

AGRO-ECOLOGICAL SUSTAINABILITY AND HORTICULTURAL FRUIT GARDENING IN THE SUB-HIMALAYAS OF INDIA: A CASE STUDY ON LIVELIHOOD PROSPECTS AND PROBLEMS THEREIN

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Abstract: *This paper is an attempