhuli

Executive Summary

Despite the suitable climate, comparative advantages, expanding markets for fresh fruits and processed products, the growth of fruit industry has remained slow in the past. Work on fruit research is inadequate and extension program is very general and cereal crop dominated. Donors, I/NGOs and other development partners are least interested in fruit development as most of the fruit crops take long time to give economic returns. The overall objective of the present project is to prepare the "Fruit Development Project" and make a plan of action on short term, medium term and long term basis for the overall development of the fruit sector. During project preparation, primary data and information from 11 DADOs, 10 Government Farm /Stations, 20 Experts, 31 private orchard owners, 21 nursery owners, 5 fruit processors, 8 importers, 2 exporters, 9 wholesalers, 9 retailers and 7 consumers were ***collected*** and analysed in a systematic manner. This sector has not taken momentum due to long gestation period of the fruit crops, high initial cost for orchard establishment,high risk due to climate change and lack of reliable weather forecast system, poor marketing networks and***highly perishable nature of the***commodity. ***These factors have hindered*** farmers to go for fruit crops plantation. Smallholder farmers and land limitation is also a limiting factor for big orchard establishment. Long-term orchard security from being demolished for township and plotting for residential purpose are also discouraging factor for large scale orchardists. Yet, there is a possibility of creating employment and reduce poverty by mobilizing returning youths and retaining others backhome which in turn contributes to lower down the women's burden in agriculture. In***the*** light of the huge agriculture trade deficit and Nepal's comparative advantage in fruit production, there is clear scope of domestic production and value chain development of apple, mango, banana, lime and lemon for import substitution; and mandarin, apple, pear, kiwi, and walnut for export promotion.There is need of production and promotion of avocado, persimmon, pear, kiwi and different nut fruits for fulfilling the demand of tourism sector and promote export. With the rise in population and knowledge on health benefits, the demand for fruits is increasing day by day. At present,local production of fruits is so low that large quantity of the fruits consumed in the country accounting to annual Rs. 6 billion come from India and China. Post-harvest losses especially at storage and transportation are estimated between 20-40% which clearly shows the poor situation ***in the***fruit sector.

Recently, Nepal has progressed significantly in developing fruit plant propagation technologies with different methods of grafting including stone grafting in mango, shoot tip grafting in citrus, etc. Biotechnology such as tissue culture is contributing to produce disease free saplings in banana and citrus. Water harvesting and multiple use water system like drip and sprinkler irrigation technology are contributing ***to*** efficient utilisation of water in nursery and orchards. Improvement in farm yard manure, composting and vermi-composting technologies are gradually replacing chemical fertilisers in fruit culture and is contributing to improving soil fertility and fruit quality. Most of the fruits are environment friendly, and some of the fruits can be grown in marginal and undulated terrace land with minimum of irrigation facilities. The recent youth migration and abandoned land in the hills and degraded forest and public land, if brought under fruit cultivation,could contribute to revive hill agriculture and carbon sequestration. Considering all these advantages and recent trends of farmers leaving cereal crops cultivation due to lack of farm workers, fruit plantation is the only left opportunity. The present Fruit Development Project may be one of the best alternatives for rural reconstruction. Thus, smooth and dedicated implementation of the proposed project will certainly bring revolutionary change in the development of the fruit industry in Nepal.

Based on the requirements and gap analysis the project has proposed to increase fruit production from 992,703 MT at base year to 2,786,161 MT by 2036/37 and productivity from 8.96 to 11.25 MT/ha. The per capita availability and real intake will increase from 39 kg to 71.3 kg and 23.4 kg to 42.8 kg respectively.

To achieve the above target the project has proposed 5 strategic pillars: Production increase through increased area under production,***increased*** productivity through better management practices;***reduction in*** postharvest losses through improved postharvest handling including packaging, transportation and storage;infrastructural support for quality planting material production and post-

harvest handling; institutional strengthening for research, production and marketing, and increased access to finance.

1. Background

1.1 Introduction

Nepal is situated in the lap of great Himalayas and has favourable agro ecological diversity for agricultural production, especially in the horticulture sector. Different ecological belts are endowed with different types of climates due to its geographical locations and physiographic setting. Most of the important fruits of the world can be grown in Nepal ***with*** comparative advantages for producing temperate to tropical fruits and value chain development for apple, mango, litchi, banana, avocado, citrus (mandarin, lime, lemon) for import substitution; and mandarin, kiwi, hog-plum and berries, chestnut, pecan-nut and walnut for export promotion***; and*** production of avocado, persimmon, pear, kiwi and different nut fruits for fulfilling the demand of tourism sector.

Fruit demand is increasing as a result of rise in middle class population and knowledge on health consciousness and nutritional benefits, increased tourist flow and other behavioural change about fruit consumption, and increased purchasing capacity of the consumers.However, local production of fruits is not meeting the increased demand and Nepal is importing fruits accounting to annual Rs. 6 billion from India,Chinaand other countries.

The present average productivity of fruits is hovering around 9 metric ton per hectare which may go up to 15 metric ton per hectare with increased access to information, modern production technology and inputs (high quality saplings, fertilizers, credit and water). Agro-climatic variability available in Nepalhave not effectively been linked and utilized for fruit production and commercial networking. Post-harvest losses during harvest, transportation and storage are also high***and*** estimated between 20-40 percent. ***Despite*** more than six decades of effort with the given strength and opportunities in the fruit development in Nepal, the productivity of fruit ***has remained*** low mainly due to the following reasons:

- The orchards established during the past decades (late 20th century) have become old and senile, and need rejuvenation with better management and replanting with high quality saplings.
- Citrus decline, Mango malformation, Fruit drops due to varied reasons and other pests along with poor management of fruit orchards have been emerging as new challenges and requires renovation
- Fruit researches during recent past are not getting priority from the Govt. and other organizations as it has long gestation period for fruiting
- Mechanization, post-harvest technology and value chain development activities in fruits have been in low key
- Donor's funding is almost nil in fruit research and development, and government investment is also not up to the level expected
- Coordination, collaboration and co-working among DOA, NARC, University system and private stakeholders are very inadequate

In view of the above realities, the government of Nepal announced the year B.S. 2075 as Fruit Year and the years 2016/17 (2073/74 B.S.) to 2025/26 (2082/83 B.S.) as the fruit decade. In this context, the Fruit Development Directorate (FDD) has a program in the FY 2016/17(2073/74 B.S.) to develop a **"Fruit Development Project"** to guide the fruit sector for the coming decades. Nepal Horticulture Promotion Centre submitted the expression of interest (EoI) to FDD and was accepted to submit full proposal. In response to the letter of FDD dated 2016/11/15 (2073/07/30), Nepal Horticulture Promotion Centre developed and submitted the Technical and Financial Proposal for preparing "Fruit Development Project". The Fruit Development Directorate awarded the contract to Nepal Horticulture Promotion Centre to prepare the Fruit Development Project.

1.2 The Vision, Mission and Objectives of Fruit Development Project

1.2.1 Vision: The vision of fruit development project aims at increasing fruit production and productivity, raising income and generating employment,acquire self-sufficiency in fruits during next ten years with import substitution and export promotion of quality fresh fruits.

1.2.2 Mission: The conceptual framework of the fruit development mission is based on value chain components: demand based high yielding variety promotion, quality sapling production and distribution, modern production technology dissemination and better orchard management, post-harvest handling, packaging, processing, ***utilization*** and marketing. The mission envisages nearly three times more fresh fruit production and doubling the productivity and reducing post-harvest losses. Convinced ***by*** the fact that fruit sector of horticulture is one of the best options to improve income, attain food and nutrition security in a sustainable way in the long-run and also to improve ***environment,the*** mission ***has*** envisaged coordinated approach among NARC, DOA /FDD, Agricultural Universities, NGO/INGOs and private sector actors and market players through improved research, training, extension and post-harvest management and marketing to acquire self-sufficiency in fruit production.

1.3 Objectives

The overall objective of the “Fruit Development Project” is to prepare a plan of action on short term, medium term and long term basis for the overall development of fruit sector; and the the specific objectives are to;

- Identify gaps in fruit research, production, processing and marketing,
- Analyse the major constraints faced by the fruit development programs in past and explore fruit development scope and opportunities in all ecological belts of Nepal. Map the present scenario of fruit cultivation, and future suitability maps for major fruit crops
- Prepare and present programs for conserving indigenous and potential exotic fruit genetic resources,
- Prepare and present program to produce healthy saplings, suggest the appropriate technologies and infrastructure with budgetary frame considering the fruit decade requirement and future demand
- Assessment of present human resources, infrastructure and policy to reform farm/centres/stations/horticulture institutions to ensure full utilization of them and to ensure and attract human resources in these institutions for fruit development
- Preparation of program to increase public-private partnership and investment in major fruits, research and development, commercialization, value chain and the market
- Prepare a detail appraisal to utilize the niche pockets with niche commodities for the import substitution and /or export promotion
- Explore the suitable methodologies for extension and technological dissemination in the context of fruit development

To prepare the implementable project for fruit year and fruit decade, analysis of past performance of the sector, present strength, opportunities, issues and challenges was inevitable. For this, methodologiesand tools were developed and werepresented in an inception workshop organized by FDD and was approved by FDD incorporating the recommendations and suggestions received from the inception workshop which is presented in separate **Volume 2 as Annexes**. Based on the approved inception report this “Fruit Development Project” has been prepared.

2. Review of Fruit Sector for Secondary Information

2.1 Fruit Sector History

During Rana Regime (prior to 1950 AD) horticulture grew ***with*** a collection of fancy and exotic horticultural plants such as persimmon, loquat, some peaches, pears, figs, litchis and mangoin the aristocratic gardens of Ranas. Some flowering plants like coral, magnolia, Chinese rose, and evergreen plants like exotic pines, Monkey's puzzle nut, etc.***were collected*** in PutaliBagaincha and these were meant for entertaining Rana Prime Ministers. In addition, large mango orchards were established by Ranas in different parts of the country where climate was suitable as aristocratic ecstasy. In the private sector, horticulture during that period was limited to growing indigenous fruits such as traditional guava, pear, citrus, etc. Generally, fruit growing was limited to homestead gardens with few trees scattered here and there.

Formal fruit research and developmentin Nepal began in late thirties and planned development started in fifties with the introduction of new fruit varieties from India and other countries. The chronological key events in fruit development is presented in table 1

Table 1: Time line and chronology of the fruit sector development in Nepal

Year	Formal fruit sector key events
1937	Chandra Samsher(JBR)[1] established Agricultural Council as the first government entity for agricultural development in 1937.
1952	The Agriculture Council established in 1937 was converted to the Department of Agriculture in 1952
1955	The newly established Department of Agriculture established horticulture section under it in1955 which established horticulture farms at Nuwakot/Kakani, Kaski/Pokhara and Bara/Parwanipur etc.
1960-1973	The government of Nepal implemented Extensive Fruit Development Programme from 1960 to 1973 through Indian bilateral assistance
1967	Department of Horticulture established several horticulture farms such as Kirtipur, Dhankuta, Dhunibeshi, Palpa, Janakpur, Helambhu, Baitadi, Jumla, Marpha, Yagyanpuri/Chitwan and Humla in different agro-ecological zones with the support of Indian Cooperation Mission (ICM).
1969	GTZ supported Gandaki Zone Agriculture Development Project (GADP) was started in 1969 that had a significant component on horticulture development.
1972	Five agriculture related departments were merged to create the Department of Agriculture Development (DOAD). Fruit Development Division (FDD), Vegetable Development Division (VDD), National Potato Development Programme (NPDP) and National Citrus Development Programmes (NCDP) were started.
1973	Japan government (JICA) helped to establish Janakpur Zone Agriculture Development Project (JADP) and has impact in the development of *Junar* (Sweet Orange) in Sindhuliand Ramechhap district of Nepal.
1973	Food and Agriculture Organization (FAO) supported Hill Agriculture Development Project (HADP) which strengthened Horticulture Farms of Kirtipur, Nuwakot/Trisuli, Dolakha/Jiri, Bonchand Jumla.

[1]JBR Title given to Ranas as Jung Bahadur Rana as his the successor

Year	Formal fruit sector key events
1975	Celebration of "Agriculture Year 1975" brought a paradigm shift in horticulture sapling production. Private nurseries were established all over the country to produce fruit saplings locally. However, to regulate the quality standards of saplings, Nursery Act and Regulation is still lacking and fruit saplings are produced and marketed on ad-hoc basis.
1985	JICA supported Horticulture Development Project (HDP) was commenced with its project office at Horticulture Center Kirtipur. This project promoted Junar in Ramechhap and Sindhuli; pear, persimmon and Chest nut in Kathmandu, Bhaktapur and Lalitpurand Grapes in Banke and Bardiya.
1975	Integrated Hill Development Project (IHDP) – A Swiss funded Project Implemented some fruit development activities in Dolakha and Sindhupalchowk
1987	ADB supported Hill Fruit Development Project (HFDP) was started to develop citrus fruit in the 11 eastern mid-hill districts of Nepal.
1990	Nepal Horticultural Society (NHS) was established officially to enhance public awareness towards the importance of horticulture and to promote linkages with national and international institutions.
1990	An ambitious 20-year Master Plan for Horticulture Development (MPHD) was prepared in 1990with the technical and financial support from Asian Development Bank; however, the government did not approve it and was never implemented.
1990	After the restoration of democracy in 1990, Department of Horticulture was re-established with District Horticulture Offices in 30 districts. However, this was later discontinued. However, the post of Horticulture Development Officers were created in all 75 districts
1990	Horticulture Research Division under NARC for fruit research; horticulture farm centres divided between DOA and NARC and still some functional anomalies exists.
1992	Some horticulture farms such as Horticulture Farm Rasuwa and Helambu (Orchard site) were handed over to the Ministry of Forests and Soil Conservation. Horticulture Farm Kakani to the Ministry of Tourism which was historical mistake committed by the Ministry of Agriculture. During the same year, Horticulture Farms Humla, Dhunibesi, Helambu (Sermathang) and Janakpur were given to private sector with certain conditions to ensure the continuation of horticultural activities.However, it did not work and were re-turned to the government by the private sector in 1994
1995	Agricultural Perspective Plan (APP) was formulated and implemented. APP recognized Citrus and Apple as high value commodity. As a result, during ending of APP, Apple Self Reliance programme, Lime Mission Programme and Citrus Rejuvenation Programme were implemented.However, these have not been effective as expected.
2002	Commodity development divisions were promoted to Development Directorates such as Fruit Development Directorate (FDD) and Vegetable Development Directorate (VDD). National Citrus Development Programme and National Spice Crops Development Programme.
2007	One village one product (OVOP)for fruits like Hog plum, Wood Apple, Sweet orange, Kiwi fruit, Banana, Mandarin, Mango

Year	Formal fruit sector key events
2012	One district one product (ODOP) was extended to other districts as well
2010-2018	High Value Agriculture Project (HVAP) funded by IFAD supportedApple value chain based sub-projects in Jumla and Kalikot
2011-2017	HIMALI - ADB funded project in 10 Himali Districts supported apple value chain initiated high density planting in Manang
2015-2035	Agriculture Development Strategy(ADS) Agriculture sector growth through 4 strategic components-Governance, Productivity, Commercialization and Competitiveness;however, no specific fruits under value chain but apple identified as a potential crop
2016-2026	Prime Minister's Agriculture Modernization Project (PMAMP) - GoN Project ○ Apple Super Zone (1): Jumla ○ Mandarin Zone (3): Syangja, Udaypur, Solukhumbu ○ Junar Zone (1): Sindhuli ○ Mango Zone (1): Saptari ○ Olive Zone (1 Bajura ○ Apple Block (8): Mustang, Manang, Humla, Mugu, Kalikot, Dolpa, Rukum, Bajura ○ Mandarin Block (8): Kaski, Dailekh, Baglung, Gulmi, Arghakhanchi, Parbat, Tanahun, Gorkha ○ Junar Block (1): Ramechhap ○ Kiwi fruit Block (1): Dolakha ○ Banana Block (1): Bardia
2017	At present, there are horticulture officers in all 75 districts for horticulture extension; Horticulture Research Division under NARC for fruit research. There has been significant development ofAcademic institutions outside MoAD.Tribhuvan University and Agriculture and Forestry University are conducting higher education and research works.There are 5 private colleges running B.Sc. Ag. (Baitadi, Tulsipur and Lamahiin Dang, HICAST in Kathmandu and others. Mahendra Multiple Campus, Illam (TU) is running B.Sc. Horticulture. There are schools and colleges giving technical education and CTEVT giving vocational education on agriculture. There are eight commodity associations: Nepal Ginger Producer & Traders Association, Nepal Tea Planters Association, Nepal Tea Association, Himalayan Orthodox Tea Producers Association-Nepal, Seed Entrepreneurs Association of Nepal (SEAN), Floriculture Association Nepal, Coffee Producers' Association Nepal, Federation of Fruits and Vegetable Entrepreneurs, Nepal (FEFVEN), Nepal Mushroom Association; however,**Fruit Producer's Association is lacking except in case of Junar.** There are more than 500 commodity specific cooperatives (Vegetable and Fruit – 202, Tea – 109, Coffee – 146, Junar – 44), and their Federations. Likewise, there are 8,069 Agriculture Cooperatives which also deal with horticultural commodities mainly vegetables. At the grassroots level, there are more than 25,000 producers' groups organised in various commodity groups including fruits, tea, coffee, vegetables, spices and vegetable seeds.
Source: Compiled from different sources	

2.2 Policy Development

There has been several policies being developed and implemented to promote horticulture development in the country. The major policies include: Ten Years Agriculture Plan (1975-85), 20-year Horticulture Master Plan which was not approved by government, Agriculture Perspective Plan (1995-2015), Irrigation Policy (2003), National Agriculture Policy (2004), Agribusiness Policy (2007), Agro biodiversity Policy (2006) Ist Ammendment (2014), Land Use Policy (2012), Agriculture Mechanization Policy (2014).Recently,the government has approved and implemented Agriculture Development Strategy

(ADS, 2015).ADS expects to guide agricultural sector for the next 20 years and mentions that horticulture has larger role to play, and points out increasing trend of deficit trade due to import of fruits;however, **it does not prioritise fruit development activities.**Fruit is not even listed in top 15 value chain ranking. Fruit is just addressed in ADS as a commodity in special support to overall rural communities' livelihood across Nepal. **Specific policy for fruit development (Fruit Nursery Policy, Orchard Establishment and Management Policy, Fruit Processing, Fruit Export and Import Policies etc.) are still lacking in the country.**

2.3 Technological Development

From traditional methods of growing indigenous seedling varieties, Nepal has progressed significantly in developing fruit plant propagation technologieswith different methods of grafting including stone grafting in mango. Biotechnology such as tissue culture is contributing to produce disease free saplings in banana and citrus. Water harvesting and multiple use of water system, and drip and sprinkler irrigation technology are contributing in efficient utilization of water. Improvement in farm yard manure, composting and vermi-composting technologiesare gradually replacing chemical fertilizers in horticulture and is contributing to improving soil fertility and fruit quality.

Few varieties have been released by Variety Releasing Committee such as Sun Kagati-1 and Sun Kagati-2***, but there are no any released varieties in*** major fruit crops. Most of varieties are introduced from abroad and adapted in different ecological zones in Nepal. The common / popular varieties grown in Nepal in main fruit crops are: 15 varieties in mango, 7 varieties in banana, 7 varieties in Litchi, 4 varieties in areca nut, 10 varieties in mandarin, 8 varieties in sweet orange, 6 varieties in acid lime, 11 varieties in apple, 10 varieties in pear, 7 varieties in kiwi, 5 varieties in walnut. The other fruit varieties are given in **Annex -2 in volume 2Annexure.**

2.4 Production and Productivity Enhancement

Area expansion and production of fruits have increased significantly in the last six decades. Available data show that area and production of fruits have doubled during last 15 years (2000/01 to 2015/16). Though area and production of fruits have increased, fruit yield is hovering around 10 MT/ha. The performance of the fruit sector during last 15 years are presented in table 2, 3, 4 and 5 below:

Table 2: Area and Production of Fruits in Nepal

Year	Total area ('000 ha)	Productive Area ('000 MT)	Production ('000 MT)	Productivity (MT/ha)
2000/01	74	48	487	10.12
2001/02	78	50	474	9.51
2002/03	80	51	519	10.17
2003/04	87	54	511	9.45
2004/05	89	55	553	9.99
2005/06	92	57	535	9.47
2006/07	95	58	575	9.99
2007/08	100	63	631	9.94
2008/09	104	69	686	9.98
2009/10	107	71	707	10.00
2010/11	118	79	794	10.03
2011/12	139	101	1030	10.17
2012/13	138	101	939	9.25
2013/14	150	111	980	8.86
2014/15	150	111	993	8.96

Source: MOAD, 2015

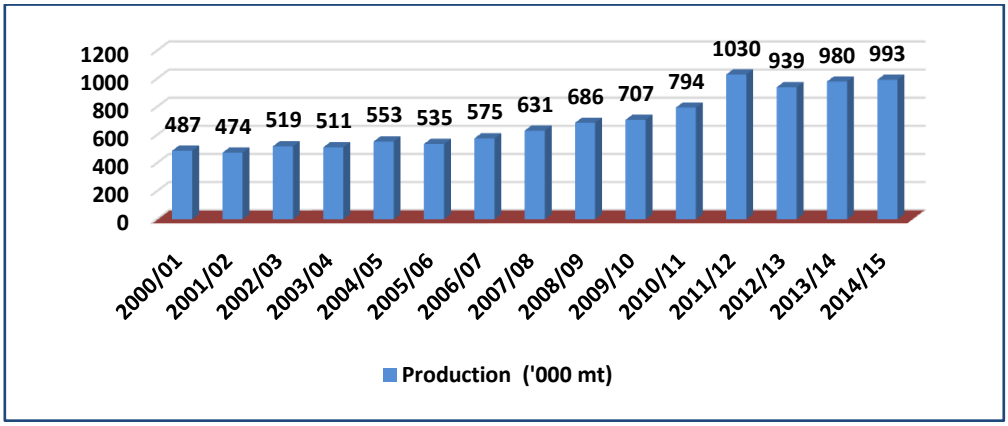


Figure 1: Total fruit production ('000 MT)

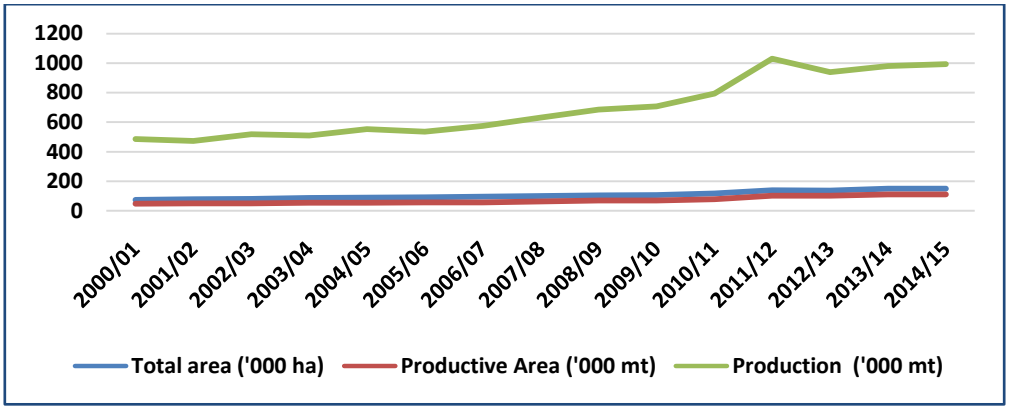


Figure 2: Trend of Fruits in last 15 years in Nepal

Table 3: Area and production of Tropical Fruits in Nepal

Year	Total area ('000 ha)	Productive Area ('000 MT)	Production ('000 MT)	Productivity (MT/ha)
2000/01	37	26	276	10.68
2001/02	39	27	251	9.47
2002/03	40	27	287	10.66
2003/04	44	29	268	9.19
2004/05	45	30	299	10.09
2005/06	46	30	275	9.17
2006/07	47	30	306	10.08
2007/08	49	32	304	9.55
2008/09	50	34	329	9.61
2009/10	51	35	340	9.65
2010/11	58	42	419	10.98
2011/12	75	61	658	10.78
2012/13	76	62	600	9.64
2013/14	84	68	627	9.18
2014/15	84	69	642	9.34

Source: MOAD, 2015

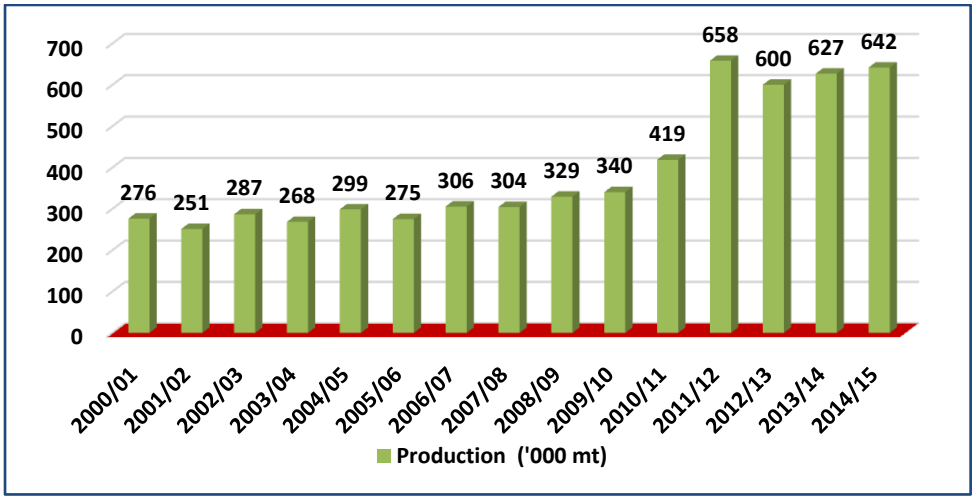


Figure 3: Tropical fruit production ('000 MT)

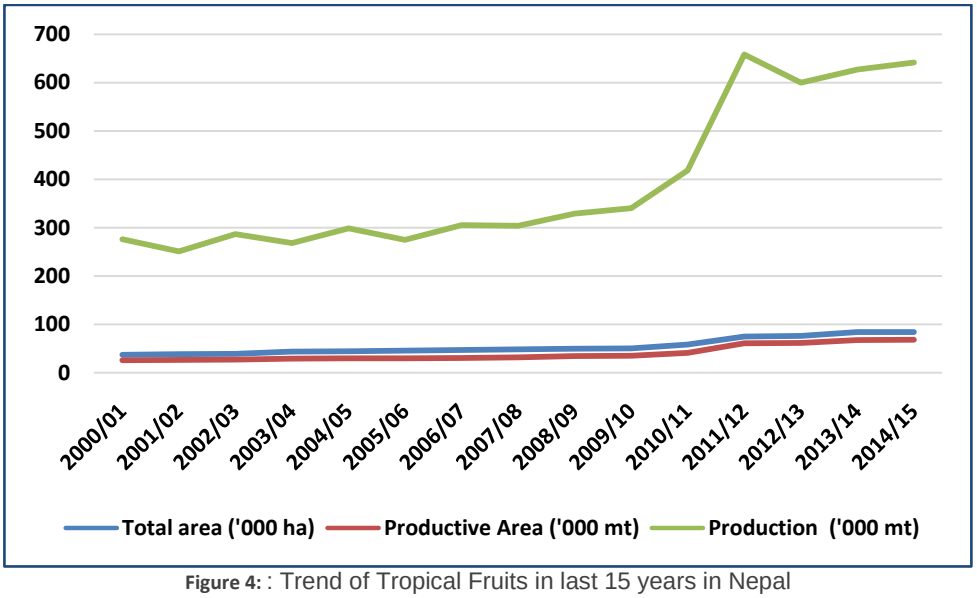


Figure 4: : Trend of Tropical Fruits in last 15 years in Nepal

Table 4: Area and production of Citrus Fruits in Nepal

Year	Total area ('000 ha)	Productive Area ('000 MT)	Production ('000 MT)	Productivity (MT/ha)
2000/01	21	12	122	10.23
2001/02	22	13	131	10.38
2002/03	24	13	139	10.45
2003/04	25	14	148	10.62
2004/05	26	15	157	10.75
2005/06	27	15	164	10.79
2006/07	28	16	172	10.86
2007/08	31	20	226	11.37
2008/09	32	22	254	11.29
2009/10	34	23	259	11.32
2010/11	36	24	264	11.17
2011/12	38	24	241	10.00
2012/13	37	24	216	9.14
2013/14	39	25	224	8.80
2014/15	39	25	223	8.82

Source: MOAD, 2015

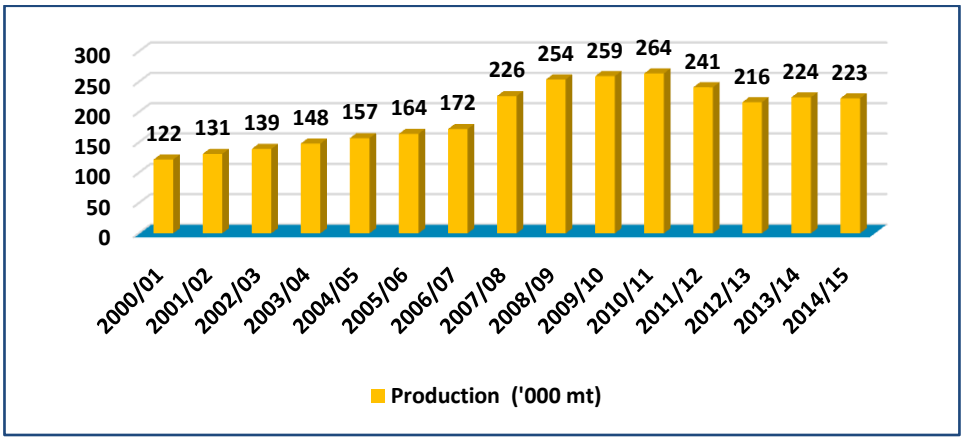


Figure 5: Citrus fruit production ('000 MT)

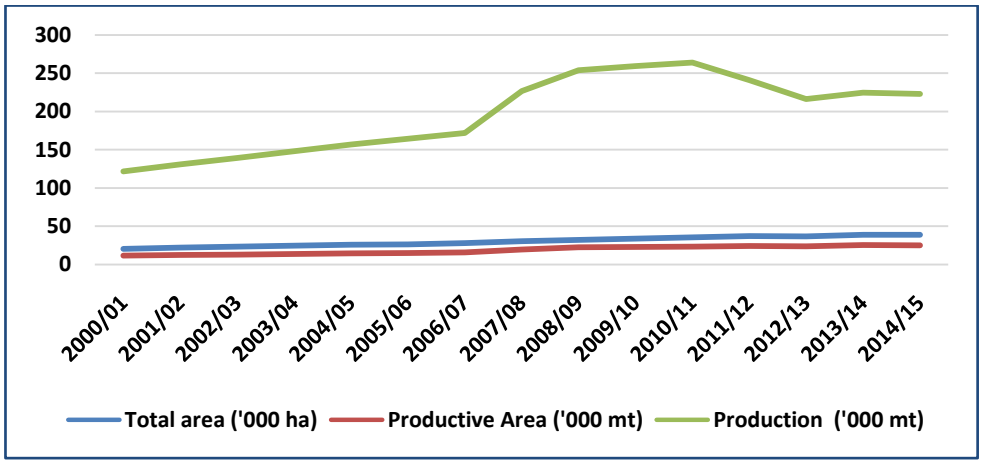


Figure 6: Trend of Citrus Fruits in last 15 years in Nepal

Table 5: **Area and production of Temperate Fruits in Nepal**

Year	Total area ('000 ha)	Productive Area ('000 MT)	Production ('000 MT)	Productivity (MT/ha)
2000/01	16	10	90	8.58
2001/02	17	11	92	8.60
2002/03	17	11	93	8.61
2003/04	18	11	95	8.65
2004/05	19	11	97	8.72
2005/06	19	11	96	8.49
2006/07	20	11	98	8.52
2007/08	20	12	100	8.56

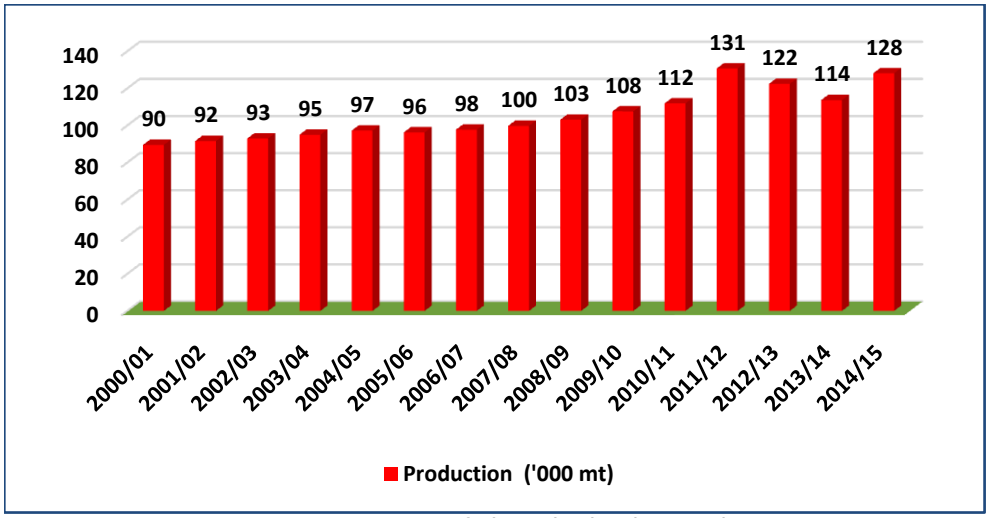


Figure 7: Temperate fruit production ('000 MT)

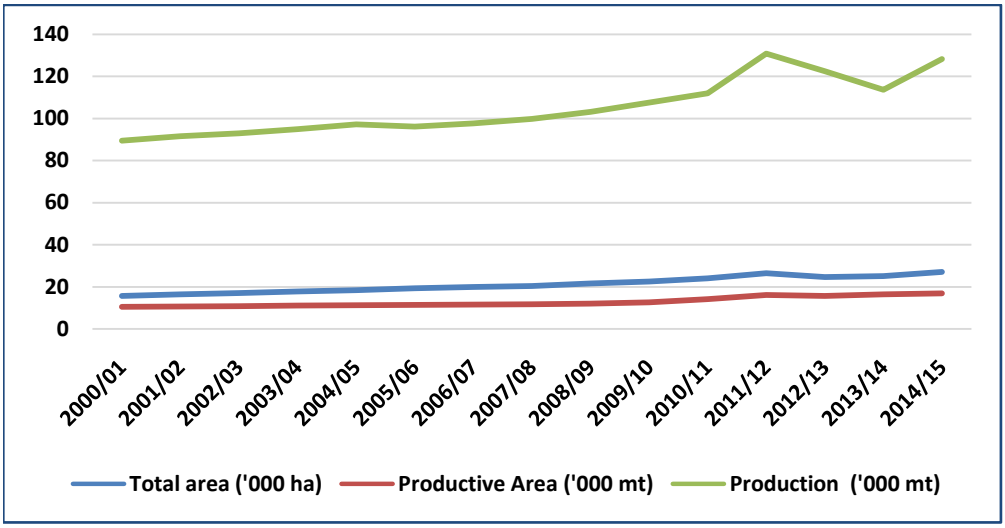


Figure 8: Trend of Temperate Fruits in last 15 years in Nepal

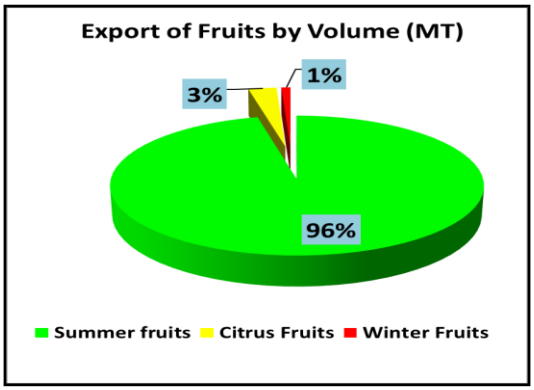
2.4.1 *Import* and Export of Fruits

The recent scenario import and export of fruits in Nepal are presented in Table 6 and fig 9, 10, 11

Table 6: **Import and Export of Fruits in Nepal**

Fruits	Import		Export	
	Volume (MT)	Values (NRs.)	Volume (MT)	Values (NRs.)
Summer fruits	110765	6879595221	15824	2841629170
Citrus Fruits	30242	1406894111	452	5272891
Winter Fruits	48151	2243149422	146	3501978
Total	**189,158**	**10529638754**	**16422**	**2850404039**

Source: MoAD, 2014/15



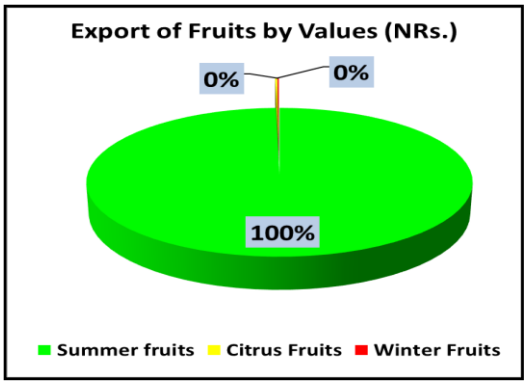


Figure 9: Export of fruits by volume and values

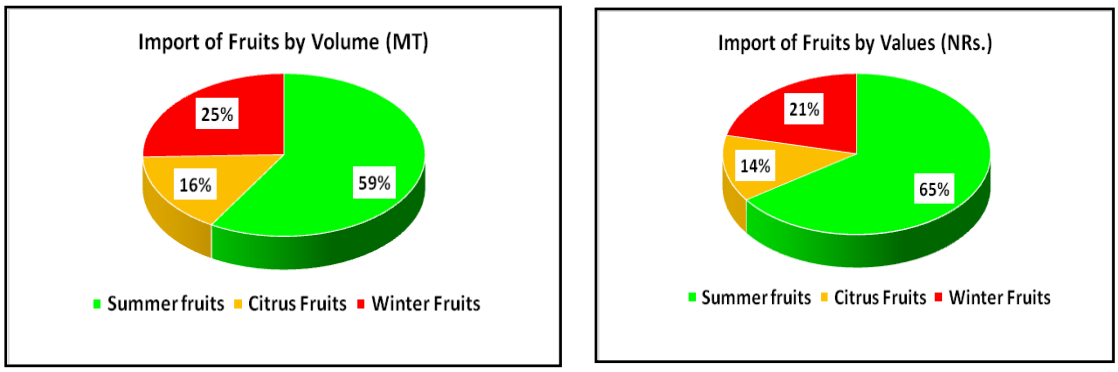


Figure 10: Import of Fruits by Volume and Values Year?

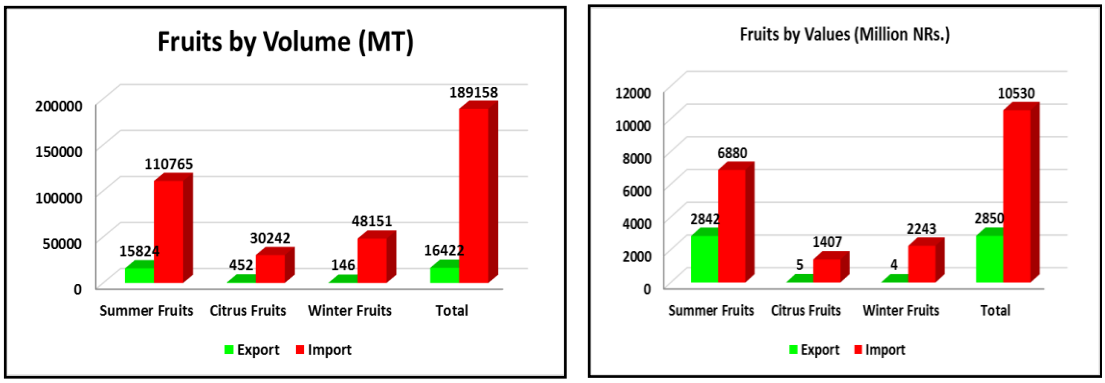


Figure 11: Comparison of Export and Import of fruits by volume and values

2.5 Infrastructure Development

The basic infrastructures required for fruit development in a sustainable way are: (1) quality sapling production infrastructures (mist houses, tissue culture labs, modern grafting and nursery houses, etc.) (2) Transportation facilities, (3) irrigation facilities, (4) value addition facilities (mechanical harvesting, grading, packaging, processing, etc.)and (5) marketing facilities. Transportation is the key link in the value chain of any commodities including fruits. Road transport is the only possible means of transportation of fruits in Nepal from high hill through mid-hillsto Terai. There were no motorable roads in Nepal during the early eighties. Now, the scenario has changed. At present, the total length of all kinds of road is 25,115 km (MOF, 2010). There are different north-south roads and east-west highways extending from the eastern border to the western border. Mid-hill highway is under construction from east to west. The number of north-south roads is more than a dozen. Such road network has provided opportunities to expand areas under fruit crops manifold. For example, Karnali Highway has now shown its impact on the market access of apple production of those areas. Road transport in Nepal consists of mainly trucks owned by the private transport companies. Most district headquarters are connected by roads. Now remote districts such as Manang, Mustang, Kalikot and Jumla are also connected by road. It has opened new avenue for the promotion of high value horticultural products such as apple, walnut, almond, etc. for both export promotion and import substitution. However, there are still many fruit production pockets having no access to road. Though many district headquarters are connected by road transportation network, the horticultural production pockets are yet to be connected by roads. Although APP emphasized connecting potential production pockets by roads, the budget allocated for agricultural roads have been diverted to connect townships (FAO, 2010). The Competition Promotion and Market Protection Act of 2007 are in place. However, this law needs to be implemented in practice to deal with

disputes in transport syndicates. Fruitsfrom such production areas are transported by the porters using *Dokos* or mules backas the means of transport. In some hilly areas mules are used to transport fruits from production areas to the road heads. In the Terai, bullock cartsare used where there is motorable road access.Regarding irrigation facilities, fruit crops in Nepal are generallygrown under rain fed conditions. But some commercial farmers havestarted to establish plastic ponds, drip or sprinkle irrigation facilities intheir orchards. In hilly and mountainous areas, cellar stores have nowbecoming popular to store fruits in the production areas especially forapple and citrus. Besides, these areas few cold stores in the vicinities ofhighways and wholesale markets are cropping up. In recent years, many collection centresare developed in the production areas and wholesale market facilities atthe strategic points. For example, wholesale cum retail market facilitiesare developed in Kathmandu, Narayangadh, Butwal, Kohalpur, Attariya,Pokhara, Dhalkebar, Dharan and Birtamod. Fruit processing facilitiesare also developed in many strategic points by private entrepreneursand cooperatives. But progress on the development of volume production, grading andpackaging facilities is very limited. Hence, grading and packaging operationsare manually done.

2.6 Nursery Developmentand Sapling Production

Review of the fruit plant production by government sector goes back to the establishment of fruit nurseries at Chhauni, Balaju and Godawari in 1937. Asexual propagation of fruit plants (apple, pear, peach, plum etc.) was started after the establishment of these three nurseries at the government level in earlier days.Establishment of horticulture farms during sixties were mainly engaged in adaptive researches on imported exotic fruit germplasms. Researches were carried out to find out appropriate method and time of propagation under Kathmandu conditions and in the horticultural farms of different ecological zones. Up to 1972 horticulture extension in the vicinities of farms were the responsibilities of horticultural farms. In Terai, grafted plants of mango used to be imported from private nurseries of India located near the border. When many other horticultural farms were established during the sixties, fruit plant production and distribution programs were implemented by the government through these farms. The celebration of the Agriculture year in1975 was very important milestones in fruit sapling production and distribution. Thefruit plant production function was the public sector function up to 1974 and there was always shortage of fruit plants in the country. Realizing this fact, the government initiated establishing private nurseries in intensive fruit production pockets from 1975onwards. Nursery owners were trained in different aspects of fruit plant production and they were then supported to establish the nurseries. Then private nurseries were established in many parts of the country and the function of fruit sapling production was gradually shifted from the government farms to these private nurseries.

In 2014, the number of registered private fruit nurseries in Nepal reached to 32 for citrus, 161 for winter fruits and 53 for summer fruits (FDD, 2014). About 2.5 million fruit saplings are produced and distributed annually, and the share of private nurseries is more than 90 percent. However, in many cases, even when planting materials were available, quality of planting materials was low in absence of regular monitoring of nurseries and due to absence of nursery act and guideline as an issue (FDD, 2013).

2.7 History of Fruit Research and Extension

The department of horticulture established in 1967 had both research and extension responsibilities. Research activities were focused on introduction, selection and identification of fruit crop varieties, root stock selection, development of propagation methods under local conditions and orchard establishment. Thoughthe Horticulture Department of 1967 had no extension network at grass root level, extension activities used to be carried out by the horticulture farms/centres within their limited command areas. Extension activities were focused on site selection, planting material distribution, demonstration on orchard layout.

When five different departments were integrated to one Department of agriculture in 1972, with integrated responsibility of research and extension both, the fruit research continued in farm centers as it was under the separate department of horticulture and the responsibility of horticulture extension was given to District Agriculture Development Office and horticulture farm/centres administratively under Regional Directorate and technical link with commodity divisions. At present, Horticulture Development Officers are in DADO offices responsible for horticulture extension including fruits.

While establishing NARC in 2048 B.S. most specialized horticulture farms were kept under DOA and senior horticulturists also remained with DOA.However, thesehorticulture farms/station (e.g. Horticulture farm Kirtipur, Sarlahi, and Marpha etc.) were not mandated for research. Fruit research in NARC has been in low key due to lack of specialized horticulture research farms. The horticulture units of most NARC research centres are cereal crop dominated.Horticulture research has been grossly underfunded to address the research needs of time.

2.8 Fruit Processing

Fruit processing industries are established in Nepal by private investors. Wine industries, pickles, juice, jam and marmalades are produced in Nepal. Brandy and ciders are also produced from fruits in remote areas where fresh fruit marketing is difficult using unsold fruits. Some industries are established under joint venture. Such joint fruit processing industries are from domestic level to large industries. However, the raw fruit productions as per the demand of such processing industries are not linked properly with the processing varieties development and most industry use unsold fresh fruits. Some of the joint venture processing industries established in Nepal import fruits for their industries blaming that Nepal has no desired processing varieties they need. Research, development and production of processing varieties are still lacking in Nepal.

2.9 Recent Government Guidelines

Recently, government of Nepal has approved two important guidelines for fruit decade program implementation and fruit sapling production infrastructure development guideline. The major provisions of these guidelines are as under:

1. Fruit Decade Implementation Guideline, 2016 (2073)

This guideline summarizes the progress of fruit development so far made and has envisaged the development program for the next ten years. Under the provision of this guideline, capital subsidy program for additional sapling production infrastructure (Tissue culture lab, net house, shed house, green house) has been proposed. Quality saplings will be produced during 2016-17 (2073/74)to celebrate year ~~2018~~2075 B.S.as fruit plantation year. During first five year of fruit decade quality saplings will be made available to the orchardists as short term strategy and next five years will be emphasized for new technology transfer and post-harvest handling and processing industries development.

This guideline has classified fruits and major districts for nursery establishment as presented in Table7.

Table 7**: Classification of fruits as per districts and number of additional nurseries**

Fruit categories	Major fruits	Number of nursery per district	Districts
Temperate fruits	Apple, Walnut, Apricot	One nursery per district =10	Jumla, Humla, Dolpa, Mugu, Kalikot, Mustang, Manang, Rasuwa, Solu and Baitadi
Warm Temperate fruits	Pomegranate, Hog-plum, Kiwi, Pear, Persimmon	Two nurseries per district = 10	Dolakha, Sindhupalchowk, Ilam, Bhaktapur, Sindhul, Dhading, Salyan, Dailekh, Kathmandu, Makawanpur
Subtropical fruits	Citrus (Mandarin, Lime and Sweet orange)	One nursery per district =20	Bhojpur, Udaipur, Terhathum, Dhankuta, Palpa, Baglung, Kaski, Chitwan, Ramechhap, Kavrepalanchowk, Gorkha, Tanahun, Syangja, Arghakhanchi, Salyan, Dailekh, Doti, Dadeldhura, Kailali,

Tropical fruits	Mango, Litchi, Banana and Papaya	One nursery per district =20	Bara, Rautahat, Siraha, Saptari, Sarlahi, Rupandehi, Banke, Bardia, Surkhet, Kanchanpur
	Olive (Net house, shed house)	FDD=10	Budget in FDD for launch of program in the production districts
	Banana (Tissue culture lab)	FDD=2	Budget in FDD for launch of program in the production districts

Source: FDD, Kirtipur

The guideline has also specified the major activities, specific fruits for selected districts and mainresponsible organization and persons for joint functions. As the responsibilities for preparing and implementing the fruit research activities rest on different organization under MoAD (NARC, DOA and DADOs) a strong steering committee under the chairpersonship of Secretary MoAD represented by DG/DOA, Dean of university of Agriculture and Forestry (UAF) and ED/NARC be formed for integrated fruit research and development.

2. Fruit Sapling Production Infrastructure Development Guideline,2016(2073)

The main objectives of this guideline include the following:

- Promote and support quality fruit sapling production by private sector establishing and managing infrastructures like tissue culture lab, green house, screen house and shed houses
- Capacitate the individual nursery owners/farmer's group/cooperatives/company to produce quality fruit sapling
- Help to increase productivity and production of fruit crops using quality sapling
- Supply required quality fruit saplings for fruit decade which is going to be implemented from 2016-17 to 2026/27(2073/74 -2082/83)

These guidelines also have prescribed and clearly described the procedures for applying for support, different technical committees at centraland district levels have been formed. The guideline has set the norms, fund flow mechanism, percentage of subsidy on different infrastructures, monitoring process, production, distribution and quality control mechanism and other necessary requirements. These guidelines, if applied properly, the fruit decade will be successfully implemented.

2.10 Prioritization of Major Fruit Districts

MoAD/FDD has identified major fruits, development regions and districts as presented in Table8.

Table 8: **Prioritized districts for commercial fruit production in Nepal**

Fruits	Development Region	Potential Districts	Total districts
Citrus	Eastern	Taplejung, Panchthar, Terhathum, Sankhuwasabha, Dhankuta, Khotang, Bhojpur, Okhaldhunga, Udayapur, Solukhumbu and Illam (11)	42
	Central	Kavre, Sindhuli, Dolkha, Dhading, Sindhupalchok, Ramechhap, Kathmandu, Lalitpur, Bhaktapur, Makawanpur, Nuwakot (11)	
	Western	Gorkha, Lamjung, Tanahun, Kaski, Syangja, Parbat, Baglung, Myagdi, Palpa, Gulmi, Arghakhanchi (11)	
	Mid-Western	Sallyan, Rolpa, Rukum, Dailekh, Pyuthan (5)	
	Far-Western	Achham, Doti, Baitadi, Dadeldhura (4)	
Apple	Western	Mustang (1)	12
	Mid-Western	Dolpa, Humla, Jumla, Mugu, Kalikot, Rolpa, Rukum (7)	
	Far-Western	Baitadi, Bajhang, Bajura, Darchula (4)	
Mango and Litchi	Eastern	Siraha, Saptari, Udaypur (3)	19
	Central	Mahottari, Sarlahi, Dhanusha, Bara, Parsa, Rautahat, Dhading (7)	
	Western	Nawalparasi, Kapilvastu, Rupendehi (3)	
	Mid-Western	Dang, Banke, Bardia, Surkhet (4)	
	Far-Western	Kailali, Kanchanpur (2)	
Walnut	Western	Mustang (1)	10
	Mid-Western	Humla, Jumla, Dolpa, Mugu, Kalikot (5)	
	Far-Western	Baitadi, Bajhang, Bajura, Darchula (4)	
Banana	Eastern	Morang, Saptari, Udaypur (3)	12
	Central	Sarlahi, Chitwan, Nuwakot (3)	
	Western	Nawalparasi, Rupendehi (2)	
	Mid-Western	Banke, Bardia (2)	
	Far-Western	Kailali, Kanchanpur (2)	
Papaya	Central	Sarlahi, Chitwan, Nuwakot (3)	8
	Western	Nawalparasi, Gorkha (2)	
	Mid-Western	Banke, Dang (2)	
	Far-Western	Kailali (1)	
Pineapple	Eastern	Morang, Udaypur (2)	5
	Central	Chitwan, Nuwakot, Dhading (3)	
Pear	Eastern	Panchthar, Terathum, Dhankuta (3)	13
	Central	Kathmandu, Bhaktapur, Lalitpur, Kavre, DhadhingandMakawanpur (6)	
	Western	Gorkha, Tanahun, Syangja, Palpa (4)	
Areca nut	Eastern	Jhapa, Morang and Sunsari (3)	3

Source: FDD Year Book, 2070/71

3. Field Survey for Primary Information Collection

Primary data and information were collected from 11 DADOs, 10 Government Farms/Stations, 22 Expert's interviews, 31 Private orchard owners, 21 Nursery owners, 5 Fruit processors, 8 Importers, 2 Exporters, 9 Wholesalers, 9 Retailers and 7 Consumers. The details information gathered from these respondents are presented in Annex 3 to Annex 12 in a separate Volume 2.

3.1 District Agriculture Development Offices (DADOs)

Considering three ecological belts, five development regions and the seven new provinces of Nepal, information were collected from 11 sample districts. Among them, three were from Terai, six from mid-hill and two from mountain districts as presented in Table 9

Table 9: Districts sampled and surveyed with reference to main fruits

S. No	Ecological Regions	Districts Surveyed	Main fruits
1	Temperate Region	Jumla and Mustang	Apple, Walnut, Apricot
2	Warm Temperate & Sub-tropical Region	Dadeldhura, Dailekh, Palpa Syangja, Sindhuli &Dhankuta	Mandarin, Junar, Acid Lime, Pear, Kiwi, Avocado
3	Tropical Region	Sapatari, Sarlahi and kailali	Mango, Litchi, Banana and Papaya

In all the surveyed ***sample***districts, specific pockets for major fruits have been identified and there exists sufficient scope for area expansion and increase production and productivity through supplying quality inputs (saplings, improved orchard management practices, rejuvenation of old orchards, using appropriate plant protection inputs, post-harvest tools and improved post-harvest handling and marketing management.

Some special focus program in apple, mandarin, banana and mango are implemented in different agro-ecological zones according to their potentialities by government of Nepal through DADOs.DADOs are providing facilities to the nursery owner of Terai region with 50 percent subsidies in rootstock's seeds, nursery tools and equipment purchase. In mid-hill region nursery owners are facilitated with trifoliate seeds for rootstock, screen house, nursery tools and equipment whereas in high-hill region nursery owners are getting crab apple and edimayal seeds for rootstock, callusing house for grafted saplings, irrigation and pest management facilities.

Orchard owners of Terai region are provided with gutter sprayer, power sprayer, fruit saplings at 50 percent subsidy and training and pest management as demanded by farmers, in mid and high-hill farmers are being facilitated with pruning saw, secateurs, plastic pond, plastic crate, and digital balance as well as pest management services.

Mostly fruit processors of Terai and mid-hill regions are not supported with processing equipment but in high-hill districts such as Mustang and Jumlahave provided solar dryer, slicer, packaging boxes and potassium meta bi-sulphide (KMS) as a preservative for juice preservation. Similarly, apple entrepreneurs especially transporters are supported with packaging cartoons of 20 kg capacity with 75 percent subsidy for marketing.

DADO office admitted that the technical service provided to the farmers is not sufficient and there are no any other agencies to support them technically; rather the agro-vets support for pest management though they take money for inputs.

All the 11 DADOs confessed that the existing extension system is not satisfactory.That is why modification with capacity building of orchard owners, management of old orchards, introduction of new high yielding varieties with at least 10 years work plan for commercial farming should be adopted. Similarly, training should be based on practical work instead of traditional one. Appropriate fruit cultivation practices and post-harvest techniques should be disseminated through mass media. The new concept of community fruit farming should be developed in larger scale.

There are no any private institutions to support the fruit cultivation in surveyed districts but after DADO other government andgovernment owned institutions have supported in some districts. In Dhankuta, DDC used to provide small funds for awareness and pest management program. Similarly, AapasiSahayogi Kendra has supported for mandarin production. In Jumla, HIMALI project has supported for the production of saplings of apple. A sizable support is given by HVAP, PMAMP and World Vision for the value chain development in apple. In Dadeldhura, LI-BIRD has provided saplings for homestead garden. Two government owned projects, RJKIP and RISM-FP have supported in fruit sector

where RJKIP has supported commercial banana farmers in Kailali district and RISM-FP has supported in fruit cultivation, cold storage construction and processing in ten districts of mid andFar-Western Development Regions through competitive matching grant funds.Remaining districts namely, Saptari, Sarlahi, Sindhuli,Palpa and Dailekh districts have not got any support from any other institutions except DADOs from regular annual program.

The Terai districts supply (trade out) mango, banana and litchi, mid-hill districts supply mandarin, sweet orange, lime, avocado, and pear whereas high hill districts supply apple, walnut, etc. Likewise, the Terai districts import (trade in) apple, mandarin, grapes, lime, pomegranate, papaya, mid-hill districts trade in apple, mango, banana, litchi, Nagpure Mandarin, lime, papaya, pineapple whereas high hill districts trade in Mandarin, Banana, Mango, pineapple mostly(Table 10).

Table 10**: Fruits trade inand trade out in the surveyed districts**

S. No.	District	Fruits trade out from district	Fruits trade in to district
1.	Dhankuta	Mandarin, Mango, Litchi, Custard apple, Avocado, Pear, Plum	Apple, Grapes, Kinnow, Nagpure Mandarin, Banana
2.	Saptari	Mango	Lime, Pomegranate, Papaya, Apple, Mandarin, Grapes
3.	Sarlahi	Mango, Litchi	Lime, Pomegranate, Papaya, Apple, Mandarin, Grapes
4.	Sindhuli	Sweet orange, mandarin	Papaya, Pomegranate, Banana, Apple, Nagpure Mandarin, Grapes, Lime
5.	Syangja	Mandarin	Mango,Litchi,Banana, Apple, Grapes, Pomegranate
6.	Palpa	Mandarin	Apple, Mango, Banana, Litchi, NagpureMandarin, Lime, Papaya, Pineapple
7.	Mustang	Apple and Walnut	Mandarin, Banana, Mango, pineapple
8.	Dailekh	Mandarin	Apple, Banana, Mango, Grapes, Pineapple
9.	Jumla	Apple and Walnut	Banana, Mandarin, Mango
10.	Dadeldhura	Mandarin, Mausambi, Walnut	Lime, Pomegranate, Papaya, Apple, Mandarin, Grapes
11.	Kailali	Banana & Mandarin	Apple, Grapes, Pomegranate, Lime, Pineapple, Mandarin, Mango, Litchi

Source: Field Survey, 2017

Normally, fruits after harvesting have not been properly graded in farm gate but it has been customarily graded by retailers and wholesalers. Generally grading is practiced on the basis of size and colour of the fruits. On the basis of size, fruits are graded in four categories as A, B, C andD. In Jumla, apple fruits are graded in four categories by grading machine in the District Cooperative Union Office in headquarter and in farm gate orchard owners graded manually on the basis of size and colour. Usually packaging of fruits is done in*doko* and *bamboo* crates but nowadays modern packaging materials like cartoons of standard 10 kg and 20 kg capacity are also found to be used in Jumla and Mustang districts (Table11).

Table 11: **Grading system and materials for packaging of fruits in surveyed districts**

S. No.	District	Grading of Fruits	Packaging of Fruits
1	Dhankuta	Not in farm gate, graded by traders	Doko and cartoon
2	Saptari	Not in farm gate, graded by wholesalers	Plastic and bamboo crates
3	Sarlahi	Not in farm gate, graded by wholesalers	Plastic and bamboo crates
4	Sindhuli	Graded at farm gate as well as by traders	Cartoon
5	Syangja	Graded at farm gate as well as by traders	Plastic crate, Bamboo basket and paper cartoon
6	Palpa	Graded at farm gate as well as by traders	Cartoon
7	Mustang	Graded at farm gate as well as by traders	Cartoon
8	Dailekh	Not in farm gate, graded by wholesalers	Doko and plastic crates
9	Jumla	Graded by grading machine in headquarter while in VDCs, vendors graded manually	Cartoons
10	Dadeldhura	Not in farm gate, graded by traders	Doko, Cartoon, plastic bags
11	Kailali	Graded at farm gate as well as by traders	No packaging but covered by leaves in case of banana

Source: Field Survey, 2017

While asked about the benefit cost (B: C) ratio of fruit cultivation all DADOs admitted that cultivation of fruits has been found profitable in comparison to the cost of production. Though this profession is profitable, due to lack of cold storage facilities, occurrence of disease and pests, poor transportation facilities and interference of middlemen orchard owners are not getting expected benefit **(Annex -3 in volume 2).**

Physical facilities like office rooms are available to all DADOs but in Mustang, office rooms are not sufficient. Similarly, laboratories facilities are available in Sindhuli and Syangja but limited to plant protection and other districts are not having any laboratory facilities. Likewise, staff quarters are available in all DADOs but Dhankuta, Palpa, Dailekh and Jumla do not have sufficient quarter facilities to

their staffs. Regarding office vehicles no any vehicles are available in DADOs Mustang and Jumla whereas other DADOs have vehicles but not sufficient to mobilize technical staffs to run the program smoothly (Table12).

Table 12: **Human resources and physical facilities in surveyed DADOs**

S. No.	Districts	Human resources		Physical facilities			
		Technical Staffs	Administrative Staffs	Office room	Laboratory	Staff Quarter	Office Vehicles
1	Dhankuta	24	20	Available	Not available	Not sufficient	Pick-up -1,Lack of motorcycles
2	Saptari	34	18	Available	Not available	Available	Available
3	Sarlahi	25	14	Available	Not available	Available	Lack of motorcycles
4	Sindhuli	35	11	Available	Plant protection lab available	Available	Available
5	Syangja	28	18	Available	Plant protection lab available	Available	Available
6	Palpa	28	18	Available	Not available	Not sufficient	Available
7	Mustang	16	10	Not sufficient	Not available	Available	Vehicles needed
8	Dailekh	23	16	Available	Not available	Not sufficient	Available
9	Jumla	22	11	Available	Not available	Not sufficient	Vehicles needed
10	Dadeldhura	27	16	Available	Program to be established	Available	Available
11	Kailali	28	17	Available	Not available	Available	Available

Source: Field Survey, 2017

3.1.1 Problems and Solutions Suggested by DADOs

Among the DADOs, Dhankuta has emphasized for the management of existing orchards and gap filling program rather than new plantation and further suggested to award orchard owners and nurserymen for better orchard management and quality fruit sapling production. Mustang has highlighted to identify the commercial orchard owners first and then, classify them based on the management as Green for the top most level, Blue for medium level and Yellow for poor one and provide facilities and award accordingly. In general the problems faced by DADOs and their suggestions are as follows:

Problems faced by DADOs	Solutions suggested
• Non-availability of quality planting materials	• Establish hi-tech nursery for quality saplings production. • Provide new varieties for mother plants to nursery owners. • Provision of tools and equipment and modern sapling production infrastructure in subsidized rate.
• Absence of specially trained field technician(JT/JTA) for fruit extension	• Capacity enhancement of technical staffs in special fruits and posted and transfer accordingly • Extension system modification with capacity building of orchard owners, management of old orchards, introduction of new high yielding varieties • Link facility of e-laboratory for plant protection. • Training should be based on practical work instead of traditional one. • Appropriate fruit cultivation practices and post-harvest techniques should be disseminated through mass media. • Priority should be given to the commercial orchard owners instead of distributing one or two fruit saplings for kitchen garden and registration of commercial private farm • Farmers having at least 100 fruit trees in their orchard categorize as commercial one and should be facilitated with better subsidy scheme.

Problems faced by DADOs	Solutions suggested
• Orchard management, plant protection and post-harvest extension system is not satisfactory	• Farmers should be guaranteed that disease and pest will be managed at the time of havoc. • Clear cut policy of land bank and lease hold land for the cultivation of long gestation fruit orchards should be implemented. • Commercial famers should be trained and well equipped with all required tools and machineries. • Orchard and nursery owners should be appreciated and rewarded after unbiased monitoring and evaluation system. • Government should strengthen post-harvest management practices like harvesting, packaging, processing, cold chain system with reliable marketing network. • Networking of production to the market • Capacity enhancement of technical staffs, orchard owners, nurserymen, fruit processors etc. • Provision of soft loan, crop insurance, installation of drip irrigation, networking of production to the market, • Develop new norms to address old and large orchard management, • Provide vehicles for transport of inputs and to conduct outreach program

3.2 Horticulture Farm/Centres

During field survey 10 farm/stations were surveyed from different agro-ecological zones. Among them 8 farm/stations were from Department of Agriculture (DOA) and 2 were from Nepal Agriculture research Council (NARC) because the number of horticulture farms are more under DOA. The sampled farm/stations were:

1. Horticulture Research Center, Rajikot, Jumla (HRCRJ)under NARC
2. National Citrus Research Program, Paripatle/Dhankuta (NCRPP) under NARC
3. Temperate Region Horticulture Center, Marpha (TRHCM) under DOA
4. Tropical Region Horticulture Center, Nawalpur/Sarlahi (TRHCN) under DOA
5. Tuber Vegetable Development Center, Sindhuli (TVDCS) under DOA
6. Central Horticulture Center, Kirtipur (CHCK)
7. Horticulture Center Phaplu, Solukhumbu (HCPS)
8. Citrus Development Farm Palpa under DOA
9. Dry Fruits Development Center, Satbanjha/Baitadi (DFDCS) under DOA
10. Tropical Region Horticulture Nursery Development Center, Janakpur (TRHNDCJ) under DOA

Among sampled farms Temperate Region Horticulture Center, Marpha (TRHCM) under DOAwas established in 2018 B.S and Horticulture Center Phaplu, Solukhumbu (HCPS) was established in 2034 B.S.DOA farm/stations are involving in developmental work especially seed and sapling production, mother plant conservation whereas NARC farms are doing research works on seedling production, fruit production, pest management and post-harvest management.

The germplasm collection was found maximum in NCRPP/Dhankuta where there were 28 varieties of mandarin and all total 120 genotypes of citrus groups. Similarly, large number of mango, litchi and other tropical fruit varieties are collected and conserved in TRHCN/Sarlahi. These varieties are collected from India, Pakistan, Thailand and USA and from different parts of the country.

A large number of sub-tropical and temperate fruits are collected and conserved in CHCK/Kirtipur. The source of germplasm collection is from Japan, Thailand, USA, Europe, India and local collection from own country. A big number of temperate fruits cultivars are found collected in TRHCM/Mustang and DFDCS/Baitadi and source of collection are from India and Nepal. Some indigenous varieties of fruits are collected in every farm/stations but no separate blocks and scientific tagging and nomenclature are maintained.

Limited research works are being done in NARC farms as high density planting, pest management, irrigation management and post-harvest technology related in NCRPP, Dhankuta and selection of rootstock for grafting, varietal and post-harvest related typesome fruits research works are being done in Horticulture Research Center/Rajikot/Jumla (HRCRJ). Some adaptive type of research works are being done in TRHCM/Mustang and DFDCS/Baitadi.

Farm/stations under DOAare producing and distributing fruit saplings according to the balance sheet of FDD in their command areas whereas selling and distribution of fruit saplings are not confined to any districts and distributed all over the country in the case of farm/stations under NARC.

Regarding the mechanization of farms TRHCN has practised little mechanization by using tractor, power tiller, sprinkler and drip irrigation, power sprayer in farm work. In the same manner CHCK has used tractor for ploughing the field, drip, mist, and sprinkler for irrigation purpose andgreen house for sapling production. Others farm/stations have not practised mechanization and they are performing their farm works manually.

Outreach program under NARC farm is being performed in the farmers' field by conducting problem based research with the collaboration of DADOs whereas Farm/canters under DOA has been performing monitoring of private nurseries and orchardsand provide technical support through training and observation in coordination with DADOs.

3.2.1 Problems and Solutions Suggested by Farm/Centers

Problems faced by Farm/Centers	Solutions suggested
• Farm fencing and security management is poor and infrastructures are old and ruined and no good residential facilities	• Improve farm fencing and security • Develop modern quarter facilities • Develop infrastructure facilities like labs, working sheds and modern plant propagation infrastructures
• Farm staffs are demotivated due to lack of incentives, skill training and vehicles to conduct outreach program and carrying of inputs etc.	• Provide overtime incentive and risk allowance for the laboratory staffs • Capacity enhancement of farm technicians through timely training and observation visits in and outside country. • Vehicle facilityto attract the employee to work in the farm and its command areas
• Lack of farm/center management specific guideline and insufficient budget allocation (*Horticulture farm/stations are like public hospitals and require 24-hour care and maintenance for bio-research, plant propagation and other activities*)	• Formulate and execute specific policy guideline for farm management,reform the deputation system of staff as vertical promotion to work on specific fruits crops and scientific transfer system in both DOA and NARC farms • Allocate enough budget to manage farm/centers employing enough daily workers and for farm mechanization, • Develop farm as a practical training resource centers

Problems faced by Farm/Centers	Solutions suggested
• No modern facilities for quality sapling production, extinct germplasms and unidentified mother plants	• Establish high-tech nursery for the production of disease free saplings. • Introduction of new and improved varieties of different fruits. • Identification of existing germplasm, mother plants and fruit varieties with scientific nomenclature, tagging and help to develop separate mother plant block
• Poor linkage with private sectors, processors and exporters	• The role of farms/stations should be modified to help the private fruit orchard for commercialization by developing sample demo plot in the farm for the demonstration of improved technology, producing quality fruit saplings, conducting training and observation visits programs • Allocate enough budget for orchard management and outreach program so that farm/station can disseminate improve technology to the orchardist, processors and exporters with value chain based program as and when needed, so that all stakeholders take the ownership

Basic information of different farm/stations and the annual production of fruit saplings are given in **Annex 4in volume 2 Annexure.**

3.3 Fruit Nurseries

Altogether 21 private fruit nurseries were surveyed in 11 districts considering three ecological belts. Among them 6 were from tropical districts, 12 were from sub-tropical districts and 3 were from temperate districts. The basic information gathered during survey is presented in **Annex 5of volume 2 Annexure.**

Among 21 nurseries surveyed majority of tropical region nurserymen (47%) usually used to collect seeds for rootstock locally. Similarly, sub-tropical and temperate region nurserymen (38%) used to buy seeds for rootstock production from the farm/stations. Few nurserymen (14%) used to buy seeds from farm as well as from local vendors.

Likewise, majority of the nurserymen (90%) of all regions had their own mother plants for scions and they use their own scions for grafted saplings production whereas few nurserymen (10%) of sub-tropical region use scions of farm/stations as well as their own mother plants scions.

While asking about the irrigation facilities about 50% of the nurserymen had been using natural source (*Khola)* whereas few nurserymen (20%) were using canal as a source of water for irrigation in sub-tropical and temperate regions. Almost one third of nurserymen (33%) had boring facility as a source of water for irrigation in the tropical region where they use motor pump or pumping set for irrigation purpose.

While asking about the application of manure and fertilizers to grow nursery plants one third of nurserymen (38%) use both compost manure and chemical fertilizers, about two third of nurserymen (62%) do not use any chemical fertilizers but all nurserymenof tropical, sub-tropical and temperate regions are found to use compost manure for the production of rootstocks and saplings. More than half

of the nurserymen (57%) used to apply manure and fertilizers two times in a year, nearly one third (28%) used to apply three times while few of them (15%) usually apply one time.

While selling saplings, more than two third of nurserymen (71%) use plastic sheet, jute sack and moss as a packaging materials for sub-tropical and temperate fruits saplings whereas less than one third of nurserymen (29%) use paddy straw and poly pot for packing tropical fruit saplings.

Among the 21 nurserymen, more than one third (38%) have got training for nursery sapling production from respective DADOs whereas the same number of nurserymen have got training from farm/stations and very few (1%) have got training from private sectors while 15% nurserymen have not got any kind of formal trainings for sapling production.

Regarding the support for private nursery establishment and functioning about one fourth of nurserymen (24%) have got support as cash (7 lakhs) for screen house construction and nursery tools and equipment as kind from DADOs, a few nurserymen (15%) has got support from foreign aided projects (RISM-FP, HVAP, RJKIP) as cash (up to 24 lakhs) for screen house construction, green net house construction and old nursery strengthening program. More than one third of nurserymen (38%) have got support from both institutions i.e. DADOs and foreign aided projects while nearly one fourth of nurserymen (23%) have not got any kind of support from any institutions.

3.3.1 Problems Faced by Nurserymen

Problems faced by Nurseries	Solutions suggested
• Absence of screen house especially for the production of citrus saplings	• Support in construction and management of high tech screen house for qualitative and quantitative citrus fruits saplings production Capacity development skill training of grafting and tissue culture
• Problem of disease and pests	• Capacity enhancement training on pest control to nurserymen
• Having no any guarantee of selling of fruit saplings	and guarantee of selling of saplings according to the balance sheet

3.4 Orchard Owners

Altogether 31 private orchards were surveyed in 11 districts considering three ecological belts. Among them 9 were from tropical districts, 17 from sub-tropical districts and 5 from temperate districts. The basic information gathered during survey has been given in Annex 6 in volume 2 Annexure.

Among the respondents the sub-tropical and temperate fruit orchard owners have been found usually trained and pruned their orchard trees in the month of December-January where they remove dead, diseased, broken, dense branches, suckers and use Bordeaux paste for wound protection while tropical regions orchard owners have not trained and pruned their fruit trees. On the other hand banana orchard owners generally used to remove dry and dead leaves of banana mother plants in the month of October-November. However, all the orchard owners of all three regions practiced weeding of orchard trees as and when needed.

Regarding the application of manure and fertilizers all orchard owners have responded about the use of compost in their orchard but only 26 percent respondents had been using fertilizers in their orchards. As far as frequency of application of manure and fertilizers is concern 71 respondents have been applying one time while only 29 percent have been using it for two times.

Concerning the mechanization in the orchard almost half of the respondents i.e. 48 percent have been using tractor, power tiller, drip irrigation, foot sprayer, and gutter sprayer machineries for their convenience while 52 percent respondents do not have experiences mechanization in their orchards.

For the training point of view 26 percent respondents got training from DADOs, 13 percent from Farm/stations and 13 percent both from DADOs and Farm/stations whereas 48 percent orchard owners did not get any trainings from any institutions for fruit orchard management.

In relation to post-harvest practices 58 percent respondents have been using tools (secateurs, sickle etc.) for harvesting fruits while 42 percent orchard owners plucking their fruits by hand. After harvesting 74 percent orchard owners were found grading their fruit according to the size of fruits (A, B, C grade) before selling while 26 percent respondents replied that they did notgrade their fruits. In the case of banana, grading is practiced in the ripening chamber. As far as packaging of fruits is concerned 23 percent respondents used to pack fruits in a traditional manner i.e. in *DoKo,* 26 percent in plastic crates, 13 percent in cartoons whereas 19 percent use all the three packaging material to pack their fruits while another 19 percent respondents do not use any kind of packaging material for packing the fruits and such fruits are used to be packed by the traders whom they sold out.

While asking about the selling of fresh fruits 39 percent respondents have sold their fruits in the local market by their own effort whereas 55 percent respondents have given to fruit contractors who came to their orchards and only 6 percent orchard owners sold their fruits through cooperatives.

All the respondents from tropical, sub-tropical and temperate regions have stated that fruit cultivation business was profitable to them while comparing with the cost of production although they have to bear the post-harvest losses with the types of fruits as 5-6 percent in mango, 8-10 percent in citrus, 10-12 percent in apple and 10-15 percent in banana.

Regarding the support for establishment and management of fruit orchard 48 percent orchard owners have got support as a cash and kind from DADOs. DADO Jumla have supported for drip irrigation (4.5 lakhs), DADO Dadeldhura for plastic pond (1 lakh) and as kind almost all DADOs have supported in fruit saplings at 50 percent subsidy, orchard tools and equipment, crates and ladder, pesticides and small irrigation facilities. Only 6 percent orchard owners have got support from foreign aided projects like Project for Agriculture Commercialization and Trade (PACT) and Rani Jamara Kularia Irrigation Project (RJKIP) as cash up to 11 lakhs from PACT for commercialization of banana fruit whereas RJKIP have supported for buying banana suckers at 50 percent subsidy and irrigation scheme. Very few orchard owners (4 percent) have got support from both institutions i.e. DADOs and foreign aided projects while 42 percent orchard owners have complained that they have not got any kind of support from any government and non-government organizations.

3.4.1 Problems Faced by Orchard Owners

Problems faced by Orchard Owners	Solutions suggested
• Problem of quality saplings especially lack of tissue culture suckers for the banana plantation	• Increase the capacity of tissue culture labs to increase the availability of good quality saplings for better yield
• Unavailability of modern orchard tools and equipment	• Modern orchard tools and machineries for training, pruning and harvesting
• Problem of disease and pests	• Campaigning program during the havoc of disease and pest

Problems faced by Orchard Owners	Solutions suggested
• Lacking cold storage facility for storing and marketing of fruits	• Cold storage to keep the fruits for lean season • Proper marketing network to sell the fresh as well as processed products
• Problem of transportation of perishable bulky fresh product	• Good road and special vehicle for safe transportation products

All orchard owners have suggested the campaigning program during the havoc of disease and pest, good quality saplings for better yield, good road and special vehicle for safe transportation, modern orchard tools and machineries for training, pruning and harvesting, cold storage to keep the fruits for lean season, processing plants for the production of varieties of processed products and proper marketing network to sell the fresh as well as processed final products (Detailed information in **Annex-6 volume 2 Annexure**).

3.5 Fruit Processors

All together five fruit processors were surveyed for primary data and information. Among them one was MuktiAwtar Sauce Industry from Terai district, Sarlahi. This industry was established in 2059 B.S. and producing mango juice, amot (mada) and pickles using around 20 MT locally produced mango per year as raw materials. The industry was closed during political insurgency and yet it is not functioning properly. The proprietor is facing problem due to low quality imported processed products, raw materials are to be collected from different places, unavailability of cold storage to store for lean period.

In mid-hills two industries were surveyed where mandarin, acid lime, mango, litchi, bael, banana fruits around 1050 MT has been processed per year to prepare different varieties of juices, squash, jams, jelly, pickles etc. Similarly, two processing industries were surveyed in high hill districts of Mustang and Jumla which were established after 2070 BS. These industries are producing dry slice, jam, chips, candy, brandy and cider using around 100 MT of apple, apricot and chilly. Among five industries R.K.Processing Center based in Chandannath, Jumla is functioning properly and producing around 450 kg of dry slice and jam annually and around 5500 litre of apple brandy (Detail in **Annex-7 Volume 2 Annexure**).

3.5.1 Problems Faced by Fruit Processors

All five processing industries are facing problem of low market price due to imported products basically Indian processed poor quality products, difficulty to store raw material for longer period due to poor post-harvest handling, lacking cold storage and vehicle for long term storage and transportation for distance market.

The proprietors are eagerly waiting fruit year and fruit decade to address value chain development in processing sector, subsidy increment, properly managed marketing. They have demanded subsidy in the machinery, soft loan, multi chamber cold storage facility, cultivation of suitable variety of fruits for processing, organized processing and packaging system, establishment of laboratory of WTO standard etc. Some major problems faced by processors are presented below:

Problems faced by fruit processors	Solutions suggested
• High cost of production and facing problem of low market price due to imported products basically Indian processed poor quality products	• Subsidy in the machineryand other inputs to lower down the production cost • Government support in processing and packaging system with the provision of soft loan

Problems faced by fruit processors	Solutions suggested
	• Address value chain development in processing sector
• Difficulty to store raw material for longer period due to poor post-harvest handling	• Train farmers and provide proper harvesting tools
• Lacking cold storage for long term storage • Lacking of processing varieties for standard product	• Support to construct multi chambered cold storage facility • Develop suitable variety of fruits for processing • Establishment of laboratory of WTO standard etc.
• Lacking vehicle and transportation for distance market	• Support in purchasing proper vehicle for transportation

3.6 Fruit Importers

During collection of primary data and information eight importerswere interviewed. Among them one has started his business in 2047 BS and others in between 2050 to 2065 B.S. Importers usually import fresh fruits like apple from China and India; grapes, pomegranate, banana, pineapple, papaya, mango etc. from India and litchi from Thailand and India. Small importers normally import fruits in the range of 4 MT to 32 MT whereas big importers import fruits in the range of 600 MT to 1500 MT per year. The quantity of fruit demand depends on the preference of consumers and the market.

Regarding storage of fruits after importing, Kuleshwor, Kathmandu based importers used tostore their fruits in Dugar Cold Store, Balaju cold store and Budhathoki Cold Store andSitapaila cold store whereas outside Kathmandu importers used to store their fruits in ordinary rooms. Due to lack of proper cold storages most of the fruits used to rot and they have to bear great loss and consequently consumers have to buy in higher price.

3.6.1 Problems Faced by Fruit Importers

Problems faced by fruit Importers	Solutions suggested
• Syndicate during transportation increases cost and fruits rot due to delay • Delay due to traffic check and sometimes delay in customs offices due to which fruits ***are*** damaged.	• Control syndicate and provide express transportation for perishable fruits • Qualitative and quantitative production of fruits locally in the long term • Easy access to international standard packaging materials
• While storing in cold storage due to load sheddingand lack of cool chambers sometimes total fruits used to become non-sellable	• Support to organized market networking • Matching grant supportfor the establishment of modern cold storage with cool chambers

In nut-shell the solution to these problems is that there should be qualitative and quantitative production of the fruitslocally as per their demand, easy access to packaging materials of international standard, organized market networking, and matching grant supportfor the establishment of modern cold storage with cool chambers (Details presented in **Annex-8, Volume 2 Annexure**).

3.7 Fruit Exporters

During the survey only two exporters were interviewed because export of fruits from Nepal to other countries is very rare. Of the two exporters one has started his business since 2070 BS involving 2-3 persons in Kiwi fruit and he has exported 5 MTto India, Bangladesh and Dubai in 2072/73. Similarly, another exporter has started his business since 2062 involving 4-5 people and exporting around 100 MT in 2072/73. Both of them are using private cold storage for storing the fruits for longer period. Kathmandu based exporter ***has been using*** the cold storage facility of Illam and Kathmandu whereas Jumla district based exporter ***has been using*** the facilities of Kohalpur and Balaju cold store.

3.7.1 Problems Faced by Fruit Exporters

Problems faced by fruit Exporters	Solutions suggested
• No laboratory facility of international standard for safety measures of fruits	• Establish accredited laboratory facilities of international standard to promote export • Hi-tech cold storage and chilling van for safety measures of fruits at export point
• Quarantine system is not properly implemented/***functioning.***	• Strict internal quarantine system and tax relaxation in importing packaging materials from the government

Both of them are seeking accredited laboratory facilities of international standard, hi-tech cold storage, chilling van, strict internal quarantine system and tax relaxation ***by the government for***importing packaging materials**(Detail is given Annex-9, Volume 2 Annexure)**.

3.8 Fruit Wholesalers

During collection of primary data and information nine wholesalers were interviewed. Among them one has started his business ***since*** 2047 BS and others in between 2048 to 2067 BS. Most of them are doing single fruit business and only one is doing fruit and vegetable buying and selling business. There are two categories of wholesalers, one who normally sellfresh fruits in the range of 6 MT to 400 MT purchased from Nepal whereas the other categories of wholesalers are selling fruits in the range of 9000 MT to 35000 MT***by importingfruits***, especially apple and mandarin, from China and India. They usually used to sell seasonal fruits like apple, mango, banana, mandarin, grapes, pomegranate, etc. in huge amount.

The sampled wholesalers are not having their own cold storage/cool chambers for storing the fruits. Majority of them store their fruits in ordinary rooms and very few of them store in private cold storage bearing very high charge. According to the respondents the post-harvest loss of fresh fruits ranges from 10 to 20 percent.

3.8.1 Problems faced by the Wholesalers

Problems faced by fruit Wholesalers	Solutions suggested
• Lacking of cold storage with cool chamber facilities due to which percentage of fruit loss becomes high	• Modern cold storage with cool chambers at strategic market centers
• Problem of transportation and skilled manpower to handle the fruits	• Easy access to soft loanfor vehicle and packaging materials

Wholesalers were not aware about the Fruit Year and Fruit Decade Program launched by GoN but they have the expectation of efficient market and modern cold storage with cool chambers, easy access to

soft loan, packaging materials during the implementation of these programs (**Details in Annex-10, Volume 2, Annexure**)

3.9 Fruit Retailers

During data and information collection nine retailers were interviewed from different districts. They have started their business since 2054 to 2070. Majority of them used tosell only fruits in their shop and very few of themsell vegetables side by side. They used to sell seasonal fruits like mango, mandarin, apple, banana on an average quantity of 10-15 MT per season whereas kiwi, grapes, pomegranate, etc. on an average of 2-5 MT per season. Majority of the retailers were satisfied with their business andvery few of them said that fruit business alone could not be sufficient for their livelihoodbecause of perishable and seasonal nature ***of the commodities***. The majorproblems faced by the retailers during business periodare the sorting, grading, storage and transportation where they have to bear minimum of 10-15% loss.

Problems faced by fruit Retailers	Solutions suggested
• Majorproblems faced by the retailers during business periodare the sorting, grading, storage and transportation where they have to bear minimum of 10-15% loss	• All are in favor of cool chambers for storage • Good road for transportation • Easily available market information, • Easy access to packaging materials • Organized market in their working vicinity

All the retailers are in favour of soft loan, cool chambers for storage, good road for transportation, easily available market information, easy access of packaging materials and organized market in their working vicinity (Details in **Annex-11, Volume 2 Annexure**).

3.10 Fruit Consumers

During data and information collection seven consumers were interviewed for their preferences to eat fruits. Majority of the consumers had the choice of eating major fruits like mango, banana, mandarin, apple, pear, grapes etc. All of them agreed that fruits are easilyavailable in the market but with expensive price rate. They are aware of ***the fact*** that fruits are available in the market because these are brought from distant market and even importedfrom neighbouring and other countries. Consumers have the experience that during the past fruits were not easily available and few people used to buy and consume.But, nowa day, people are accustomed to eat fruits dueto increasing education and awareness towards nutritionalimportance of fruits (Details in **Annex-12, Volume 2 Annexure**).

Problems faced by fruit Consumers	Solutions suggested
• Fruits are easilyavailable in the market but with expensive price	• Fruits should be made available in affordable price • Fruit production should be increased in the country itself

The questionnaires/check list for collecting information from all above respondents is presented in ***Annex 1*****in volume 2Annexure**

3.11 Strength, Opportunities, Issues and Challenges of Fruit Sector

Fruit development project/program is in fact a package of activities with the common goal of acquiring self-sufficiency in fruit production vis a vis assuring adequate availability of healthy fruits balancing trade deficit through import substitution and promoting export of good quality fruits. The major elements of the fruit development program are: appropriate variety identification, quality planting material production and supply, scientific orchard planning and planting, proper and timely orchard management, post-harvest handling and management, quality assurance, fruit processing, storage and marketing. From the review of past performance and present survey findings Nepal's strength and opportunities in fruit sector development are summarized below:

3.11.1 Strength

- Suitable agro-ecological diversity for fruit production from tropical to temperate fruits with comparative advantages for producing apple, mango, litchi, banana, avocado, citrus (mandarin, lime, lemon) for import substitution; and mandarin, kiwi, hog-plum, berries, chestnut, pecan-nut and walnut for export promotion.
- There are established horticultural farms/centres in different ecological zones and also have established institutional set up for research, development and teaching (NARC, DOA and horticultural units under Tribhuwan University, Agriculture and Forestry University and Purbanchal University).
- Horticultural human resources in all the Districts and Farm/Centres, Universities and private sectors (I/NGOs),
- Registered private nurseries in most commercial pockets and private processing industries are coming up,
- Road accessibility from north to south and east to west is increasing.
- ***The Agriculture Development Strategy (ADS, 2015-2035 AD) has specified agriculture sector's growth through 4 strategic components: Governance, Productivity, Commercialization and Competitiveness. Apple has been recognized and identified as a potential high value crop.It has been recognized as an engine of growth for rural economy and poverty alleviation.***

3.11.2. Opportunities

- Nepal has potential market access to different countries such as India, China, Singapore and Bangladesh etc.
- Commerce Policy, 2072 has identified fruits as one of the potential export commodities and production of avocado, persimmon, pear, kiwi and different nut fruits for fulfilling the demand of tourismsector and product diversification of hog-plum, different berries and butter fruit (Chiuri) and domestication of underutilized wild fruits are possible.
- Barren lands are increasing in the hills and it is possible to convert them into fruit orchardsas opportunities.
- Fruit demand is increasing due to nutrition consciousness and health benefits***. Urban population and income of middleclass people are also increasing.***
- Tha government has approved Agriculture Development Strategy, declared 2018 as Fruit Year and 2017/18 to 2026/27 as FruitDecade to substitute fruit import and promote export.

3.11.3 Major Issues and Challenges

Despite the above strength and huge opportunities for fruit development, the productivity of this sector has remained low due mainly to the following issues and challenges:

1. **Lack of Fruit Research Policy:**Policy issues were also encountered for promoting new fruit varieties. NARC has limited ability and a long process to release /register new fruit varieties. There is no international linkage for fruit crop varieties' import and adaptation as it exists in other cereal crops. Fruit is long term crop and NARC's research program is basically annual based. NARC is endeavoring to establish long term research base for fruits establishing international linkage with institutions like Tibetan Academy of Agricultural Science (TAAS) and trying to increase research funding and fruit scientists for long term researches (Y.R. Pandey, ED, NARC: Personal communication 2017). Horticulture farms/centres are in low key in fruit research and development. Fruit research in NARC has been in low key due to lack of specialized horticulture research farms. The horticulture units of most NARC research centres are cereal crop dominated. Horticulture research has been grossly underfunded to address the research needs of time (K.P.Paudel, 2011).

2. **Contract Farming Act:**There is a lack of Contract Farming Act to promote plantation crops such as tea, coffee, fruits, etc. The existing policy of supporting communities/cooperatives to construct

collection center/marketing structure is yet to be made favorable to promote horticultural markets especially fruits. This is because farmers cannot avail land in a place where marketing can really take place.***In the places where farmers can avail land, marketing of fruit does not take place.***

3. **Quality Planting Materials:**Supply of quality planting materials, proper orchard management including manuring, irrigation, training and pruning, plant protection have been found as major areas for intervention. Despite the potential of fruit, fruit productivity has remained low due mainly to the lack of access to information, technology, inputs (quality saplings, fertilizers, post-harvest management,credit) and market. Improper intercropping in orchards is still negatively contributing to orchard health and fruit yield. For example, in Solukhumbu, apple orchards are generally intercropped with maize, wheat, potato and vegetables. Damage to the plants and root zone of fruit trees while plowing the field for intercrop plantation is conspicuous for poor orchard health and low productivity. Existing ecological zone of Nepal needs fine tuning to district/pocket level for successful ***volumetric and qualitative*** production ***and thisis an issue for scale of economic production***.
4. **Absence of Nursery Act:**In many cases, even when planting materials were available, quality of planting materials was low due to absence of regular monitoring of nurseries and due to absence of nursery act and guideline.***There is absence of Nursery Act and rules to regulate supply of quality saplings and absence of Pesticide Residue testing unit to test fresh fruits imported from other countries.***
5. **Rejuvenation of Old Orchards:*****Replanting and rejuvenation of the old and senile trees/orchards are not done.Even though good number of trainings have been provided to the orchardists they areassociated with the attitude that fruits once planted are guaranteed for fruiting.***Old and established orchards from public places and individual gardens established by Ranas and Royal families are at the verge of ***extinction*** and valuable germplasm are also being endangered.
6. **Poor post-harvest Handling:**Poor harvesting technique, grading, packaging and inadequate post-harvest infrastructure have resulted into high post-harvest losses at different stages (estimated 20-40 %)
7. **Poor Research and other Support:**Research, development and production of processing varieties are still lacking in Nepal. There is poor access to subsidy and insurance to nursery and orchard owners. Mechanization in fruit sector is poor.There is inadequate technical capacity for pest surveillance and monitoring for export andthereis no pest risk analysis regulation during import.
8. **Climate change:**Present climate change is threatening fruit production due to emergence of new pests and erratic flowering off the season.
9. **Import of fruits:**Fruits fluxing from China, India, and other countries are the major competitive threats to Nepalese produces. There is also threat of pest and diseases during import and internal movement of saplings and fruits imported from other countries.Despite***the fact that*** the local fruits are rich in nutrition, they are gradually replaced by imported fruits because locally available fruits are often wrongly considered inferior in nutrition by even conscious educated mass and are detracted from consuming it.Waxed, colored and chemical treated fruits look superior to domestic organic fruits. Artificially coloured and flavoured products are becoming more common drinks rather than consuming fresh fruits.

3.12 Gap analysis in Research, Production, Processing and Marketing

3.12.1 Gaps in Fruit Research

From the review of secondary information, expert's views,analysis of primary information collected from the field surveys, the causes of poor research in fruit crops and research gaps are as follows:

1. While establishing NARC in 1990 (2048 B.S.) most of the specialized horticulture farms were kept under DOA and senior horticulturists also remained with DOA.However, thesehorticulture farms/station (e.g. Horticulture farm Kirtipur, Sarlahi, and Marpha etc.) were not mandated for research. Fruit research in NARC is in low key due to lack of specialized research farms. The

horticulture units of most NARC farms were cereal crop dominated and gaps appeared in fruit research. On the other hand, fruit specialized farms under DOA have no mandate for fruit research.

2. In addition to above structural anomalies, there is no long term research policy in fruit with incentive to fruit scientists. The promotion in NARC is based on scientific papers published. Fruit is long duration crop and requires severalyears to get the research results and paper published.***Scientists neither do nor prefer to work on fruits, thus resulting in low fruit research and technology generation.***
3. There is no international linkage for exotic fruit germplasm import, evaluation, new variety development, multiplication and distribution both in NARC and DOA. There is no foreign donor in fruit sector research and the government investment is low in fruit research and new variety identification.
4. Fruit specific team of research including pomologists, soil scientists, plant protection and post-harvest specialist in specific farm/centre with full leadership of horticulturists and crop specific regional research farms and demo farms with fully equipped lab is lacking both in NARC and DOA.
5. There are no policies and programs to go with private sector in fruit research and development. Public private partnership is limited in slogan only.Private sectors also lack in collaborative research culture.
6. Agriculture campuses under University system lack research infrastructure/ facilities viz. identified and well laid out fruit blocks and laboratories. In post graduate studies, there are only few thesis researches on fruit crops except some on propagation, management and post-harvest aspects.
7. ***There is almost no research attention*** yet on fruit cultivar development including cultivars for processing purpose.

3.12.2 Gaps in Fruit Production

The review of data shows that there is steady increase in fruit area coverage and production; however, the productivity since last 15 years is stagnant around 9-10 MT/ha (Table 2). The ***reasons*** for ***lower productivity and gaps in fruit production despite the increasingfruits demands may be due to:***

1. Very few high yielding fruit varieties and modern production technologies being developed; orchard management practices are poor; extension systems limited to distribution of fruit saplings, and ***progress reporting beingbased on sapling distribution and area coverage without having follow up and monitoring of survivals and bearing of fruit trees.***
2. The old and senile orchards are not replanted or rejuvenated and no good orchard management practices followed. Once fruit trees are planted, it is then left as such.
3. The causes of low productivity is also related to poor quality fruit saplings supplied and no nursery monitoring, orchard management service to the orchardists as there are no trained horticulture technicians in the pocket area level.
4. Fruit production is long term enterprise and has more risk.***Limitations on land holdings*** (*Hadbandi*) is hindering to develop large scale fruit orchards.Large farmers are not accommodated in most of the programs, whereas small holder farmers and scattered production areas face problems of marketing due to insufficient physical infrastructure like road, communication, cold storage, and market structures.
5. Lack of coordination between private investors and the government departments with regard to opportunities in this sector, lack of efficient marketing system, lack of special loan package (1-2%) that wouldl encourage bigger investment in this sector .

3.12.3 Gaps in Fruit Processing

Though there are some processing industries established in the country the raw fruit productions as per the demand of such processing industries are not linked properly with the processing varieties development. Most industry use unsold fresh fruits and supply is not regularized from domestic production. The specific processing varieties and their scale production are far behind the demand. Large fruit processing industries established under joint venture are importing fruits to run the processing

industries. Research, development and production of processing varieties are lacking and is the major gap in this field.

3.12.4 Gaps in Domestic and Export Marketing

1. Fragmented or loosely linked enterprises in the commodity value chain, low reliability in business relationships (in terms of variety, quantity, quality and price), absence of contract farming system and assured supply between producer farmers and marketers are the main gaps in regularized supply chain. Marketing of Nepal produced fruits is on ad-hoc basis. Most fruit farmers sell their fruits to collector or middlemen who buy the whole orchard and they manage the marketing thereafter. Proper harvesting, sorting, grading and packaging of Nepalese fruit is generally poor compared to the imported fruits in domestic market. ***Absence of grading and thus heterogeneity of the aggregated production, lack of lot numbering system leading to difficulties in produce tracing back to the farm for buyers' choice and preference, and lack of trainings to the producers or suppliers are some other problems.***

2. Storage facilities and prolonged supply management of domestic fruits are lacking. Supply is for short harvesting season only.

3. The export of Nepalese fruit is also on ad-hoc basis as in domestic market. The major export is summer fruits and citrus to India based on production volume and on year bearing. ***Apple export was initiated to Bangladesh and Kiwi; however, quality and volume became the main constrains for regular export. Lack of or no access to information on regulatory requirements (health, sanitary, phyto-sanitary) and absence of government mandatory standards are preventing assured marketing in domestic fruit markets, industry, supermarkets and export market.***

4. Absence of testing and certification system for fruit export and limited public supports in the exploration of the export market is another gap in fruit export.***Grading, packaging and fulfilling the sanitary requirements of the importing countries are also in infantry.***

5. Access to technology and market information have made it possible to explore international markets and integrate Nepalese horticultural produces into those markets. However, meeting a volume for export is a major problem. In 2001, arrangement for export of Jumla apple to Bangladesh was made. But, Nepali traders could not export apple just due to not meeting the required volume for export (FAO, 2010).

3.12.5 Organizational Gaps

There have been organizational anomalies in horticulture sector since its establishment. Since 1940 till today, several organizational changes and readjustments took place. Two times in ***1947 and 1967*** Department of Horticulture was established and demolished without proper analysis and concrete reasons. Even after establishment of NARC in 1948,most of the horticulture farms/centers specialized for fruits and vegetables research remained with the Department of Agriculture with no mandate of horticulture research. On the other hand, NARC has limited horticulture farm/center and limited human resources to undertake horticulture researches. On the contrary, horticulture farms/centers under the DOA are underutilized with limited sapling production. These organizational gaps have been realized by all concerned authorities but nobody is ready and courageous to rectify the situation.

4. Analysis of Supply and Demand of Fruits

4.1 Growth of Demand for Fruit

The main drivers of demand for fruits are the growing knowledge on food and nutrition consciousness and health benefits of the people. Increased urban population is another driver of increasing fruit demand. Increased per capita income overtime and adoption of western culture have also increased demand for fruits and fruit products compared to earlier years. Along with the availability of fruits, fruit consumption culture has increased in Nepal. There are several fruit shops and hawkers seen around the major cities.***However, most of the fruits being sold in the markets seem to have been imported from other countries.***

4.2 Individual Consumption Requirement

Internationally recommended minimum quantity of fruit to be consumed is 36.5 kg per person per year (100 gm per day per person real intake). This recommendation is for real edible intake on the plate after peeling and removing unedible parts. Average edible parts of most fruits vary from 30 % (Lime) to 97 % (grapes). On an average real edible portion of fresh fruit is 60 % of the fruits purchased from the market or collected from the garden. To consume 36.5 kg.edible portion, 60.8 kg (61 kg) fresh fruit is required. Thus, a person needs nearly 61 kg fresh raw fruit per year to supply 36.5 (36 kg) edible intake per year. The world situation of fruit consumption is as under:

World average	74.1 kg;	China	81.4 kg
Ghana	172.0 Kg	USA	115.0 kg
Slovenia	130.0 Kg	Montenegro	223.0 Kg
Chad	10.0 Kg	India	11.8 kg
Nepal	Availability 39 kg and intake 23.4 kg.		

In Nepal, as per 2014/15 data, the average availability is 39 kg and average intakeis 23.4 kg which is very low compared to the world average.

4.3 Sources of Fruit Supply, Availabilityand Intake in Nepal

There are two major sources of fruit supply in the Nepalese market:

A) Domestic supply

Table 13**: .Area, production and productivity of fruits in Nepal during last 10 years**

Year (AD)	Year (BS)	Total Area (Ha)	Productive Area (Ha)	Production (MT)	Productivity (MT/ha)
2005/06	2062/63	91923	56549	535449	9.47
2006/07	2063/64	94901	57595	575095	9.99
2007/08	2064/65	100099	63432	630563	9.94
2008/09	2065/66	103651	68785	686213	9.98
2009/10	2066/67	107322	70722	706972	10.00
2010/11	2067/68	117932	79184	794165	10.03
2011/12	2068/69	139321	101233	1029754	10.17
2012/13	2069/70	137759	101480	938730	9.25
2013/14	2070/71	150150	110617	979,542	8.86
2014/15	2071/72	150387	110802	992,703	8.96

Source: MOAD

Around 10 lakh MT (Table 13) fruit is domestically produced and harvested as raw fruit for the market without deduction of post-harvest losses. The real availability in the market and table is nearly 20 % less than the harvest as there is post –harvest loss estimated from 20 - 40 %.

B) Supply from Import:

Table 14**: Import of fruits to Nepal in last 6 years**

Fiscal Years(AD)	Fiscal Years(BS)	Fruit Import	
		Volume(MT)	Value(Rs.)
2009/10	2066/67	163,739	4,714,767,570
2010/11	2067/68	149,149	3,634,912,747
2011/12	2068/69	164,487	4,034,503,113
2012/13	2069/70	199,845	6,374,313,406
2013/14	2070/71	227,003	12,118,640,441
2014/15	2071/72	189,158	10,529,638,754

Source: TEPC

To meet the demand of urban markets, fruits are being imported from other countries especially from India and China. According to the recorded data of TEPC, nearly 2 lakh MT (Table 14) fruit is imported. However, a lot of fruit import is estimated without official record. Most of the fruit stalls and fruit vendors sell the imported fruits.

C) Export of fruits from Nepal:

Table 15**: Export of fruits from Nepal in last 6 years**

Fiscal Years(AD)	Fiscal Years(BS)	Fruit Export	
		Volume (MT)	Value (Rs.)
2009/10	2066/67	8,232	486,355,192
2010/11	2067/68	18,621	1,033,272,737
2011/12	2068/69	9,523	468,181,592
2012/13	2069/70	2,264	33,139,628
2013/14	2070/71	24,813	4,161,032,798
2014/15	2071/72	16,422	2,850,404,039

Source TEPC

Fruit export from Nepal depends on two factors mainly: comparative time and ecological advantage over India and other countries. Summer fruits, mainly mango, is exported from Terai region and foothills of Nepal. It depends on bearing year as it has alternative bearing habit. Accordingly, export also is in fluctuating quantities from one year to other (Table 15)

4.4 Scenario of Domestic Fruit Supply, Import, Export and Consumption

During 2014/15, the domestic production of fruit was 992,703 MT (Table 12), Import was 189,158 MT (Table 14), Export was 16,422 MT (Table 15), The domestic production plus import minus exportgive the fresh availability which is 1165439 MT(992,703+189,158-16,422 MT). See box 1 below:

Box 1

This quantity 1,165,439 MT is farm gate harvest and import point quantity. Considering post-harvest and handling loss of 20 % the fresh availability at the table is 932,351 MT. The average edible portion of fresh fruit is 30 % in lime, 90 % in grape, 40 % in apple, 69 % in mango, 68% in banana, 74% in mandarin, 75% in avocado and 46% in watermelon. On an average, 60% is the edible portion of fruits as a whole. The fruit consuming population of the year is 24,601,248 (Table 16), the per capita availability of fresh fruit is 39 kg with 23.4 kg per capita per year real intake.

4.5 Future Requirements /Demands Projection of Fresh Fruits

Depending on the domestic population and tourists flow in Nepal the ideal projected fresh raw fruit requirement /demand have been calculatedand projected as in Table 16.

Table 16: **Individual consumption requirement (base year status and projected)**

SN	Coefficients			Projections				
	Particulars	Unit	Factor	Unit	Base year (2014/15) status	Short term (2021/22)	Medium term (2026/27)	Long term (2036/37)
1.	Nepali Population deducting migrants	Percent	1.35	Number	24,573,010	26,991,351	30,864,707	34,823,782
2.	Tourists population	Percent	5.26	Number	28,238	40,414	67,447	106,941
3.	Total Population	Number		Number	24,601,248	27,031,765	30,932,154	34,930,723
4.	Edible portion intake Requirement after peeling and removing core stone/seed	Kg/yr./capita	37	MT	910,246	1,000,175	1,144,490	1,292,437
5.	Fresh fruit availability requirement to make up edible intake need	Kg/yr./capita	61	MT	1,500,676	1,648,938	1,886,861	2,130,774
6.	Domestic production level(if kept constant)			MT	992,703	992,703	992,703	992,703
7.	Requirement gaps (5-6) tomeet the fresh requirement for consumption			MT	507,973	656,235	894,158	1,138,071

4.5.1 Export Requirement /Demand

The fruit export from Nepal is based on the on year and off year of the major fruits as they have alternative bearing habit. However Nepal can improve the situation promoting exportable regular bearing fruits like kiwi, temperate fruits like apple and citrus etc. To improve export abroad market, improvement in internal quality control and standards accredited lab test and proper post-harvest handling and market linkage development are inevitable. In export, both quality and volume are important.

Table 17: **Projected export demand**

Export Demand	
Description	**Quantity (MT)**
Base year 2014/15 status	16,422
Short term 2021/22	32,000
Medium term 2026/27	64,000
Long term 2036/37	130,000

Box 2

Meeting a volume for export is a major problem. In the year 2001, about 12 MT of apple was exported from Jumla to Bangladesh. The Bengalis liked Nepalese apple from Jumla. The following year a team of traders from Bangladesh reached Jumla and met the apple producers. They disclosed that the apples from Jumla are of better quality than Indian apples and hence they would like to continue importing apples from the Karnali region. But when the farmers were told the quantity required is 50,000 MT per year they had their fingers crossed. It was not possible to produce that quantity of uniformly graded apples. The traders said they would not like to ***export*** apples to Bangladesh from several sources and hence if Nepal can meet the supply level, they would resort to Nepal's export. The farmers were not organized enough to meet that supply level thus resulting in no export from subsequent years.

4.5.2 Processing Requirement /Demand

Table 18**: Projected processing demand**

Description	Quantity of fruit (MT)
Base year 2014/15 status	15,457
Short term 2021/22	30,121
Medium term 2026/27	78,125
Long term 2036/37	163,073

4.5.3Demand and Supply Gaps and Production Targets (Requirements)

From the above Tables (Table 16, 17, 18) and Table 19 below requirement to increase the domestic production from base year production of 992,703MT to2,028,986 MT (base year production 992,703 MT + gap 1,036,283 MT) by 2026/27 to be self-sufficient in fruits balancing import, export and meeting consumption requirement, Nepal needs to make up the gap of 1,036,283MT by 2026/27 and 1,431,144 MT in addition to base year production of 992,703 MT by 2036/37 (Table 19).

Table 19**: Extrapolated total demand and supply gaps**

Production required to meet the demand and supply gap in consumption, export and processing demand					
Description	**Unit**	**Base year (2014/15) status**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**
Demand and supply gap in consumption requirement	MT	507,973	656,235	894,158	1,138,071
Export requirement /demand gap	MT	16,422	32,000	64,000	130,000
Processing requirement/demand gap	MT	15,457	30,121	78,125	163,073
Total requirement gaps	MT	539,852	718,356	1,036,283	1,431,144
Base year production (kept constant)	MT	992,703	992,703	992,703	992,703
Production requirement (Targets for short term, medium term and long term) Including base year's production	MT	Not applicable	1,711,059	2,028,986	2,423,847

4.6 Need for an Extra Impetus on Fruit Development

Nepal needs extra impetus in productivity increase and area expansion both to meet the supply gaps over existing production. Productivity increase has been emphasized by improving sapling quality, introducing high yielding varieties, improving orchard management, improvement and use of plant protection measures whereas area expansion is to be emphasized in establishing large sized orchards with some policy changes and attracting commercial orchards at cooperative level, company level and large commercial farmers through leasing land (degraded forest land, public land and absentee land lord's land from land banking arrangements) and also by supporting commercial farmers to establish commercial fruit orchards.

4.7 Overall Recommendations for Fruit Development Project

From a long experience and review of past efforts and analysis of opportunities for development and Nepal's comparative advantage in fruit sector development the following short-term, medium-term and long-term recommendations are made for formulating **Fruit Development Project** for future.

4.7.1 Short-term recommendations (to achieve within 5 years by 2021/22)

- To expedite fruit research at national level a strong steering committee under the chairpersonship of Secretary, MoAD represented by DG/DOA, ED/NARC, Dean of university of Agriculture and Forestry (UAF) be formed for integrated fruit research and development and Program Director FDD as member secretary.

- To strengthen and institutionalize research under one command Secretary Agriculture Research and Institute of Horticulture Research under NARC could be the alternative to present situation
- GoN/ MoAD should formulate and implement fruit research and horticulture farms/station managementpolicy/guideline to avoid structural anomalies and convince Ministry of Finance to invest in fruit research as the most priority project for fruit import substitution, export promotion and balance trade deficit by 2021/22.
- Collaborative research between government institutions and private sectors should be conducted jointly so that some pertaining issues overlooked by government researchers are also addressed.
- **Identify major fruit crop research farm/stations under NARC and DOA:**
  - Tropical fruits: Tropical Region Horticulture Center, Nawalpur/Sarlahi **(Mango, Litchi and Avocado)**Horticulture Farm Trishuli/Nuwakot**(Macadamia and Avocado)**, Horticulture farm Panchkhal/Kavre (**Mango and guava**) and horticultural units of Terahara, Parwanipur and Khajura (tropical fruits as specified by NARC)
  - Citrus and sub-tropical fruits: National Citrus Research Program, Paripatle / Dhankuta (**Mandarin, acid lime and guava**), Tuber Vegetable Development Center/Sindhuli (**Junar**), Horticulture Research Station Pokhara/Kaski (**Mandarin, guava, Macademia nut and Kiwifruit**) , Citrus Development Center/Palpa (**Mandarin and lemon**), Horticulture Research Station /Dailekh (**Mandarin and Moasambi)**
  - Temperate fruits: Temperate Region Horticulture Center, Marpha/ Mustang(**Apple and apricot**), Horticulture Research Center, Rajikot / Jumla (**Apple, walnut and other temperate fruits)**Horticulture farm Phaphlu/ Solu (**Apple, Kiwifruit)**, Horticulture farm Bonch/Dolakha (**Kiwi)**and Dry Fruits Development Center, Satbanjh/Baitadi (**Walnut, pecan-nut, etc***.)*
  - Central Horticulture Center, Kirtipur/Kathmandu (**Pumelo, Persimmon, Pear, Kiwifruit, etc.)**

Attract young scientists with vertical promotion and incentives, provide appropriate positions to the scientists working in abroad and also use retired horticulture specialists as advisors and mentors. Research should focus not only on production and propagation but also on post-harvest and marketing aspects

- **To improve the quality of planting materials implement the following interventions through Fruit Development Directorate formulating and implementing guidelines**
  - Develop fruit wise sapling standards and nursery inspection guideline by the first quarter of 2074/75 and monitor all nurseries to supply quality and healthy saplings for fruit year and fruit decade
  - Establish hi-tech nursery for quality and healthy saplings production and train horticulturists/Technicians to use identified and standard size rootstocks and scions from identified and separately well maintained mother plant blocks in the nurseries
  - Develop pictorial packages of cultivation practices manual(pruning, training, manuring, mulching and orchard management practices) and crop calendar for major fruit crops considering the geographical regions
  - Follow all sanitary and plant protection measures in nurseries to produce healthy saplings and inspect all public and private nurseries for quality check up by trained horticulturists/technicians during production and distribution/ marketing
  - Provide support and subsidy on infrastructure such as mist house,glass house, shade house, poly house, net house, hot beds and cold frames based on geographical regions with at least 75 % cost support by government for one time
  - Train nursery owners on different fruit varieties, their pollinizers and packages of production practices to explain to the buyers/orchardists
  - In case of apple for high density plantation dwarfing rootstocks of Malign Morton series and high yielding cultivars of apple with late and early maturity should be identified, propagated and supplied with 100 percent guarantee of cultivars and of standard size.

- Revitalize in vitro propagation (tissue culture) of apple rootstocks (Malign series) and trifoliate rootstocks for citrus to meet the demand of quality rootstocks to produce standard saplings of apples and citrus.
- The use of biotechnology such as tissue culture should be expanded to other fruit crops and should not be limited to Banana, apple and citrus only

Revise and improve the functioning of horticulture farm/centre whether they belong to NARC or DOA; and develop farm/centres as the centre of excellence.Implement the following interventions with the following mandates and ToR:

- Provide budget for farm fencing, farm security, transportation and residential facilities and set examples as demonstration sites with fruit specific responsibility to each farms/centre to work as centre of excellence
- Introduce and evaluate the indigenous and exotic fruit crop varieties and develop production technology by adaptive researches by designated farm/centre (Table ~~23~~24)
- Establish progeny orchards in the farm and also demonstration site to demonstrate modern production technology
- Identify and develop new varieties and production technology and distribute quality planting materials of identified varieties
- Survey and identify suitable new production pockets for different fruits in the command areas of farm/centre
- Provide technical services in orchard establishment and orchard management services in the command areas in collaboration and coordination with province, district and local level extension offices
- Develop farm as a practical training resource centre for field level technicians, nursery owners and fruit growers to transfer modern sapling production, fruit production and post-harvest technology
- Instead of separate domo farm and outreach research site, establish common demo-farm and outreach research site between NARC and DOA/DADO
- Organize advance training and observation visits for farm staffs, in and outside country.
- To attract fruit research scientists, pomologists and farm employees, modern quarter facility, overtime incentive for the lower level staff, provide sufficient budget, risk allowance for the laboratory staffs, vehicle facility in the farm. Further, new policy is needed to reform the posting and deputation at least for five years in both DOA and NARC farms with vertical promotion.

To increase productivity and production implement the following activities:

- Conduct feasibility studies on emerging fruit crops like Avocado, Kiwi etc. to increase its commercialization.
- Integrate beekeeping with fruit orchards for pollination which certainly increase production of fruit crops
- Campaign existing orchard management and gap filling program and put some rewards to the orchardists based on their performance
- Identify and make inventory of commercial orchards and classify them as Green for the topmost level, Blue for medium level and Yellow for poor level based on management (pruning, manuring, cleaning, plant protection) and inspire to move to Green level by subsidy rewards based on garden size and other standards
- Facilitate commercial orchards with provision of tools and equipment in subsidized rate, provision of soft loan, crop insurance, installation of drip irrigation and networking for marketing

- Conduct capacity enhancement training to technical staffs, orchard owners, nurserymen, fruit processors etc. and facilitate e-laboratory for plant protection.
- Introduce safe post–harvest techniques and facilitate grading, packaging and branding of apple, citrus, and other potential fruits for export
- Introduce safe and strengthen organic fruit production program in Jumla and other feasible districts to meet the growing demands of organic fruit with third party tag in fruit packs (tagging authority for quality assurance)
- Formation of local production groups at grassroots level who will also receive technical training on orchards management imparted by the farm and centre.

4.7.2 Medium-term Recommendations (Achievement within 10 years by 2026/27)

There is clear scope of domestic production and value chain development of apple, mango, banana, lime and lemon for import substitution; and mandarin, apple, pear, kiwi, and walnut for export promotion and production of avocado, persimmon, pear, kiwi and different nut fruits for fulfilling the demand of tourism sector and also promote export. Though area and production of fruits have increased during last 40 years, productivity is hovering around 8-10 MT /ha. To increase productivity, supply of quality saplings of high yielding cultivars is one of the major components. Considering the fruit decade and future demand the following procedure, techniques and budgetary frame works are recommended in medium term to be materialized

- Make conducive policy to attract foreign investment in constructing multi-chambered cold storages to regulate supply in lean season
- Establish storages and processing plants at the niche market points for the production of processed products and proper marketing network to sell the fresh as well as processed final products
- Integrate processing arrangements such as in addition to processing of citrus for squash, marmalade, jam, also include extraction of orange oil, extraction of albumin, and finally the process the peeled skin of fruits for feed to poultry
- Develop suitable varieties of fruits for processing, late and early maturity to regularize fresh fruit marketing with proper packaging system; soft fruits like peach, plums, figs may also be included
- Establish accredited laboratory facilities of international standard, Hi-tech cold storage, chilling van, and strict internal quarantine system and tax relaxation in importing packaging materials for quality guarantee of products for export
- Inter-ministerial cooperation to import the materials needed for Nursery greenhouse construction, processing, packing and transportation,
- Give priority to develop dwarf rootstocks so that the modern technology like high density plantation could be triggered
- Develop following policy to utilize abandoned land and public land to convert in to fruit orchards:
  - Declaration of specific fruit production zone and expansion of present fruit zone facilitating farmers to join as cooperative members or company shareholders and make the large farm size to solve the scattered and small scale production
  - Land ownership shall rest on individual farmers and production would be collected and processed on joint basis and income could be shared based on individual production.
  - Land consolidation is important factor for large orchard development; therefore, promote to buy land for establishing large orchards amending land limit act (hadbandhi) especially for fruit farming. Arrangement of LAND BANK

- Introduce policy of leasing Government land to private sector for long-term and introducing land banking policy and interest free loan to buy land till the orchard comes in commercial bearing
- Campaign fruit plantation both in public and private land, trustee land, school and college land etc.
- In areas of commercial orchards, road, electricity, irrigation and internet communication be developed but prohibit the township development and plotting in the fruit zone and orchard areas
- Promote home stay and resorting in large orchard areas in collaboration with tourist department
- Amend the contract farming act to facilitate and promote contract arrangement safe guarding both land owners and tenants interest

4.7.3 Long-term Recommendations(to be achieved within 20 years by 2036/37)

All activities and initiatives adopted in short-term and medium-term must be continued with certain amendments and redesign based on learning. Fruit development is the main backbone of present and future agricultural development in present changing context of Nepal and in the neighbouring countries. ***Political leaders, parliamentarians, national planning commission members and media people should be made aware of the importance of fruit sector.***

- Develop well equipped Fruit Research Centers based on Commodity of fruits and declare fruit zones
- Keep B.Sc. Ag ***or B. Sc. Horticulture***expert in municipality and rural municipality with assured link to Research, Outreach andTraining organizations
- NHS should issue license to agriculture practitioners (Pomologist) with ***evaluation***system that needs to be registered from time to time and only such person should be allowed to function as a consultant horticulture practitioners as in ***medical field***
- Develop and manage horticulture technicians at ward level who can run agro-vet and horticulture resource centre and sell imbedded service to the clients
- Local level production groups may provide service remuneration and allowances to such technicians based on her/his service delivery and result outputs but not as regular employee
- Develop ***expert's team consisting of*** Pomologist, Plant Protection Specialist, Soil and Fruit Crop Nutrition Specialist, Post-harvest and Marketing Specialist etc. at national level for conducting fruit research and development and provide expert services at Province, Municipality and Rural Municipality level.
- Develop expert's team for each major fruit crops (Tropical fruits: Mango, litchi, banana, etc.), Citrus (Mandarin, Junar, lime) and Temperate fruits (Apple, pear, peach, plum, etc.) and for export priority crops (Kiwi, Avocado, Macadamia nut, Walnut, Chestnut etc.)
- All research, teaching and development services be linked by one chain of command from Central, Province and Local level through one window command and steering committee chaired by Secretary Agriculture
- Nutritionally rich indigenous fruits need to be studied and domesticated in government farms.Among them the best cultivars should be distributed to the farmers on the basis of agro-ecological zones

A. **There are also some specific recommendations for overall fruit sector as follows**:

- As per federal structure of Nepal's Constitution 2072, demolish all present centrally clinged structures and develop decentralized strong provincial and local structures with clear roles and responsibilities

- Restructure present centrally controlled NARC and DOA and develop decentralized structures under the command of New Agriculture Ministry as per Constitution 2072
- All horticultural farms/stations should be categorized as Central, Provincial and Local level and given responsibility of research, extension and training/teaching linking with Universities and Institutions for practical internship to graduating and post graduate students. ***For post graduate thesis research on specific fruit crop, one of the senior fruit specialists of the concerned farm/center should be included as Co-advisor in the Advisory Committee of the student. Such students should be facilitated by the concerned farm/center for conduction of thesis research***
- All fruit specialists of Central, Province and Local level be linked with teaching, research and development and lab to land program
- As per ADS, establish National Horticulture Research Institute (NHRI) under new reformed NARC and develop Fruit Research Department under NHRI

B. Specific arrangement for fruit Research and Development

- Considering the mid and long term plan, develop a multidisciplinary team to work on fruits with special incentives and provide higher education, training and exposure visits
- As there is no foreign donor in fruit sub-sector increase national investment considering the vast scope of fruit development in the country
- Continue Prime Minister's Agriculture Modernization project targeting specific outputs in fruits and also include adaptive participatory research in progressive farmer's orchards
- For fruit technology generation from production to processing and marketing, a National Innovation System should be established. For this, an authoritative Fruit Research and Development Board may be created.
- NHRI should have a very close working link with the BOARD. NHRI will look after research and development and the BOARD will look after development / production to the consumers table.

C. Attract medium and large farmers

From 8th plan onward the development priorities have been addressed to small holder farmers by all projects.However, in case of fruit sub-sector, small holders only cannot meet the volume required to export and meet processing demand of industry

- Support large farmers and large scale orchards bringing degraded forest land and abandoned up-land (Bari land) of hills and high hills for fruit cultivation through long term leasing
- Introduceland banking system for absentee land-lords and renting their land to large farmers, cooperatives and companies for long term safe guarding both land owner and tenants.
- Also large scale orchard may be developed by cooperative/company farming consolidating small holder farmers and giving the alternative employment to the small holders in the village itself till the fruit trees come into bearing and earn income.

D. Attract donors and youth

- Prepare specific project to establish large cooperative of company orchards and request to donors for partnership for at least 5 years co-funding support
- Government should provide capital subsidy and technical support to the cooperatives or companies established by youths at least more than 2 ha of fruit orchards.
- The company or cooperatives of youth if establishes high–tech nurseries for fruit plant propagation of priority crops, capital subsidy and material support should be provided to attract youths in horticulture business

E. Establish link between orchard owners and Processing Industry

- Fruit based liquor wine and brandy is being imported to Nepal. GoN should promote such industry promoting fruits production in collaboration with such industries

- Linking Yarsha gumbu and fruit liquor for health benefit including sex power stimulant attract consumers of all classes of people
- Learn and adopt from Thailand duty free airport shops where such products are promoted
- Processing industry should establish nursery program and extended cultivation of desired fruit varieties in farmers groups or through cooperatives with close link between nursery and production orchards for the type and kind of fruits required for processing and value addition.
- Due to new federal structure some horticultural institutions need to be established in the province where such horticulture institution are lacking or very few in number for quick service to commercial nurseries and orchards owners of those provinces

F. **Vivid Recommendations based on suggestions from FDD during validation workshop**

- Climate change is both challenge and opportunities in fruit cultivation. Considering the temperature increase fruit crop varieties could move from lower altitude to higher altitude adapting special time of harvesting with proper plant protection measures as climate change mitigation and adaptation
- Internationally recognized laboratories for testing qualities and phyto sanitary measures for import substitution and export promotion is inevitable and Government should strengthen existing facilities with reference to fruits
- Nepal has high potential of exporting warm temperate and temperate fruits to neighboring states of India such as pear, plum, kiwi, hog-plum, citrus etc. Such fruits can be exported from east to west customs points of Nepal. Therefore fruits of all areas of Nepal are eligible for export promotion. Both import substitution and export promotion should equally be enhanced for trade balance in medium and long term basis
- Fruit research is long term activities. Formulate and implement fruit research policy to avoid structural anomalies. Involvement of NARC, DOA and universities for collaborative research in UG and PG and other academic research programmes. Provision could be made to do Post Graduate thesis researches (M. Sc.and Ph. D. degree) in specific fruit crops in the farms/stations/centers of DOA and NARC having specific agro-climatic condition by availing farm facilities to the post graduate students on cost sharing basis. For successful research, fruit researches focussed on short gestation period and dwarf varieties should be emphasized

5. Formulation of Fruit Development Project

5.1 Summary of Projected Demand for and Supply of Fruits

Formulation of this Fruit Development Project is based on the review, analysis and comprehensive recommendations made in previous chapters. The summary of consumption, export and processing requirement of fruit and supply of fruit are presented in Section 4 (Table 19) is summarised in Table 20. It clearly shows that fruit supply from Nepal's current production programme cannot meet the growing demand for fruit. This section presents fruit production projects formulated with production projections to meet this demand and supply gap.

Table 20**:Summary of projected requirement and supply of fruits**

Production required to meet the demand and supply gap in consumption, export and processing demand					
Description	**Unit**	**Base year (2014/15) status**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**
Fresh availability requirement to make up edible intake need	MT	1,500,676	1,648,938	1,886,861	2,130,774
Base year production status (kept constant)	MT	992,703	992,703	992,703	992,703
Demand and supply gap in consumption requirement	MT	507,973	656,235	894,158	1,138,071
Export status and future requirement	MT	16,422	32,000	64,000	130,000
Processing status and future requirement	MT	15,457	30,121	78,125	163,073
Total requirement gaps	MT	539,852	718,356	1,036,283	1,431,144
Minimum production to meet consumption, processing and export requirement	MT		1,711,059	2,028,986	2,423,847

5.2 Objectives of Fruit Development Project

The general objective of the fruit development project is to make Nepal self-sufficient in fruit supply from its own production in next 10 years' time referring to overall objective of the ToR.

The specific objectives are to:

- Increase fruit production and consumption thereby increasing nutrition status of the people
- Increase export and substitute import of fruits thereby reducing fruit trade deficit balance
- Increase fruit processing there by increasing value addition in fruit and employment creation

5.3 Supply Projections to Meet the Supply Requirements

From the analysis of total requirement for consumption, export and processing, steady increment in production areas, productivity and post-harvest loss reduction is required. The increments depend on many factors which are discussed in the following sections. The Table 21 below is the target projected to reach the required level of production and productivity after 20 years as long term projection depending on increase in population, export and processing needs.

5.4 Strategic Pillars

This fruit development project is based on the following strategic pillars.

1. Production increase through increased area under production
2. Productivity increase through better management practices
3. Postharvest loss decrease through improved postharvest handling including packaging, transportation and storage
4. Infrastructural support for quality planting material production and post-harvest handling
5. Institutional strengthening for research, production and marketing
6. Access to finance and mortgaging

Strategic Pillar 1: Increased production through increased area under fruit production

Feasibility of Expanding Fruit Production

Agro-climatic Feasibility: The climates of Terai, Inner Terai, river basin areas and foot-hillsaresuitablefor theproduction ofmango, banana,papaya,litchiand pineapple. Mid-hillsaresuitablefortheproduction of mandarin, sweet orange, lime, lemon, pomegranate, hog-plum (*Lapsi*) and persimmon.Higher mountainhastemperateclimateandissuitablefortheproductionof fruits like apple, walnut, apricot,pistachio and kiwi, while lower mountains are suitablefor the productionof warm temperatefruitslikepear,peach,plum,etc.Fromtheproduction point of view,many kinds of fruits can be grown in different parts of the country.Moreover, fromcommercialpointof view it is not feasible to grow all the crops in all the area.For sustainability,production should be concentrated to the area where climate is suitable and marketing is possible and at the same time economical.Suitable pockets are as for important commercial fruit crops have been identified and shown in the map of Nepal in section 5.4.1.2.

Technical Feasibility: There has been steady growth of horticulture development in Nepal.Since nineteen fifties to present date, several horticultural farm/centres at different agro-ecological regions have been established. NARC as a separate organization for research is also in existence. Academic institutions like University of Agriculture and Forestry, Tribhuwan University and many other Agricultural colleges, private institutions, Agro Enterprise Centre and some I/NGOs are also engaged in horticulture development in Nepal. Under the Department of Agriculture, Horticulture Officers have been posted in all 75 districts and farm/centers. Private fruit nurseries and orchards are also coming up in fruit sector. Climate is feasible from tropical to temperate fruit production. Therefore, Nepal has technical feasibility to grow almost all types of fruit in her space geometry from Terai to mountains.

Socio-economic Feasibility: In rural Nepal, youth migration to urban areas and abroad for cash earning has been the increasing trends and modern phenomenon. Up lands (Bari) and even terraced low lands (Khet) in the hills are left barren and abandoned from cereal cultivation due to labour shortage and high cost of production with negative return on investment. Such socio-economic situation has posed challenge in traditional subsistence agriculture. Long durational fruits/plantation crops in such land are the new avenue. Some educated and service or business people have also left their rural land barren. Such land may be planted with fruits by enacting land banking and leasing policy to cooperatives/companies or even for innovative farmers for large orchard plantation.

Market Feasibility: Nepal has become a member of SAPTA (South Asia Preferential Trading Agreement) since 1993, BIMSTEC (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) in 2003, SAFTA (South Asia Free Trade Area) in 2004, and WTO (World Trade Organization) in 2004. It has supported the export of Nepalese products. As prioritized by the government, opportunity to establish joint ventures with foreign companies has also been open. It has become more feasible with the growing financial institutes in Nepal coupled with the opportunity of

introducing modern technology and management system from developed countries and establish large fruit orchards for domestic consumption as well as for export and for processing industries.

5.4.1. Production enhancement programme projection to meet the requirement

Production enhancement to meet the requirement is based on area expansion, productivity increase and post-harvest loss reduction. Area expansion comes from two major aspects, replacement of traditional food crops by fruit crops, and plantation of fruits in escaped lands. The following is an area expansion programme with increased productivity under different fruits in different ecological regions (Table 21)

Table 21: Fruit area expansion programme (F.Y. 2015/16)

Area expansion programme (Area = Ha; Productivity MT/ha, Production = MT)
(**A) Temperate fruits:** Apple, Walnut, Apricot and other temperate fruits
District: Jumla, Humla, Dolpa, Mugu, Kalikot, Mustang, Manang, Rasuwa, Solu, Baitadi (10)

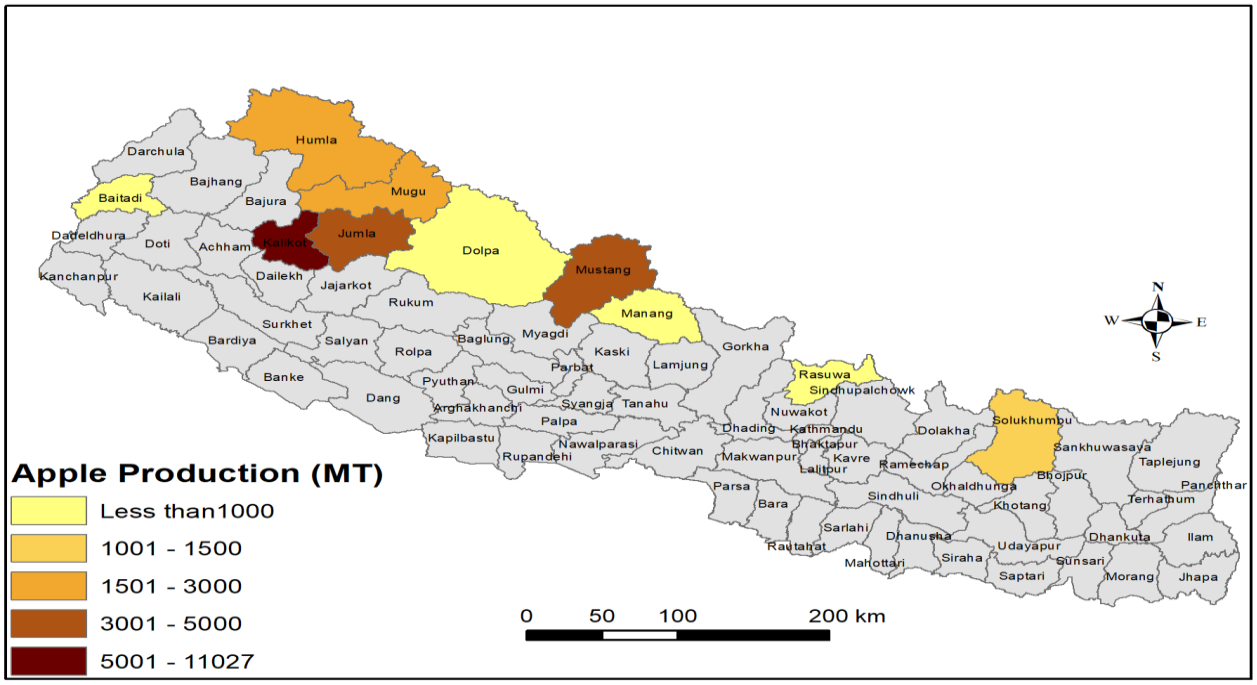


Figure 122: Temperate region districts and prioritized fruits

Fruits	Components	Base Year (2014/15)	Short term (2021/22)	~~Short~~ Mediumterm (2026/27)	Long term (2036/37)
			(5 years)	(10 years)	(20 years)
Apple	Area (ha)	11166	14487	17487	23487
	Productive Area (ha)	5600	7243	9618	13153
	Productivity (MT/ha)	7.80	7.60	8.00	10.00
	Production (MT)	43680	55047	76944	131530
Walnut	Area (ha)	3652	6770	9770	15770
	Productive Area (ha)	1850	3452	5080	8674
	Productivity (MT/ha)	4.20	4.25	4.30	4.60
	Production (MT)	7770	14671	21844	39900.4

Apricot	Area (ha)	403	913	1413	2413
	Productive Area (ha)	294	346	537	1447
	Productivity (MT/ha)	9.30	9.35	9.10	9.20
	Production (MT)	2734	3235	4887	13312
Other temperate fruits (Peach, Plum, peaca-nut, hazel nut etc.)	Area (ha)	4197	5281	6281	8281
	Productive Area (ha)	3387	3607	4334	5797
	Productivity (MT/ha)	7.03	7.05	8.00	9.00
	Production (MT)	23811	25429	34672	52173
Total Temperate	Area (ha)	19418	27451	34951	49951
	Productive Area (ha)	11131	14648	19569	29071
	Productivity (MT/ha)	7.01	6.72	7.07	8.15
	Production (MT)	77994.81	98382.25	138346.7	236915.8
(B) Warm temperate fruits: Pomegranate, Hog-plum, Kiwi, Pear and Persimmon					
District: Ilam, Dolakha, Sindhupalchowk, Bhaktapur, Kathmandu, Makawanpur, Sindhuli, Dhading, Salyan, Dailekh (10)					

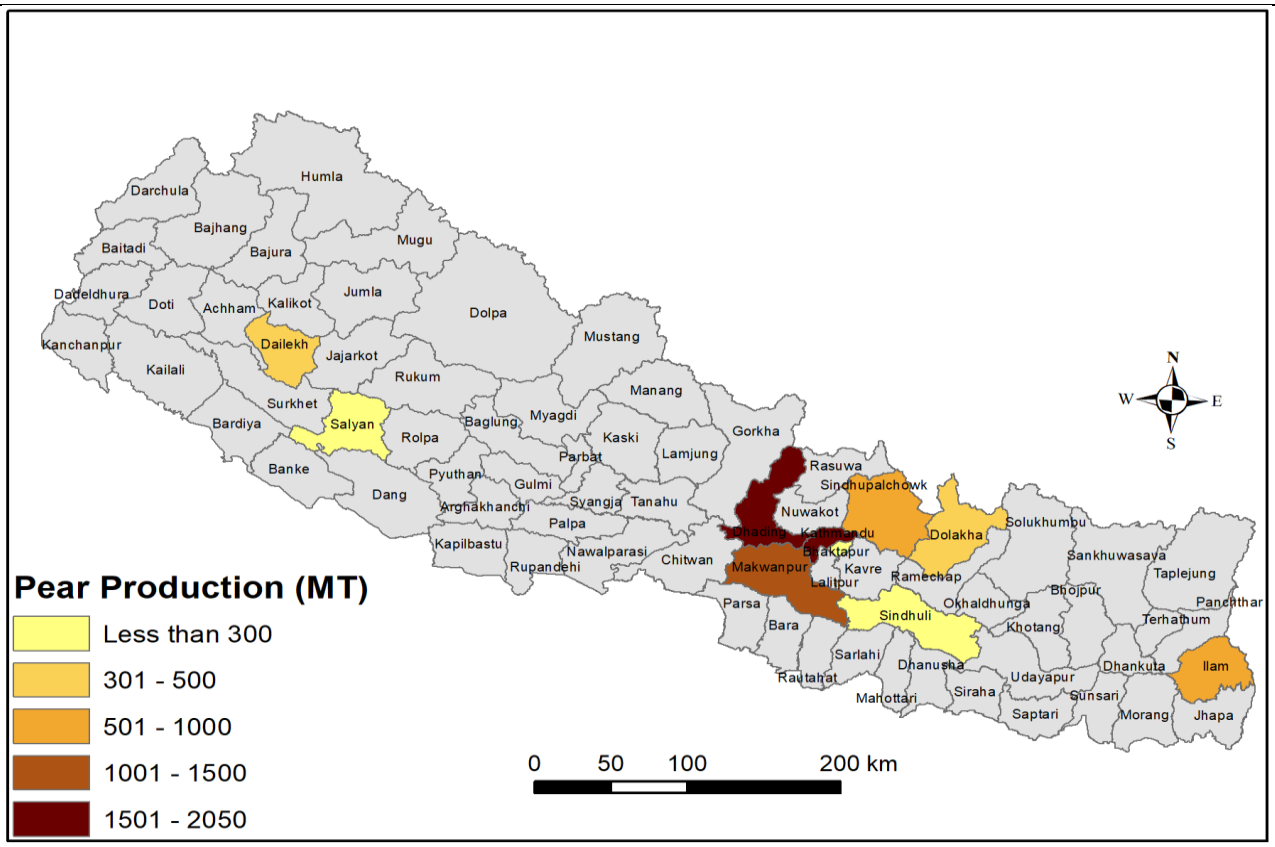


Figure 14: Warm temperate region districts and prioritized fruits

Fruits	Components	Base Year (2014/15)	Short term (2021/22)	Medium term (2026/27)	Long term (2036/37)
			(5 years)	(10 years)	(20 years)
Pomegranate	Area (ha)	596	1114	1614	2614
	Productive Area (ha)	462	505	758	1268

	Productivity (MT/ha)	6.20	7	7.5	8
	Production (MT)	2864	3131	4738	8242
Hog-plum	Area (ha)	1980	2391	2891	3891
	Productive Area (ha)	1503	1558	1933	2633
	Productivity (MT/ha)	7.00	10	11	12
	Production (MT)	10521	10906	13724	19221
Kiwi	Area (ha)	283	798	1298	2298
	Productive Area (ha)	53	160	325	925
	Productivity (MT/ha)	7.00	7.00	7.20	7.80
	Production (MT)	371	1120	2340	7215
Pear	Area (ha)	4397	7351	10101	15601
	Productive Area (ha)	3386	4390	6060	8215
	Productivity (MT/ha)	10.10	10.00	10.20	11
	Production (MT)	34199	43461	61812	85436
Persimmon	Area (ha)	452	463	963	1463
	Productive Area (ha)	311	460	510	815
	Productivity (MT/ha)	7.70	9.1	9.2	9.4
	Production (MT)	2395	4186	4692	7661
Total Warm temperate	Area (ha)	7719	12117	16867	25867
	Productive Area (ha)	5720	7073	9586	13856
	Productivity (MT/ha)	8.80	8.88	9.11	9.22
	Production (MT)	50350	62804	87306	127775
(C) Sub-tropical fruits (Citrus): :- Mandarin, Acid lime and Sweet orange (Junar)					
District: Dhankuta, Terhathum, Bhojpur, Udaipur, Dhading, Ramechhap, Sindhuli, Kavrepalanchowk, Palpa, Syangja, Baglung, Parbat, Myagdi, Kaski, Gorkha, Lamjung, Tanahun, Salyan, Dailekh, Doti, Dadeldhura (21)					

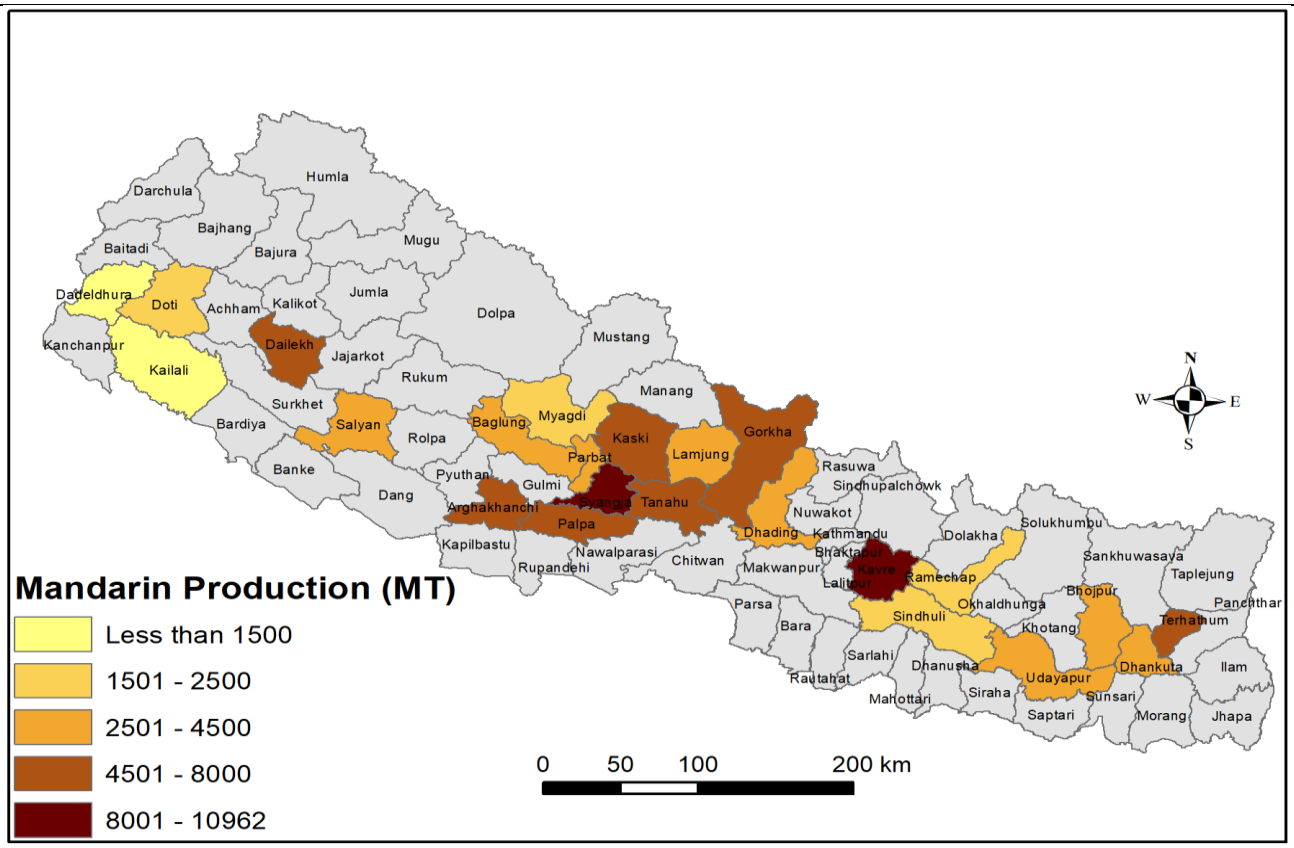


Figure 15: Sub-tropical region districts and prioritized fruits

Fruits	Components	Base Year (2014/15)	Short term (2021/22)	Medium term (2026/27)	Long term (2036/37)
			(5 years)	(10 years)	(20 years)
Mandarin	Area (ha)	25123	34282	42282	58282
	Productive Area (ha)	16224	21598	27000	37883
	Productivity (MT/ha)	9.20	9.30	10.00	11.00
	Production (MT)	149260.8	200861	270000	416713
Sweet Orange (Junar)	Area (ha)	4834	7631	10131	15131
	Productive Area (ha)	3440	4006	5369	8170
	Productivity (MT/ha)	10.10	9.90	10.10	10.40
	Production (MT)	34744	39659	54227	84968
Acid lime	Area (ha)	6864	9796	12296	17296
	Productive Area (ha)	4046	5192	6763	9600
	Productivity (MT/ha)	6.66	7.10	7.20	7.40
	Production (MT)	26946	36863	48694	71040
Other sub-tropical fruits (Lemon & others)	Area (ha)	2214	2345	2845	3845
	Productive Area (ha)	1551	1450	1792	2460
	Productivity (MT/ha)	7.70	8.40	8.45	8.60
	Production (MT)	11943	12180	15142	21156
Total Citrus	Area (ha)	39035	54054	67554	94554
	Productive Area (ha)	25261	32246	40924	58113
	Productivity (MT/ha)	8.82	8.98	9.48	10.22
	Production (MT)	222894	289564	388063	593877
(D) Tropical fruits: Mango, Litchi, Banana, Papaya, pineapple and avocado					

District: Jhapa, Siraha, Saptari, Sarlahi, Mahottari, Bara, Rautahat, Nawalparasi, Rupandehi, Surkhet, Banke, Bardia, Kailali, Kanchanpur (14)

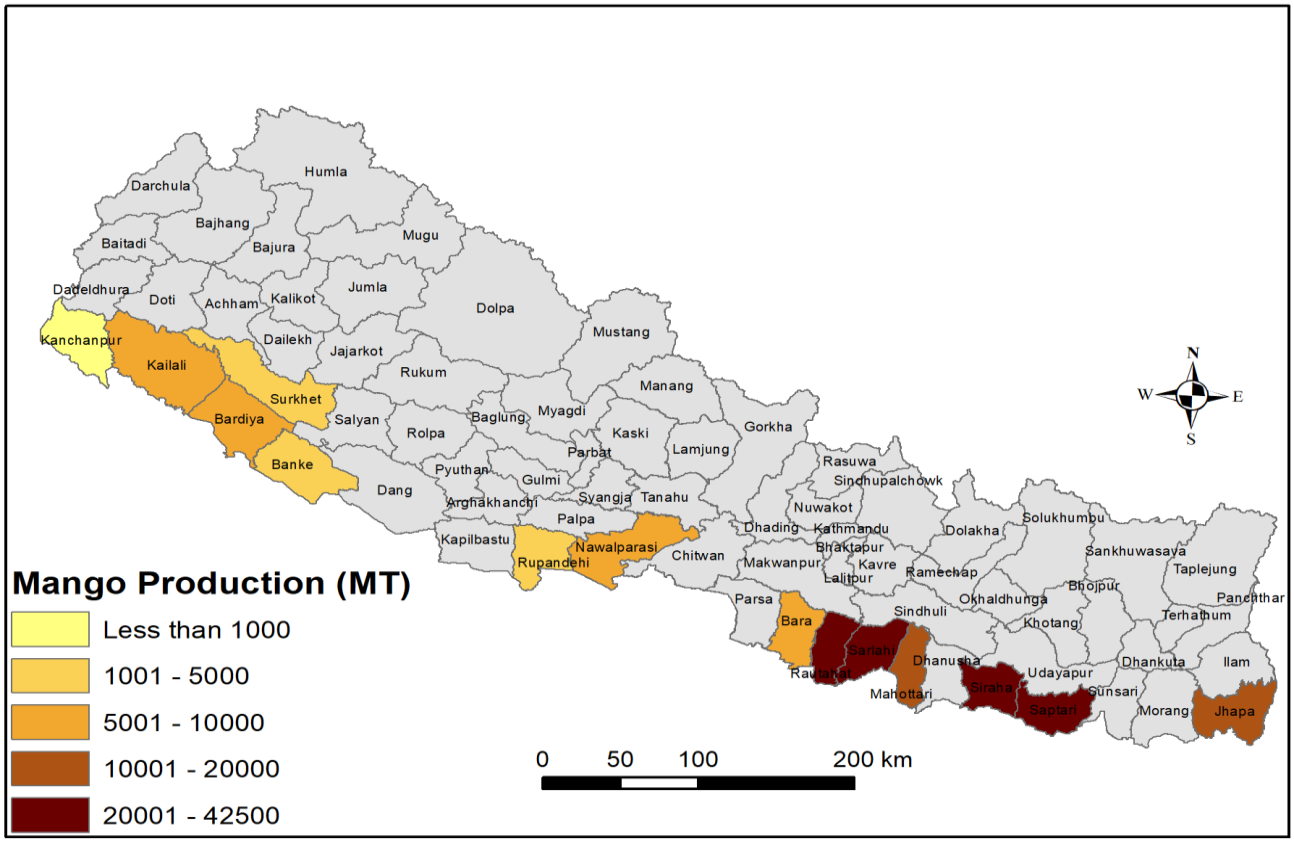


Figure 16: Tropical region districts and prioritized fruits

Fruits	Components	Base Year (2014/15)	Short term (2021/22)	Medium term (2026/27)	Long term (2036/37)
			(5 years)	(10 years)	(20 years)
Mango	Area (ha)	48247	66815	80815	108815
	Productive Area (ha)	38227	42685	53785	74785
	Productivity (MT/ha)	7.15	8.50	9.00	10.00
	Production (MT)	273323	362823	484065	747850
Litchi	Area (ha)	6635	16835	26835	46835
	Productive Area (ha)	4978	6528	11028	24528
	Productivity (MT/ha)	7.40	7.50	8.00	9.00
	Production (MT)	36837	48960	88224	220752
Banana	Area (ha)	16016	24646	33146	50146
	Productive Area (ha)	14311	16020	22208	35000
	Productivity (MT/ha)	16.37	17.00	18.00	20.00
	Production (MT)	234271	272340	399744	700000
Papaya	Area (ha)	1550	1819	2069	2569
	Productive Area (ha)	1146	1273	1490	1900
	Productivity (MT/ha)	13.31	14.00	16.00	18.00
	Production (MT)	15253	17822	23840	34200
Pineapple	Area (ha)	1253	1504	1754	2254
	Productive Area (ha)	980	1173	1267	1670
	Productivity (MT/ha)	13.78	14.00	15.00	16.00

	Production (MT)	13504	16422	19005	26720
Avocado	Area (ha)	50	260	510	1010
	Productive Area (ha)	20	4	100	700
	Productivity (MT/ha)	6	6.2	6.4	8
	Production (MT)	120	24.8	640	5600
Other tropical fruits (Guava, Jackfruit)	Area (ha)	6196	7117	8367	10867
	Productive Area (ha)	4812	5000	6024	8041
	Productivity (MT/ha)	10.10	9.50	10.00	11.50
	Production (MT)	48601	47500	60240	92472
Total Tropical	Area (ha)	79897	118996	153496	222496
	Productive Area (ha)	64467	72683	95902	146624
	Productivity (MT/ha)	9.65	10.54	11.22	12.46
	Production (MT)	621790	765891	1075758	1827594

The total of all fruits as summary of Table 21 is presented in Table 22 below:

Table 22: Summary of all projections to be achieved by long term 2036/37

Fruits	Components	Base Year (2014/15)	Short term (2021/22) (5 years)	Medium term (2026/27) (10 years)	Long term (2036/37) (20 years)
Temperate	Area (ha)	19418	27451	34951	49951
	Productive Area (ha)	11131	14648	19569	29071
	Productivity (MT/ha)	7.01	6.72	7.07	8.15
	Production (MT)	77995	98382	138347	236916
Warm temperate	Area (ha)	7719	12117	16867	25867
	Productive Area (ha)	5720	7073	9586	13856
	Productivity (MT/ha)	8.80	8.88	9.11	9.22
	Production (MT)	50350	62804	87306	127775
Citrus	Area (ha)	39035	54054	67554	94554
	Productive Area (ha)	25261	32246	40924	58113
	Productivity (MT/ha)	8.82	8.98	9.48	10.22
	Production (MT)	222894	289564	388063	593877
Tropical	Area (ha)	79897	118996	153496	222496
	Productive Area (ha)	64467.31	72683	95902	146624
	Productivity (MT/ha)	9.65	10.54	11.22	12.46
	Production (MT)	621790	765891	1075758	1827594
All Total	Area (ha)	150387	212618	272868	392868
	Productive Area (ha)	110802	126650	165981	247664
	Productivity (MT/ha)	8.96	9.61	10.18	11.25
	Production (MT)	992,703	1,216,642	1,689,473	2,786,161

The proposed areas expansion and productivity increase and its impact on fresh availability and real intake is summarized in Table 23

Table 23: **Projected targets for production, productivity and availability and intake**

S. No	Particulars	Base year (2014/15)	Short term (2021/22) (5 years)	Medium term (2026/27) (10 years)	Long term (2036/37) (20 years)
1.	Area coverage ha	150,387	212,618	272,868	392,868
2.	Productive area coverage ha	110,802	126,650	165,981	247,664
3.	Productivity MT/ha (Average)	8.96	9.61	10.18	11.25
4.	Total production MT	992,703	1,216,642	1,689,473	2,786,161
5.	Processing demand MT	15,457	30,121	78,125	163,073
6.	Export demand MT	16,376	32,000	64,000	130,000
7.	Available fresh fruit for consumption deduction processing and export	960,969	1,154,521	1,547,348	2,493,088
8.	Population (including tourists and deduction migrants)	24,601,248	27,031,765	30,932,154	34,930,723
9.	Per capita fresh availability kg	39	42.7	50	71.3
10.	Per capita real intake kg	23.4	25.6	30	42.8

The projected production if achieved the nutrition requirement of Nepalese people will be met international standard in fruit consumption by 2036/37 (Table 23)

5.4.1.1Major activities for area expansion

Area expansion will be based on the commodity specific pockets already identified and new pockets after feasibility study in each district, provisioning of quality planting materials and human resource capacity development as follows.

- Commodity specific intensive plantation in identified pockets and feasibility study in specific additional pockets in the districts
- Production and supply of quality planting materials both from government farms and private nurseries
- Human resource development for extension in each local level municipality and wards as per need
- Farmers' capacity building programme and technical support for orchard establishment

Strategic Pillar 2: Increased productivity through better management practices

Though area and production of fruits have increased during last 15 years, productivity is hovering around 8-10 MT /ha. There are several proximate causes of low productivity. This project has targeted to eliminate some of the important causes as follows.

5.4.2New and High Yielding Variety Development

New and high yielding variety development will take place as follows.

Collection and Maintenance of Exotic and Indigenous Germplasms of Fruits and Adaptive Research: Horticulture farm/centres have a collection of many exotic and indigenous fruit species. However, their evaluation, maintenance and proper utilization is poor. Therefore, already collected exotic and indigenous species will be properly tagged, reregistered and given proper care and also conduct adaptive researches. New and high yielding fruit varieties introduced from international institutions need to follow due process of plant introduction and fulfil the sanitary, phyto-sanitary and quarantine requirements. For this purpose, the following farm/centres (Table 23) will be given the responsibility of conserving and maintaining the potential exotic and indigenous germplasms. The basic adaptive and

long term researches will be carried out involving all concerned institutions (DOA, NARC, Universities and Private sector) as per need.

The strategic farm/centers will be designated for specific fruit crop collection, maintenance and research as presented in Table 24

Table 24**: Farm/centres for germplasm collection,conservationand research**

SN	Districts	Name of farm /centres	Administrative control	Germplasm to be maintained
1	Dhankuta	Horticulture Research Station /Paripatle	NARC	Mandarin, lime, Junar, trifoliate, etc.
2	Dhanusha	Horticulture farm Janakpur	DOA	Indigenous and exotic rootstocks of tropical fruits
3	Sarlahi	Tropical Horticulture Farm /Nawalpur	DOA	Mother plants of all exotic and indigenous cultivars of Mango Litchi and Avocado and adaptive researches on them
4	Sindhuli	Horticulture farm Sindhuli	DOA	Mother plants of all exotic and indigenous cultivars of sweet orange and acid lime and trifoliate
5	Dolakha	Horticulture farm Bonch	DOA	All exotic kiwi cultivars and its root stocks and plums
6	Nuwakot	Horticulture farm Trishuli	DOA	Indigenous Mango, guava, Pomegranate, avocado and Macadamia nut
7	Kathmandu	Central Horticulture farm /Kirtipur	DOA	Citrus, pear, grapes, kiwi, muntala, trifoliate, peach, persimmon and shaddock, plum
8	Mustang	Temperate horticulture farm Marpha /Mustang	DOA	Apple, apricot and Rootstocks of Malingn Morton series
9	Dailekh	Horticulture research station /Dailekh	NARC	Mandarin, Sweet orange, acid lime, lemon and trifoliate
10	Jumla	Horticulture Research station/Rajikot	NARC	Apple, apricot and Rootstocks of Mailling Morton series
11	Baitadi	Horticulture farm Baitadi/Satabanhj	DOA	Walnut, Apricot. Pecanut and hazel nut

Variety Screening and Development: Most fruit varieties except local cultivars in Nepal have been developed through introduction from other countries (e.g. apples, walnuts, litchi, mango, banana, grapes, persimmon, kiwi, etc.). In fruits like bayberry (*Kafal*), Bael, custard apple, etc., commercial varieties were developed through selection of the best performer amongst collected local germplasms. In fruits like apple, walnut, apricot, mango, banana, mandarin, etc., improved cultivars may be introduced by adopting proper phyto-sanitary measures during import and distributed to the large orchardists of priority districts for quick results.

For medium and long term new variety screening, identificationand development from germplasm introduction and local collection will be done in the designated farm/center (Table 2324) and quality planting material production and maintenance of mother plant block and rootstock block will be a major function with these farm centers including other farm/center as identified by FDD/DOA and NARC.

5.4.3Healthy and Quality Planting Material Production

Supply of quality saplings of high yielding cultivars is one of the major components of productivity enhancement programme. Despite the fact that the saplings are produced mostly by the private

nurseries, quality of planting materials is low (FDD, 2013). Production of quality planting material in general and grafting in particular, depends upon availability of mother plant and appropriate rootstock. Hence, their identification, selection and maintenance is must in various strategic locations. In order to achieve this objective, the following aspects will be prioritised.

- Maintaining separate rootstock blocks and scion (mother plant) blocks in GoN farm centers
- Emphasize to private nurseries also to maintain separate rootstock blocks and scion (mother plant) blocks
- Use of identified and standard size rootstocks and scions from identified and separately maintained mother plants
- Following of all sanitary and phyto-sanitary measures in nurseries with proper monitoring
- Inspecting and certifying all public and private nurseries by qualified professionals and technician
- Providing 75% subsidy on nursery shed-house and mist-house construction
- Practicing all recommended crop specific standards of saplings during production, packaging and distribution
- Training nursery owners on different fruit varieties, their pollinizers and packages of production practices to be capable to explain to the buyers/orchardists

5.4.4Orchard Management

The following ~~three~~ four aspects of orchard management will be duly addressed.

Management capacity development of orchardists: Proper training, pruning, intercultural operations, manuring, mulching, pasting (Bordeaux pasting) and applying pesticides during post pruning and pre-flowering and during fruiting with organic or safe chemical pesticide is important in orchards. However, due to lack of knowledge on such important aspects, orchard management is the most neglected component in fruit production Nepal. Hence, orchard management skill development of orchardists is duly emphasised by this project. Tailor made skill training at critical stages of crops will be provided by professionals and technicians to the orchardists.

Inputs Management and Intercultural Operation: Application of manure and fertiliser on time and in right quantity; hoeing, weeding and mulching; rejuvenation, prophylactive sprays, Bordeaux pasting, fruit thinning, etc. will be given priority in orchard management by this project.

Plant Protection Services: Disease and pest control in orchards in Nepal is very limited to the knowledge of the agro-vet dealer and the pesticide available in that agro vet rather than the problem in the orchard. Many times, farmers have suffered from disease problem while they have been suggested to spray insecticide. Problem diagnosis and recommendation of appropriate preventive or control measure will be highly emphasised by this project. Technical capacity building of the agro vet owners, monitoring on the use of chemicals by the orchardists and plant protection service to the orchardists will be priority actions of this project.

Irrigation Management: Except in few cases like strawberry and kiwi, farmers seem to be not aware of the irrigation requirement of the orchards. Those who are irrigating their orchards also do not have knowledge on appropriate time and method of irrigation. The orchardists in the survey conducted districts opined that they do not bother about irrigating their orchard. Hence, irrigation in general and achieving efficiency through drip and sprinkler irrigation in orchards and nurseries will be priority in this project.

Strategic Pillar 3: Decreased postharvest losses through improved post-harvest handling including packaging, transportation and storage

Poor harvesting technique, grading, packaging and inadequate post-harvest infrastructure have resulted into a high post-harvest losses at different stages (estimated 20-40 %) in Nepal. To reduce post-harvest loss, harvesting at appropriate time using proper methods, field heat management, cleaning, grading, packaging, proper transportation arrangements, and storage facilities at production and marketing sites will be developed. The following activities will be supported in general to minimise postharvest losses.

- Proper ladders with platform and hanging bags to pick the fruits and keep it in bags without breakage and damage
- Sorting and grading based on size and quality
- Support in managing appropriate containers for packaging
- Packaging in appropriate cartoons and containers with labelling
- Appropriate transportation
- Appropriate storage facilities at the point of collection, marketing centers and shipping

Strategic Pillar 4: Infrastructural Support

5.4.5 Greenhouse/Screen house for quality sapling production and controlled research

The project will provide technical support and subsidy on infrastructure construction such as mist house, glass house, shade house, poly house, net house, hot beds and cold frames based on geographical regions with at least 75 % cost support by government

5.4.5.1 Laboratoryfor Quality Monitoring

The project will establish link with the Department of Food Testing and Quality Control (DFTQC) at central and regional/provincial level for quality monitoring and also establish link with quarantine laboratory to safe guard entrance of prohibited diseases and pest during import and also provide quality guarantee in export. The international level accredited laboratory establishment will be persuaded to concerned directorates of Plant Protection and Post-harvest and DFTQC.

5.4.5.2 Market Structures

This project will support to develop market structures as follows:

- Support to construct collection centers near large production pockets
- Strengthen the linkages between collection centers and different wholesale market
- Support in constructing appropriate structures for fruit assembling at collection centers and wholesale markets
- Support in proper weighing machines and equipment's at collection centers and wholesale market

5.4.6 Increased Road Accessibility

Road accessibility is prime facility to transport high volume perishable fruits to the market centres. Road building and orchard plantation in remote hill will go hand in hand. Even small holder farmers will be convinced to plant fruits for cooperative marketing and they will be given cash earning employment in their own village till the orchards come in fruiting. Road and other construction and rural sanitation employment will give them subsistence livelihood management and once fruit comes in bearing small holder farmers will be free for other jobs and orchard management and thus rural areas may be converted into specific fruit zone. However, even if orchards are established, when it starts bearing fruits, road reaches there, urbanization increases and orchards are likely to be converted into residential areas by plotting. Such stories happened some years back in mango orchards of Terai and orchards converted into township. Therefore, land use policy must be enforced strongly to stop undue plotting and converting orchards into township.

5.4.7 Development of Cold Storages

There are 35 cold storages in operation with an average of 3,000 metric tons capacity. The average annual operation is 1,506 tons. Out of the total cost of operation of a cold storage, 38 percent is energy cost. Owing to the high cost of operation, government has subsidised 50 percent cost of electricity for the operation of a cold storage. This will be given continuity.

Cold storage units in Nepal are mainly used to store agriculture products such as potatoes, fruits, etc. Few of them store also meat items. For regular supply of fresh fruits to market, cold storages are needed at least at three critical locations:

At production sites: At large production sites, after harvesting, cleaning and grading, fruits should be stored in good condition. At higher altitude for temperate fruits and warm temperate zone for citrus during winter, zero energy level cellar storages or structured cold storages will be promoted to hold fruits to regular supply in the market. Such storages are needed in identified large production zones by individual orchardists or by cooperatives to store smallholder farmer's produce.

In sub-tropical and tropical areas, just after harvesting cleaning and grading cool chambers are required to release and reduce the field heat and then should be transported to transitional storages in cooling van maintaining cold chain to increase the shelf life such fruits (Mango, Litchi, etc.), with slogan **"Make fruit cool and keep it cool"** till it reaches to the market center

At transitional /market centre: From the storages at production site the produce should be transported to transmittal/market centre storages. Such storages should be promoted in transitional points such as Attaria/Kailali, Birendranagar/Surkhet, Kohalpur/Banke, Pokhara/Kaski, Butawal/Bhairahawa, Narayangadh/Chitwan, Bardibas/Mahottari, Lahan/Siraha, Triyuga/Udayapur, Dharan/Sunsari, Birtamod/Jhapa etc.

At large market centres: Additional market centre storages may be needed at Kathmandu, Birgunj, Bhairahawa, Biratnagar, Nepalgunj, Dhangadhi etc. for regular marketing of fresh fruits maintaining cold chain.

5.4.8 Improvement in Irrigation Facilities

In Nepal most fruit orchards are rain fed and are established in marginal lands. At present the behaviour of farmers are changing due to migration to town for other jobs and also for foreign jobs. The fertile lands in the hills are also abandoned for cereal production due to shortage of labours and negative return on investments in traditional crops. In such situation, it is an opportunity to convert these lands to fruit orchards of specific fruit for commercialization improving irrigation facilities. In the hills, following irrigation facilities will be developed with special material and labour wage subsidy to develop alternative irrigation facilities.

- Support in designing and constructing large water storage tanks to store rain water to irrigate fruit plants with drip irrigation system in critical dry periods
- Construct and develop multi-water use storage facilities for small holders with drinking water and waste water use facilities
- Individual house hold waste water and roof rain water harvesting tank construction facilities with material and skill labour cost subsidy to irrigate fruit orchards near households
- Budgetary provision for such small irrigation will be provided through local government

Strategic Pillar 5: Institutional Strengthening

5.5 Strengthening Farms and Stations

Up to 1990, horticulture farm/centres were under the unified department of Agriculture and were carrying multifarious functions of research, production and outreach services as the centre of excellence. During 1990 when the NARC was established, horticulture farms were kept under two different organizations DOA and NARC and their functions were also divided and presently, farm centres are not functioning as centre of excellence and performance seems poor. During inception workshop of Fruit Development Project formulation, the distinguished participants suggested to revise and improve the functioning of horticulture farm/centre whether they belong to NARC or DOA with following Terms of Reference (ToR) and mandates:

- Introduction and evaluation of indigenous and exotic fruit crop varieties and develop production technology by adaptive researches by designated farm/centre (Table 23) for exotic and indigenous germplasm maintenance and research
- Establishment of progeny orchards in the farm and also demonstration block to demonstrate modern production technology
- Identify and develop new varieties and production and distribution of quality planting materials of identified varieties
- Survey and identification of suitable production pockets for different fruits in the command areas of farm/centre
- Provide technical services in orchard establishment and orchard management services in the command areas in coordination with province, district and local level extension offices
- Conduct trainings for field level technicians and fruit growers to transfer modern fruit production and post-harvest technology

In the context of fruit decade all horticultural farms/centres should be given responsibility in specific fruits to functions as centre of excellence with all above mandates and revitalized the farm/centre as the centre of excellence and set examples as demonstration sites.

5.6 Strengthening Research Programme

While establishing NARC in 2048 B.S, most specialized horticulture farms were kept under DOA and senior horticulturists also remained with DOA. The specialized and major fruit specific farms/station (e.g. Horticulture Farm Kirtipur, Sarlahi and Marpha etc.) were not mandated for research. Fruit research in NARC is in low key due to lack of specialized fruit specific research farms. The horticulture units of most NARC farms were cereal crop dominated and gap appeared in fruit research. On the other hand, fruit specialized farms under DOA have no mandate for fruit research.

In addition to above structural anomalies, there is no long term fruit research policy in NARC/ MOAD with incentive to fruit scientists as it is a long term crop. The promotion in NARC is based on scientific papers published. Fruit is a long duration crop and requires many years to get the research results and paper publication; scientists neither do nor prefer to work on fruits and this is resulting in low fruit research and technology generation. There is no international linkage for exotic fruit germplasm import, evaluation, new variety development, multiplication and distributionboth in NARC and DOA. No foreign donor in fruit sector research and government investment is low in fruit research and new variety identification.

Fruit specific team of research including pomologists, soil scientists, plant protection and post-harvest specialist in specific farm centre with full leadership of horticulturists and crop specific regional research farms and demo farms with fully equipped lab is lacking both in NARC and DOA.

There was no policy and program to go with private sector in fruit research and development. Public private partnership was limited in slogan only and private sector also lack in collaborative research culture. Therefore, to improve researches in fruits, develop new variety and technology, the project formulation team recommends:

- Formulate and implement fruit research policy to avoid structural anomalies and convince Ministry of Finance to invest in fruit research as the most priority project for fruit import substitution, export promotion and balance trade deficit by 2021/22.
- Involve NARC, DOA and university for collaborative research in UG and PG and other academic research programmes
- Provision should be made to do Post Graduate thesis researches (M. Sc. or Ph. D. degree) in specific fruit crops in the farms/stations/centers of DOA and NARC having specific agro-climatic condition by availing farm facilities to the post graduate students on cost sharing basis
- Post graduate student's advisory committee should consist of Major advisor from the University and Co-advisor from the concerned farm/center of DOA/NARC. Both should be made responsible equally.

- Involve private sector's representative on the research topic related to private sector's problems, with nominal funding should be provided to the research student by the concerned private agencies
- Establish linkages with international institutions and attract donors to invest in fruit research and development and strengthen physical and human resource facilities with team of fruit research (pomologists, soil scientist, horticulture plant protection specialist, post–harvest specialists and value chain expert).
- Allow fruit research team to work in specific farms in specific crops with due duration of at least six years and incentives (Monitory and academic) with vertical promotion in the same crop and faculties.

Box: 3 Private sector Involvement in research

Private sectors in fruit sector are private nursery owners, orchardists, fruit processors, exporters and local traders. Public private partnership in fruit research is realized as vital component during recent years. The researches on all these fronts should be coordinated and guided by long term fruit research policy. The fruit research should not be limited within the fence of NARC/DOA farm/centre. It should go beyond in partnership from fruit sapling and germplasm introduction to export of finished fruit products and fresh fruit to other countries. Private nurseries and orchards also should be utilized as research sites by government and Agro Enterprise Centre (AEC) jointly co-funding by NARC/DOA/ NARDF and other agencies. Agro-Manang a private company has imported apple saplings from Italy and has established a farm in Manang with high density plantation. Why not to join hands by MOAD/FDD, NARC and AEC/FNCCI to promote such enterprise and endeavour? Fruit processing industries established in different parts of the country must link with fruit producers and they should supply the saplings of the varieties they need for their industries with buy back guarantee of produced fruits.

5.7 Human Resource Management

The human resource development in horticulture started from the creation of post of Fruit Specialist in 1941 and grew slowly. When the Department of Horticulture was established in 1967, the total horticulturists working in the country were about 15-16 only. During seventies, additional 20 horticulturists joined the profession and by 1980 the number of horticulturist were around 50 (Shrestha, A.B, 2082). Since then, the horticulturist working in the country is in increasing trends. The numbers of technical human resources working in horticulture under the Ministry of Agricultural Development are presented in Table 25.

Table 25: The number of trained human resources in horticulture working in Nepal(DOA and NARC)

Human Resources	1990			2014		
	Central offices	District offices	Total	Central offices	District offices	Total
(A) DOA						
Officer level(Gztt. class III-I)	109	14	123	146	75	221
Assistant level (JT/JTAs)	191	68	259	191	71	262
Total	**300**	**82**	**382**	**337**	**146**	**483**
(B) NARC	**Up to 1990 There was no NARC**					
Scientists level (S-1 to S-5)						45
Officer level (T-6 to T-9)						51
Total						**96**
Among 96 human resource of NARC in Horticulture only 12 scientists and 3 Technical officers are engaged in fruit research (HRD/NARC, 2017)						

Source: Bhairab Raj Kaini 2016 and NARC 2017

Besides the human resource shown in the table above, a significant number of horticulturists are working in I/NGOs. The fact that the number of horticulture human resource from one in 1941 increasednearing to 600 including all by 2014 (73 years). However, the senior horticulturists have retired

and young horticulturists have little interest to work in fruits, being its long gestation period for fruiting and taking long time to get results of researches in fruits and low facilities in fruit research and fruit farm/centres. There are also approximately 5-7 faculty members in TU and AFU together exclusively involved in fruit crop related teaching and research activities.Thus, quite a good number of horticulturists are available in the country and all of them claim that they are contributing to fruit research and development.

The table above shows that number of horticulturist under the department of agriculture at central level seems quite high, however the number in farm/centres are scarces. Therefore, the present project will reorganize central level horticulturists to provincial and local level as per the new structure of federalism. In the designated farm/centres a team of specific fruit research and service delivery team will be reorganized both in the context of fruit decade and decentralized arrangement in provincial level of organization.

Fruit specific human resource for service delivery in priority districts with special training in identified fruits with specific ToR will be managed for specialized extension service delivery in priority districts. Horticulture specialist at district level and specially trained extension technicians at rural municipality and ward level will be developed and posted under local government.

With the short term and medium term strategy the present existing organizational set-up will be reformed as per the need of provincial and local level need for fruit specific research and development for fruit self-sufficiency, export promotion and meet industrial demand

Strategic Pillar 6: Access to Finance and Mortgaging

Commercial fruit orchard establishment is a long term business. The gestation period is long involving more risk in general and threat of demolishing established orchards by undue plotting and township development in the fruit orchard areas. Returns from fruit orchards start only after five years. The initial finance need for layout of the orchards, fencing, plantation and management till it comes to full bearing needs major chunk of finance. A special provision of interest free loan and spread year wise subsidy for pit digging, plantation, care and management will be provided on the recommendation of local orchard monitoring team. The following special financial support arrangements will be lobbied/urged to the government by the project (FDD)

a) Production credit: The credit needs of small holders and large orchardists differ and arrangements have to be made accordingly. Smallholder farmer's operational credit need should be met through cooperatives who take wholesale loan from financial institutions with low interest rate while orchard establishment loan for both smallholders and large holders through commercial banks as interest free for five years on government guarantee and subsidy with due process of monitoring. Orchard care and management subsidy support (>50 plants planted in system with layout) Rs 100 per plant per year up to 5 years will be provided by local government, if maintained well on the recommendation of monitoring team of District Agriculture Development Office.

Provision of soft loan, subsidy and technical support will be provided through DADO office to agriculture graduate to start up his/her own horticulture business and to lease lands for orchards with certain conditions. Similar facilities will be provided to the companies established by rural youths for fruit nursery and orchard establishment at least 50 Ropanies or more. There will be provision of loans to Agriculture Graduates, especially with horticulture specialization, for undertaking fruit related enterprises by retaining their original academic transcripts and certificates as collateral.

b) Processing credit:industries need huge investments and it is needed in specific locations where raw materials assembly and finished productstrade out is accessible. Such industrial loans will be made available to the processors based on design and estimate for construction and equipment purchase as medium term soft loan for fixed cost. For regular operational cost, annual or six monthly loans will be made available to buy the raw materials, process and produce finished goods and marketing to wholesalers or distributors. The industry itself will be the collateral for such loan.

c) Infrastructure credit: Cold storages construction and marketing loan to fruit distributors, processors and wholesalers may be required and will be granted from commercial banks on regular process and rules. This project will verify the proposal by FDD and recommend through MOAD.

The fruit trees in the orchards and value of produce in the cold storage will be accepted as collateral for interest free credit /loan disbursement.

5.8 Fruit Specific Projects

In addition to the generic project specifications, fruit specific projects are also developed. The major contents of each fruit specific project is presented in Table 26.1 to Table 26.4 below:

Table 26: **Fruit Project (26.1 to 26.4)**

Table 27.1: **Temperate Fruit Project**					
Districts: Jumla, Humla, Dolpa, Mugu, Kalikot, Mustang, Manang, Rasuwa, Solukhumbu and Baitadi Fruits: Apple, Walnut, Apricot, Peach and Plum etc.					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
Area (ha)	19418	27451	34951	49951	
Productive Area (ha)	11131	14648	19569	29071	
Productivity (MT/ha)	7.01	6.72	7.07	8.15	
Production (MT)	77994.81	98382.25	138346.7	236915.8	
Major activities		Estimated costs (Million NRs)			**Total**
Research					
- Varietal development		30	20	15	65
- Identification, collection and establishment of mother plant orchards for propagation		10	12	15	37
- Identification, collection and establishment of rootstock orchards		5	7	5	17
- Insect Pests Management		10	10	10	30
- Disease Management		10	10	10	30
- Postharvest Management		10	10	10	30
Extension					
- Technology transfer training to 2000 farmers (200 farmers per district in 10 districts)		10	10	10	30
- Establishment of one demonstration farm per district in 10 districts		2	1	0	3
- Training materials		5	5	5	15
- Excursion visits		5	5	5	15
-		0	0	0	0
Production					
- Distribution of saplings		10	10	10	30
- Subsidy on production inputs including tools and irrigation		10	15	20	45
- Production mechanisation		10	15	20	45
- Feasibility study on reducing cost of production		5	0	5	10
Processing					
- Feasibility studies		5	0	5	15
- Promotion and subsidies on solar driers		2	2	2	6
- Production and supply of raw materials (pulp, juice, and whole fruit of apricot and peach) with processing factories		2	3	5	10
Storage		0	0	0	0
- Subsidies on the establishment of cold storage for temperate fruits in production pockets		90	0	90	180
- Linking cold storages with producer and department stores		2	2	2	6
- Promotion of zero energy cold storage		10	10	10	30
Marketing					
- Promotion of grading and use of 'A' grade apples only for long distance marketing, 'B' grade apples for cold storages and local markets, and 'C' grade apples for processing.		5	3	2	10

Table 27.1: **Temperate Fruit Project**					
Districts: Jumla, Humla, Dolpa, Mugu, Kalikot, Mustang, Manang, Rasuwa, Solukhumbu and Baitadi Fruits: Apple, Walnut, Apricot, Peach and Plum etc.					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
- Promotion of packaging		2	2	2	6
- Linking traders with fruit producers		5	3	2	10
- Price information on market, quality, and quantity		2	2	2	6
- Market Exploration studies		2	2	2	6
Export promotion		0	0	0	0
- Information on SPS requirements of the importing countries		2	2	2	6
- Quarantine requirement of the importing countries		1	1	1	3
- Information on FOB prices		1	1	1	3
- Feasibility studies		2	2	2	6
Total costs (Million NRs)		265	165	270	700

Table 26.2 : Warm Temperate Fruit Project					
District:- Ilam, Dolakha, Sindhupalchowk, Bhaktapur, Kathmandu, Makawanpur, Sindhuli, Dhading, Salyan, Dailekh (10) Major fruits:- Pomegranate, Hog-plum, Kiwi, Pear and Persimmon					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
Area (ha)	7719	12117	16867	25867	
Productive Area (ha)	5720	7073	9586	13856	
Productivity (MT/ha)	8.80	8.88	9.11	9.22	
Production (MT)	50350	62804	87306	127775	
Major activities		Estimated costs (Million NRs)			**Total**
Research					
- Varietal development		20	15	10	45
- Identification, collection and establishment of mother plant orchards for propagation		5	7	10	22
- Identification, collection and establishment of rootstock orchards		3	5	3	11
- Insect Pests Management		8	8	8	24
- Disease Management		8	8	8	24
- Postharvest Management		10	10	10	30
Extension					
- Technology transfer training to 2000 farmers (200 farmers per district in 10 districts)		10	10	10	30
- Establishment of one demonstration farm per district in 10 districts		2	1	0	3
- Training materials		5	5	5	15
- Excursion visits		5	5	5	15
Production		0	0	0	0
- Distribution of saplings		5	5	5	15
- Subsidy on production inputs including tools and irrigation		10	15	20	45
- Production mechanisation		10	15	20	45
- Feasibility study on reducing cost of production		5	0	5	10
Processing					
- Feasibility studies		5	0	5	15
- Production and supply of raw materials (fruit pulp, juice etc.) to processing industries		2	3	5	10
Storage					
- Subsidies on the establishment of cold storage for Warm temperate fruits in production pockets		0	80	0	80
- Linking cold storages with producer and department stores		2	2	2	6
Marketing					
- Promotion of grading and use of 'A' grade only for long distance marketing, 'B' grade for cold storages and local markets, and 'C' grade for processing.		5	3	2	10
- Promotion of packaging		2	2	2	6
- Linking traders with fruit producers		5	3	2	10
- Price information on market, quality, and		2	2	2	6

Table 26.2 : Warm Temperate Fruit Project					
District:- Ilam, Dolakha, Sindhupalchowk, Bhaktapur, Kathmandu, Makawanpur, Sindhuli, Dhading, Salyan, Dailekh (10) Major fruits:- Pomegranate, Hog-plum, Kiwi, Pear and Persimmon					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
quantity					
- Market Exploration studies		2	2	2	6
Export promotion					
- Information on SPS requirements of the importing countries		2	2	2	6
- Quarantine requirement of the importing countries		1	1	1	3
- Information on FOB prices		1	1	1	3
- Feasibility studies		2	2	2	6
Total costs (Million NRs)		137	212	147	496

Table 26.3: Citrus Fruit Project					
District:- Dhankuta, Terhathum, Bhojpur, Udaipur, Dhading, Ramechhap, Sindhuli, Kavrepalanchowk, Palpa, Syangja, Baglung, Parbat, Myagdi, Kaski, Gorkha, Lamjung, Tanahun, Salyan, Dailekh, Doti, Dadeldhura (21) **Major fruits:-** Mandarin, Acid lime and Sweet orange (Junar)					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
Area (ha)	39035	54054	67554	94554	
Productive Area (ha)	25261	32246	40924	58113	
Productivity (MT/ha)	8.82	8.98	9.48	10.22	
Production (MT)	222894	289564	388063	593877	
Major activities		Estimated costs (Million NRs)			**Total**
Research					
- Varietal development		30	20	15	65
- Identification, collection and establishment of mother plant orchards for propagation		15	20	25	60
- Identification, collection and establishment of rootstock orchards		10	15	10	35
- Insect Pests Management		20	20	20	60
- Disease Management		20	20	20	60
- Postharvest Management		15	15	15	45
Extension					
- Technology transfer training to 2000 farmers (200 farmers per district in 21 districts)		20	20	20	60
- Establishment of one demonstration farm per district in 21 districts		4	2	0	6
- Training materials		5	5	5	15
- Excursion visits		5	5	5	15
Production					
- Distribution of saplings		20	20	20	60
- Subsidy on production inputs including tools and irrigation		20	25	30	75
- Production mechanisation		15	20	25	69
- Feasibility study on reducing cost of production		10	0	10	20
Processing					
- Feasibility studies		10	0	10	20
- Production and supply of concentrate juice to processing factories		4	4	6	14
Storage		0	0	0	0
- Subsidies on the establishment of cold storage in strategic locations (6)		180	180	180	540
- Linking cold storages with producer and department stores		6	6	6	18
- Promotion of zero energy storage in production pockets		40	40	40	120
Marketing					

Table 26.3: Citrus Fruit Project					
District:- Dhankuta, Terhathum, Bhojpur, Udaipur, Dhading, Ramechhap, Sindhuli, Kavrepalanchowk, Palpa, Syangja, Baglung, Parbat, Myagdi, Kaski, Gorkha, Lamjung, Tanahun, Salyan, Dailekh, Doti, Dadeldhura (21) **Major fruits:-** Mandarin, Acid lime and Sweet orange (Junar)					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
- Promotion of grading and use of 'A' grade only for long distance marketing, 'B' grade for cold storages and local markets, and 'C' grade for processing.		5	3	2	10
- Promotion of packaging		2	2	2	6
- Linking traders with producers		5	3	2	10
- Price information on market, quality, and quantity		2	2	2	6
- Market Exploration studies		2	2	2	6
Export promotion					
- Information on SPS requirements of the importing countries		2	2	2	6
- Quarantine requirement of the importing countries		1	1	1	3
- Information on FOB prices		1	1	1	3
- Feasibility studies		2	2	2	6
-		-	-	-	-
Total costs (Million NRs)		471	471	942	1884

Table 26.4: Tropical Fruit Project					
District:-Jhapa, Siraha, Saptari, Sarlahi, Mahottari, Bara, Rautahat, Nawalparasi, Rupandehi, Surkhet, Banke, Bardia, Kailali, Kanchanpur (14) **Major fruits:-** Mango, Litchi, Banana, Papaya, Pineapple ,Avocado and Guava					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
Area (ha)	**79897**	**118996**	**153496**	**222496**	
Productive Area (ha)	**64467.3**	**72683**	**95902**	**146624**	
Productivity (MT/ha)	**9.65**	**10.54**	**11.22**	**12.46**	
Production (MT)	**621790**	**765891**	**1075758**	**1827594**	
Major activities		Estimated costs (Million NRs)			**Total**
Research					
- Varietal development		20	20	15	55
- Identification, collection and establishment of mother plant orchards for propagation		12	15	15	42
- Identification, collection and establishment of rootstock orchards		3	5	5	13
- Insect Pests Management		10	10	10	30
- Disease Management		10	10	10	30
- Postharvest Management		10	10	10	30
Extension					
- Technology transfer training to 2000 farmers (200 farmers per district in 14 districts)		8	8	8	24
- Establishment of one demonstration farm per district in 14 districts		3	2	0	5
- Training materials		5	5	5	15
- Excursion visits		5	5	5	15
Production		0	0	0	0
- Distribution of saplings		15	15	15	45
- Subsidy on production inputs including tools and irrigation		20	15	20	55
- Production mechanisation		15	20	20	55
- Feasibility study on reducing cost of production		5	0	5	10
Processing					

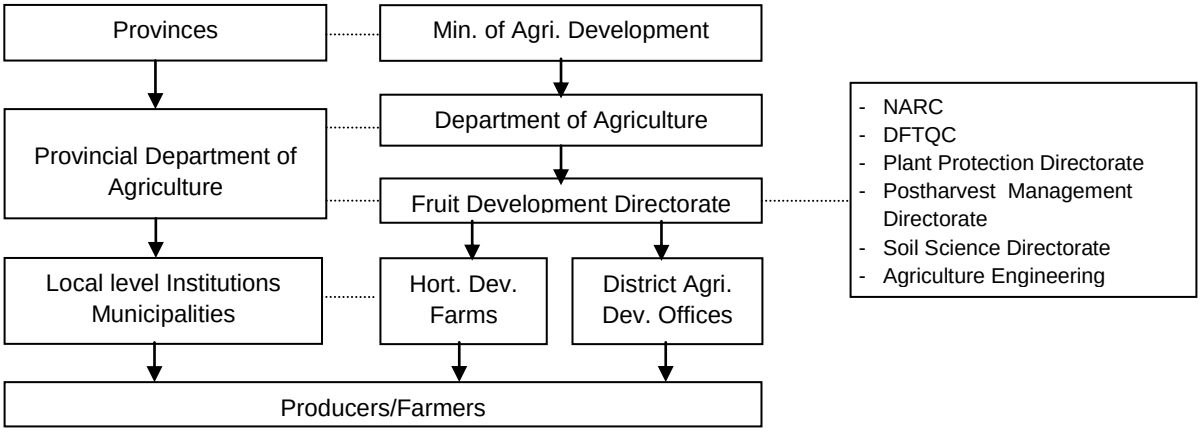
Table 26.4: Tropical Fruit Project					
District:-Jhapa, Siraha, Saptari, Sarlahi, Mahottari, Bara, Rautahat, Nawalparasi, Rupandehi, Surkhet, Banke, Bardia, Kailali, Kanchanpur (14) **Major fruits:-** Mango, Litchi, Banana, Papaya, Pineapple ,Avocado and Guava					
Area & production	**Year (2014/15)**	**Short term (2021/22)**	**Medium term (2026/27)**	**Long term (2036/37)**	**Remark**
		(5 years)	**(10 years)**	**(20 years)**	
- Feasibility studies		5	0	5	15
- Promotion and subsidies on solar driers(for drying of banana chips, mango and papaya pulps)		6	6	6	18
- Production and supply of pulp/ juice of mango ,litchi, guava, to processing factories		4	6	6	16
Storage					
- Subsides on establishment of ripening chambers for mango and banana in strategic locations (7)		30	30	30	90
Marketing					
- Promotion of grading and use of 'A' grade only for long distance marketing, 'B' grade for local marks, and 'C' grade for processing.		5	3	2	10
- Promotion of packaging		2	2	2	6
- Linking traders with fruit producers		5	3	2	10
- Price information on market, quality, and quantity		2	2	2	6
- Market Exploration studies		2	2	2	6
Export promotion					
- Information on SPS requirements of the importing countries		2	2	2	6
- Quarantine requirement of the importing countries		1	1	1	3
- Information on FOB prices		1	1	1	3
- Feasibility studies		2	2	2	6
Total costs (Million NRs)		208	200	206	614

5.9 Implementation Arrangement

5.9.1 Implementation Process

This project will be implemented by the Fruit Development Directorate through the existing agriculture development structure and also through the new organizational set-up as approved under the principles of Federalism.

5.9.2 Organisational Structure (suggested but to be finalized latter on by Government)



5.9.3 Implementation Plan

Fiscal year 2075 has been proposed to celebrate as Fruit Year. For this the project implementation will start with quality sapling production from 2073/74 with due consideration of standard size, identified varieties on identified root stocks. For this FDD will perform the following actions:

- Designate farm /centres and private nurseries for sapling production (with crop varieties and numbers) by the first quarter of 2073/74
- Prepare and obtain approval for nursery supervision and sapling standards guideline from MOAD by the first quarter of 2073/74
- Supervise and provide technical backstopping to all registered and designated nurseries throughout the year by horticulture experts, plant protection 0fficers and field technicians
- Campaign for fruit year from radio, TV and FM radios for wide information dissemination
- For fruit decade mobilize and manage all the plans as described in this report

5.9.4 Public Private Partnership

The major partners in marketing, processing, import and exports are fruit traders (wholesalers and retailers), processors, importers and exporters. These partners will be linked to research and production as they are main actors in fruit marketing processing and export. They know the market demanded varieties for consumption, processing and demanded quality standards in the importing countries. Therefore, public private partnership in fruit research for desired varieties development, demanded quality and scales of production and other standards will be sought. The researches on all these fronts will be coordinated and guided by fruit research and development policy (***which yet to be prepared and approved***). The fruit research will not be limited within the fence of NARC/DOA farm/centre. In all steps and process of fruit development public private partnership from fruit sapling and germplasm introduction to export of finished fruit products and fresh fruit to other countries will be linked and worked together. Private nurseries and orchards also will be utilized as research sites by government and Agro Enterprise Centre (AEC) jointly by co-founding among NARC/DOA/NARDF and other agencies. Agro-Manang a private company has imported apple saplings from Italy and has established a farm in Manang. MoAD/FDD, NARC and AEC/FNCCI should join hands to promote such enterprise and endeavour in other districts. Fruit processing industries established in different parts of the country must link with fruit producers and they should supply the saplings and production technology of the varieties they need to the farmers of niche pockets in collaboration with government extension authority. Industries should have their own nurseries for standard sapling production of the varieties they need for their industries and plantation in niche pockets with buy back guarantee of the fruits produced thereof. This will help to sustained supply of raw fruits to the industries.

5.9.5 Major Responsible Sectors, Agencies and their Role

The major responsible institutions and agencies are MOAD, NARC, DOA, FDD, DADOs, farm/centres and local level municipalities in public sector.

AEC/FNCCI, private nurseries, orchardists, fruit market players and I/NGOs are the private sectors.

The major roles of these organizations are summarized below:

Role of Government/Public sector:

- Technology generation and variety development, specialized human resource management for research with attractive incentives like residential quarters, rewards etc.
- Disease free root stock and scion wood maintenance as progeny orchards in GoN farm/centre; Collection, introduction and evaluation of both indigenous and exotic germplasm,
- Develop modern production technology and demonstrate both in farm/centres and demo orchard establishment in innovative farmer's field on cost sharing basis,
- Conducive policy formulation, enforcement and facilitate for import and export

- Prepare business plan and packages of practices for each major fruit crops
- Quality monitoring of planting materials and products for export and import
- Interaction with different stakeholders and campaign to aware the farmers about the importance of fruits and its production, marketing and consumption
- Collaborate and supportprivate sectorsfor research and development
- Conduct base line survey of different fruits to record crop wise production area and productivity to rectify the present doubtful data
- Update varietal characteristics of all indigenous and exotic fruits cultivated in Nepal with coloured pictures
- Revisit project programmes and the road map for fruit industry development
- Amend the contract farming act and regulation in favour of long term lease out of public land
- The government owned degraded forest land, community forest land, trusty land, and institutional fallow land (T.U. land School land) should be leased out to establish fruit orchards to individuals/cooperatives/farmer's groups /companies etc. under contract farming act
- Such leased land must be zoned for particular fruit plantation only with technical facilitation and regular and regulatory monitoring
- The fallow and abandoned upland in the hills be consolidated for cooperative/company orchard establishment for suitable fruit
- Enact and enforce strongly the land use policy to protect the encroachment of orchards being converted to residential plotting by the local provincial and national government
- Leasing out large scale production areas must be for at least minimum for 30 to 50 years for fruit orchard establishment
- Introduce a land bank system for the promotion of land consolidation and lease out for fruit plantation protecting the ownership of absentee land lord and tenants avoiding crisis of confidence between absentee land lord and tenants and support proper utilization of land

Role of I/NGOs:

- Awareness raising, demonstration of homestead garden and orchard establishment in coordination with DADO and FDDfor nutrition security and income generation
- Awareness and investment in partnership with Government sector to contribute to reduce poverty
- Lobby and support Government to make conducive policy and give appropriate role to all stakeholders. Nepal Horticulture Society (NHS) can play an important role in it

Role of Private Sectors (AEC/FNCCI, Cooperatives, farmers groups, Nursery owners, orchardists, exporters and processors):

- Collaborate with government in orchard establishment, commercialization of fruits with commercial orchard with specific purposes such as import substitution, export promotion and for processing purposes
- Entrepreneurship development by private sector and nursery establishment and quality sapling production
- Resource centre development by Govt and private sector for sapling production of industrial varieties and campaign plantation to the new areas in collaboration with DOA extension mechanism to supply raw fruits to processing industries
- Construct multi-chamber storages maintaining different temperature and humidity for different fruits and other produce and store fruits to regulate supply and produce different products
- There is also a cold storage developed and handed over to Junar Cooperatives by JICA which is underutilized and can be renovated for present use by jointly working with government
- A Chinese mobile chamber/ container with all facilities to store 5 ton fresh product costing 1.7 million Rs is available which may be useful storing high value fruits in transitional point at international airport
- Fruit processing industries establishment, market promotion and post-harvest management, business support services (Collection, marketing, processing, storage and trade) by private sector and conduction of different entrepreneurship development training by private sector.

Role of Universities:

- Its role will be to conduct basic/fundamental research on unsolved problems related to fruit development.

5.9.6 Inputs Management at Local Level

High quality planting materials, manure and fertilizers, horticultural tools and equipment's and plant protection and other chemicals are the major inputs required for commercial fruit production. Supply managements of these inputs could be assured by the following arrangements:

- Facilitate and strengthen the existing nurseries providing appropriate training, mother plants and rootstocks and link them with district, provincial and national balance sheet for sapling supply
- Prepare nursery standards for different saplings and obtain approval from central government and observe it for quality check of saplings
- Promote agricultural cooperatives and facilitate them to market and supply fertilizers, horticultural tools and equipment and plant protection and other chemicals at local level
- Manage wholesale soft loan to cooperatives from financial institution to manage inputs business and also to provide working loan to its shareholders orchardists and general farmers
- The cooperatives can also work as collector and commission agents of fruits produced by smallholder farmers to wholesalers, exporters and processors as the case may be

5.9.7 Information Management

Information is power. In fruit marketing information of different level helps to all stakeholders to benefit each other.

a) Local Market Information

Information of different local markets helps producer farmers and local collectors to regularize fruit harvest and ship their products for better price.

b) National Market Information

The aggregate of the information of all local markets constitute the national market information. This information helps fruit distributors and wholesalers to ship their products to different markets taking out from their storage and regularize the supply and demand in the national consumer's market.
For authentic market information AEC/FNCCI is playing the lead role and it should further be strengthened and linked to concerned Departments and institutions broadcast the information regularly from National media and also from local Medias.

c) International Market Information

The aggregate of international market for different months help to regularize export and import of fruits to benefit exporters. The trend of different fruit price and supply volume and price of competitor suppliers help to safeguard the export.

5.10 Effective Extension and Technology Dissemination Approach

Change in knowledge, attitude and behaviour or change in head, heart, hands and behaviour in the field are the four steps of extension. In extension not all the farmers adopt new innovation and technology at the same time. There are some innovator farmers, norm setters, early adopters, mass adopters and laggards. The extension process sometimes takes the steps of adoption, adaption, expansion and crowding in. Fruits being long duration and risky crops the process of extension is also takes long time. Therefore, social mobilization and prepare people for under taking fruit plantation by educating them through different methods and media, increase their technical capacities and institutionalize them in

groups and cooperatives and sometimes in company also should be done. Then the following methods of extension be made available to the farmers.

5.10.1 Demand Based Extension Service

Fruit Development Project has prioritized specific fruits for specific districts (Maps 5.4.1.2). Government (MOAD/FDD) should post specially trained Specialists and Technicians in those districts and local level units. The general B. Sc. Ag and CTEVT Technicians are educated in general agriculture with specific elective courses. While appointing officers and technician those who have taken horticulture electives only should be appointed in fruit sector (MOAD should make these arrangements with Public Service Commission). While appointing Technicians at local level, only local candidates should be selected. Then they should be trained on particular fruits (e. g. Train in temperate region fruits and post in western high-hills). Transfer and promote within those districts respecting federalism and local priorities. Thus the fruit specialists and Technicians would be able to deliver demand based extension service in the priority areas

5.10.2 Demo Farm and Common Outreach Sites between NARC and DOA

Seeing isbelieving and learning by doing is the principle of agriculture/horticulture extension. Establishments of demo-farms in the innovative farmer's field on cost sharing with farmers in each pockets to demonstrate technology and use as training venue to the adopter farmers is the most effective way of extension and technology dissemination. The demo-farm size should be at least of 2500 square meter at appropriate locations with irrigation facilities. The material cost should be shared by government and land labour and orchard management by cooperating farmers.

In addition to local demo-farm agro-ecology based horticultural demonstration farms/stations under provincial government structurewill be designated from existing horticulture farm/center or be established new farm/center as per need for training to farmers and technicians

5.10.3 Internal and External Farmer's Visits

Integrate farmer's visit to different successful farms within the country on eco-belt basis. Norm setter and innovative farmers from different ecological belts may be organized to increase their confidence and inspire them to go for innovative fruit development and large scale production of fruits with wide objectives of import substitution and export promotion. External visits could be organized to specific districts and provinces of India and China for widening knowledge and skill in fruit sectors developed there and adopt in Nepal

5.11 Human Capital Development

Human capital is the basis for any technological development. Horticulture education as a short term training was started sine 1937 in the government nurseries and gardens, however, formal one year course programme was started from 1957. In 1974 Institute of Agriculture and Animal Science (IAAS) was established under Tribhuwan University for under graduate study in agriculture and there is a branch of Department Horticulture Education and offers elective horticulture in B. Sc. Ag and at present runs M. Sc. and Ph. D courses.

Besides of this University of Agriculture and Forestry (UAF), Himalayan College of Agricultural Science and Technology (HICAST) and many colleges are offering graduate courses in agriculture. These are academic courses for basic qualification to enter in the job. For mid-level and lower level human resource development Council for Technical Education and Vocational Training (CTEVT) and many other non-academic organizations and institutions also run different short term training. However to meet the envisaged requirements and deliver effective service the following long term academic and short term skill development training may be linked with Fruit Development Project

5.11.1 Long-term Academic Training

Long- term Academic Training should be integrated to work as internship as in medical education for at least six months. This may be arranged as follows:

- Internship programme of six months should be included for graduate and post graduate students in the DOA and NARC research/development farms as a part of their academic programme
- All newly recruited horticulture development officers should be required to work for one year in the horticulture research/development farm before their posting in the extension programme
- Specific post graduate degree programmes should be initiated in M.S. Hort. (Pomology)and M. S. Hort. (Post-harvest), etc.
- Fruit related higher education research should be tied up with research and extension related farms of NARC and DOA
- MOAD should establish fellowship opportunities for problem oriented researches in fruits in NARC and DOA farms/centers

5.11.2 Short-term Skill Development Training

Short term advanced professional training course could be offered by the academic institutions on Pomology, Post-harvest management, Processing and Packaging etc. in collaboration with MOAD/FDD. Specific fruit group related short term course could be designed by FDD hiring a team of horticulture experts and offer such training to the Technicians, commercial orchardists and nursery owners of particular ecologic regions.Such skill development training on specific horticulture crops should be conducted with practical practices at different agro-ecological regions. For example temperate fruit training at Jumla, Marpha and Baitadi, Citrus and warm temperate fruit training at Dhankuta, Kirtipur, Pokhara and Palpa. Similarly, training for tropical fruits could be organized at Sarlahi and Nepalgunj. Short term courses on i) Nursery enterprise development and ii) Horticulture entrepreneurship and enterprise development should be made.

Likewise as short-term and medium term strategy FDD should design training curriculum in collaboration with AEC and a team of horticulture consultants and should offer the following training to the needy people:

- Fruit Production Entrepreneurship Development Training
- Fruit Processing Entrepreneurship Development Training
- Fruit Marketing Entrepreneurship Development Training

5.12 Estimation of Investment Requirements

The major investments that are required are in the areas of research, extension, processing, marketing and production inputs and infrastructure. The World Bank estimates that two percent of the AGDP should be invested in agricultural research (FAO, a-bo573e.pdf). If not, then for a substantially visible outcome of agriculture, spending on agriculture research should be at least one percent of agricultural GDP in any country (WB, 1981). However, Nepal spends about 0.17 percent only for the whole agricultural research. In 1990s, it was 0.26 percent which increased to 0.43 percent in 2001 when there was Agriculture and Research Project and declined again after the completion of the project (IFPRI, 2011). Agriculture contributes about 33 percent to GDP (MOF, 2016) and fruits and spices sector contributes around seven percent of AGDP (Karki, 2015). As compared to its contribution, spending on agricultural research in Nepal is very low. It needs to be increased to at least one percent of its sectoral GDP. Even if direct subsidy cannot be given due to globalization policy, increased investment in research, extension and physical infrastructures such as agriculture roads, irrigation, and storage and laboratory facilities reduces the cost of the produce thereby making the produce more competitive in both domestic and export markets. Fruit Development Project is a process project and annually budget and investment should be analyzed and calculated, however, long term commitment in investment is always desirable in long term fruit sub-sector. Therefore, estimated budget projection for at end point year of short term, medium term and long term is presented in Table 27.

Table 28: Estimated budget at different point of project life (In NRs millions)

S. No	Programmes	Base year 2016/17	End of short term 2021/22	End of Medium Term 2026/27	End of long term 2036/37	Remarks
1	Regular activities of FDD and farm Centers	250	500	750	1000	This is just rough estimate at particular point of project life. It needs every year projection
2	Fruit self-sufficiency and import substitution	50	100	200	300	
3	Orchard and nursery improvement/management	50	150	300	500	
4	Fruit research and variety development	0	250	500	500	
5	Fruit area expansion and post-harvest management	150	300	600	900	
6	Fruit decade programme	400	600	1200	1500	
7	Vivid	0	200	400	600	
	Total	900	2100	3950	5300	

Note:- calculation is estimated based on the fruit sector budget of FY 2016/17

Once fruit orchards are established, it must be protected from being demolished in the name of township development and plotting. The life of each fruit species should be calculated and its fruit bearing capacity and economic return. Then if fruit trees are to be cut the compensation as per its life time return should be calculated and remunerated to the orchardists.

5.13 Monitoring, Evaluation and Information Management

Objective of monitoring and evaluation is to make thematic and sectoral agencies responsible for ensuring that fruit development project results are achieved. Results arising from monitoring and evaluation shall make the fruit development strategies more effective. This Framework shall include national-level monitoring and evaluation. Qualitative and quantitative information and data of the indicators of such national-level monitoring and evaluation shall be obtained through the monitoring and evaluation of the overall fruit development activities in the country.

5.13.1 Aspects to be Monitored and Evaluated

This includes three major areas of monitoring and evaluation.

Under this framework, four types of results shall be monitored and evaluated.

a.1) Monitoring and evaluation of the results sought to be achieved under the objectives and six strategic pillars.

Results shall be monitored and evaluated by taking the base of indicators presented in Table 28.

a.2) Monitoring and evaluation of the assumptions made by this project for the achievement of the expected results

a.3) Monitoring and evaluation of risk reduction measures presented in Table 29

a.4) Monitoring and evaluation of Fruit Development Project Implementation Plan

The following aspects are analysed in the process of monitoring of plans, policies, programs and projects:

1. Whether or not resources are available to and used by the constituent units within the limits of an authorized budget and stipulated timeframe.
2. Whether or not expected outputs are achieved in a timely and cost-effective manner.

3. What is the level of implementation capacity?
4. What kind of problems and constraints are being faced and what kind of remedial measures are called for?

During monitoring, data and information on the above mentioned aspects are collected, processed and reported in a continuous, systematic, and time-bound manner. This helps identify problems and initiate corrective measures before it is too late.

5.13.2 Indicators to be Monitored and Evaluated

The fruit development project has formulated short term, medium term and long term plans focusing fruit decade and overall development of fruit sub-sector. Monitoring and evaluation of these plans can be performed on the basis of the output indicators. These indicators have been prepared for the Result Based Matrix as envisaged by the Agriculture Development Strategy (ADS).

Major quantitative targets of the fruit sector have been set considering FY 2014/15 as a base year. The Result Based Matrix with output Indicators of the fruit sub-sector development has been given below in Table 28 and risk and mitigation measures in Table 29.

Table 29: Indicators to be monitored

Results	Indicators and Source of Information						Responsible Institution	Assumptions
	Indicators	Base Year (2015/16) Status	Target			Source of Information		
			Short term 2021/22 (5 years)	Medium term 2026/27 (10 years)	Long term 2036/37 (20 years)			
Outcome 1 Food and nutrition security enhanced	Per capita consumption of fruits and fruit products (real intake kg/year)	23.4	25.6	30	42.8	• Progress Report • Survey Report • Livelihood Survey	Fruit Development Directorate/ DOA	• There is continuous increase in people's knowledge about the nutritive importance of fruits in human food.
Output 1.1 Production and productivity of fruits increased	Annual Fruit Production ('000 MT)	976	1,378	1,706	2,130	• Progress Report • Survey Report	Fruit Development Directorate/ DOA	• Government priority on fruit develop continues
	Fruit Productivity (MT/ha)	8.46	10	12	14			
Output 1.2 Quality of fruit saplings increased	Recommended fruit saplings production ('000/year)	6,680	7,710	8,550	9,400	• Progress Report • Monitoring Report • Survey Report	Fruit Development Directorate/ DOA	• Extension programme complies with the recommended sapling quality • Package of government services and credit is linked with quality planting material
	Recommended fruit saplings distribution ('000/year)	6,090	7,500	7,710	8,400			
Output 1.3 Use of organic manure and fertilizers increased	Use of average fertilizers (kg/ha/year)	84	100	125	150	• Survey Report	Fruit Development Directorate/ DOA/AICL	• Fruit production support package include the use of recommended package of fertilizer and manure. • Supply of fertilizer and organic manures are ensured by the government
	use of organic manure (MT/ha//year)	NA	9	12	15			
Output 1.4 Good agriculture practices (GAP) adopted	Bio-pesticides production(dust) (Quintal)	22	30	40	50	• Progress Report • Monitoring Report • Survey Report	Fruit Development Directorate/ DOA	• Bio pesticide production is promoted by the government at the private sector
	Bio-pesticides production(Liquid) (Litter)	10	15	25	35			
Outcome 2 Competitiveness of commercialized fruit produced enhanced	Increased productivity, Improved quality, reduced cost of production, timely supply with good packaging of main fruits (B:C Ratio at farm gate)							
	Mandarin		0.30	1.17	1.44	• Benefit: Cost Ratio study report	Fruit Development Directorate/ DOA	• Sufficient training programmes are provided on the ways for reducing cost of production • Extension programme includes cost reducing techniques
	Sweet orange		0.34	1.29	1.58			
	Apple		0.29	1.12	1.33			
	Mango		0.44	1.34	1.56			
	Litchi		0.31	1.60	1.83			
	Kiwi		0.38	1.74	2.33			

Results	Indicators and Source of Information						Responsible Institution	Assumptions
	Indicators	Base Year (2015/16) Status	Target			Source of Information		
			Short term 2021/22 (5 years)	Medium term 2026/27 (10 years)	Long term 2036/37 (20 years)			
	Banana		2.24	2.83	2.78			
	Pomegranate		0.89	1.57	1.69			
Output 2.1 Farm mechanization strengthened	Use of tractor, power tiller, and other machineries by fruit farmers (No.)	NA	100	200	300	• Survey report	FDD/ DOA	• Small mechanization tool suppliers are contracted out by the government on the delivery of subsidized tools and equipment
Output 2.2 Fruit processing industries developed and strengthened	Processing Industries (No.) Supply of fresh fruits for processing (MT)	35 15,457	40 30, 121	45 78,125	50 163,073	• Progress report	FDD/ DOA and processing Industries	• Accredited laboratory is established in the private sector
Output 2.3 Market Infrastructures developed and strengthened	Wholesale markets (No.)	27	29	32	35	• Progress report	FDD/ DOA	• All local bodies give due priority to establish wholesale market in their municipalities/village institutions
	Cold Storage (No.)	7	10	12	14			
Output 2.4 Capacity of farmers and technicians enhanced	Trained Nurserymen (No. / Year)	NA	75	100	150	• Progress report	FDD/ DOA	• Government links all extension and credit services to the trained farmers.
	Trained Orchard owners (No./year)	NA	300	400	500			
	Trained Technicians (No./Year)	NA	200	300	400			

Table 30: Risks and Mitigating Measures

Assumptions	Risk assessment	Mitigating measures
There is continuous increase in people's knowledge about the nutritive importance of fruits in human food.	No risk	
Government priority on fruit develop continues	Low risk	• Regular follow-up during periodic and annual plan preparations to ensure that required instructions are included in the plan preparation guidelines
Extension programme complies with the recommended sapling quality	Medium	• A system of sampling purchase by the extension programme from the registered nurseries established • Sapling quality is certified before distributed for planning
Package of governmentservices and credit is linked with quality planting material	Medium	• Government services and subsidies are provided to only those farmers who plant certified quality planting materials
Fruit production support package include the use of recommended package of fertilizer and manure.	Medium	• Inclusion of recommended package of fertilizers and manures is made mandatory in the fruit production support package
Supply of fertilizer and organic manures are ensured by the government	High	• Supply system is privatized • Agro vet dealers are given the dealership by the AIC
Bio pesticide production is promoted by the government at the private sector	Medium	• Registered bio pesticide producers are given subsidy to establish the production factory • Bio pesticide producers are given long-term training by the government
Sufficient training programmes are provided on the ways for reducing cost of production	Medium	• Training packages are approved for funding only when they include ways for reducing cost of production
Extension programme includes cost reducing techniques	Medium	• Fruit extension programmes are approved for funding only when cost reduction programmes are explicitly included
Small mechanization tool suppliers are contracted out by the government on the delivery of subsidized tools and equipment	Medium	• Subsidy is provided only after the delivery of goods
Accredited laboratory is established in the private sector	High	• Private sector is supported to conduct a feasibility study
All local bodies give due priority to establish wholesale market in their municipalities/village institutions	High	• Feasibility study is supported by FDD
Government links all extension and credit services to the trained farmers.	Medium	• FDD monitors the compliance with the policy

5.13.3 Monitoring and Evaluation Schedule

Monitoring will be carried out by the Fruit Development Directorate in collaboration with the monitoring units of the Ministry of Agriculture development, Department of Agriculture and Nepal Agricultural Research Council. Monitoring will be done regularly as per the monitoring schedule of the Ministry of Agriculture Development. There will be trimestral, semi-annual and annual monitoring reports produced.

Evaluation will be conducted at the end of short-term, mid-term and long-term plan periods of this Fruit Development Project (FDP). Evaluation will be carried-out by the third party.

5.13.4 Information Management and Use

A monitoring and evaluation report on the implementation of this FDP shall be prepared based on the objectives and six strategic pillars. Based on the results of monitoring and evaluation, the monitor and evaluator shall recommend clear directions regarding what related agencies shall have to do to achieve the expected results. The FDD, based on those recommendations, shall direct related agencies accordingly. The FDD shall take necessary action on such monitoring reports and present details for policy decisions at a meeting of the FDP Implementation Coordination Committee for policy.

A Fruit Development Project Information Centre shall be established in the FDD. The Centre shall collect and manage required information by with the related agencies and individuals. The Centre shall also collect and manage local-level information by co-ordinating with the Local Government.The Unit shall also ensure that replication and promotion of knowledge has been included in the Programme Planning Guidelines to include it in future plans and programmes. Based on the lessons learned from the implementation of this FDP, feedback shall be provided at the FDP Implementation Coordination Committee.

5.11 Cost benefit Analysis

Benefits and costs were computed for major fruits on per hectare basis. Details of the estimates are presented in Annex 21in volume 2 Annexure. Summary of benefits and costs of the major fruits is presented in Table 30. The results show that fruit production is profitable in Nepal. The financial internal rate of return was about 23 percent in apple to as high as 59 percent in Banana.

Table 31: **Benefit Cost Analysis**[2]

Fruit	Benefit cost ratio (at 10% discount rate)	Financial internal rate of return (%)
Mandarin	1.44	24.94
Sweet orange	1.58	28.45
Apple	1.33	22.86
Mango	1.56	31.67
Litchi	1.83	34.78
Kiwi	2.33	39.16
Banana	2.78	60.27
Papaya	1.69	37.48
Pomegranate	1.44	24.94

5.14Project Benefits

Major project benefits will be through increased production, increased productivity, import substitution, and export promotion. Increased benefit from production will be mainly through the increased area under production replacing the traditional crops, increased productivity through the use of improved technology and management practices; reduction in post-harvest losses, and fetching better price through improved marketing practices. Hence, the increased benefit will depend upon the production programme that will be designed and launched in future.

5.14.1 Other Benefits

Fruit plantation itself has multifarious benefits. In short these benefits are described in the following sub-headings

5.14.1.1 Employment Generation and Reduction of Outmigration

Successful implementation of fruit development project opens employments to different entrepreneurs. Nursery owners, orchardists and different market players will generate self-employments and outmigration will be reduced. Different skills required by fruit industry will attract the youths to work in this profession and earn income in the country itself

5.14.1.2 Environmental Enhancement and Climate Change Mitigation

Fruit trees are the plantation crops and increases the greenery and help in carbon assimilation and improve the environment. Thus, it helps in climate change mitigation. Fruit trees have dual advantages of forestation and food production.

5.14.1.3 Enhanced Food Security and Social Cohesion

Fruits are high value high volume crops. Fruits are more nutritive than cereal crops and gives return for long time once it is established. The value of fruit is higher than cereal crops and by selling fruits can be purchased more quantities of food grains and thus

[2] The basic cost and production information was adopted from Agribusiness Promotion and marketing Development Directorate's report on "Average Cost of Production and Gross Profit of Fruit Farming in Nepal" 2071/72.

enhance food security and by consuming fruits also enhance nutrition security. Exchange of fruits and fruit gifts increases the social cohesion in the community

5.14.1.4 Social Inclusion and Gender Empowerment

Fruit industry has a long chain of employments involving different skilled people. It requires large number of farm labour to technicians, mechanics to factory workers, packagers, loaders, transporters and many others. Both men and women employees are required. Women workers will develop different skills in production, marketing and processing will be economically empowered and socially recognized.

6. Conclusion

Nepal has suitable climate and comparative advantages for the production of different kinds of fruits. However, the growth of fruit industry has remained slow in the past. Work on fruit research was inadequate and extension program is very general and cereal crop dominated. Donors,I/NGOs and other development partners are least interested in fruit development as most of the fruit crops take long time to give economic returns.To expedite fruit production and productivity to meet the domestic increasing demand substituting import and promoting export and to minimize the trade deficit, Fruit Development Directorate is celebrating fruit year 2018 (B.S.2075) and Fruit Decade 2016/17- 2026/27 (2072/73 to 2082/83). In this context, the Fruit Development Directorate (FDD) has a program in the FY 2016/17(2073/74) to develop a **"Fruit Development Project"** to guide the fruit sector for the coming decades.

Nepal Horticulture Promotion Centre submitted the expression of interest (EoI) to FDD and FDD accepted EoI and asked to submit full proposal. Nepal Horticulture Promotion Centre developed and submitted the Technical and Financial Proposal for preparing "Fruit Development Project". The Fruit Development Directorate awarded the contract to Nepal Horticulture Promotion Centre to prepare the Fruit Development Project.

The general objective of the fruit development project was to make Nepal self-sufficient in fruit supply from its own production in next 10 years' time referring to overall objective of the ToR provided in the contract agreement with following specific objectives of preparing project with action plans.

- Increase fruit production and consumption thereby increasing nutrition status of the people
- Increase export and substitute import of fruits thereby reducing fruit trade deficit balance
- Increase fruit processing there by increasing value addition in fruit and employment creation

To meet the above specific objectives the project preparation team reviewed the past performance of the sector and analyse the present situation and calculated the requirements and gaps. The analysis established the fact that present production was 992,703 MT and availability 39 kg and real intake 23.4 kg at the base year. The projected achievement for consumption, export and processing together was to 2,786,161 MT by 3036/37 and will reach availability to 71.3 kg and real intake 42.8 kg. For this area increase was from 150,387 ha to 392,868 ha production from 992,703 to 2,786,161 and productivity from 8.96 to 11.25 MT/ha.

To achieve the above target the project has proposed 5 strategic pillars as, Production increase through increased area under production, productivity increase through better management practices, postharvest loss decrease through improved postharvest handling

including packaging, transportation and storage, infrastructural support for quality planting material production and post-harvest handling, institutional strengthening for research, production and marketing and increased access to finance

The “Fruit Development Project” includes plan of action on short term, medium term and long term for the overall development of fruit sector. In light of the huge agriculture trade deficit and Nepal's comparative advantage in fruit production, this project has proposed to increase domestic production and value chain development of apple, mango, banana, lime and lemon for import substitution; and mandarin, apple, pear, kiwi, and walnut for export promotion.Project has also proposed production and promotion of avocado, persimmon, pear, kiwi and different nut fruits for fulfilling the demand of tourism sector and promote export. At present local production of fruits is so low that large quantity of the fruits consumed in the country accounting to annual Rs. 6 billion come from India and China. Post-harvest losses especially at storage and transportation are estimated between 20-40% which clearly shows the poor situation on fruit sector and has proposed improvement in this front as well.

Most of the fruits are environment friendly, and some of the fruits can be grown in marginal and undulated terrace land with minimum of irrigation facilities. The recent youth migration and abandoned land in the hills and degraded forest and public land if brought under fruit cultivation contribute to revive hill agriculture and carbon sequestration. Considering all these advantages and recent trends of farmers leaving cereal crops cultivation due to lack of farm workers, fruit plantation is the only left opportunity. The present Fruit Development Project may be one of the best alternatives for rural reconstruction. Thus, smooth and dedicated implementation of the proposed project will certainly bring revolutionary change in the development of the fruit industry in Nepal.

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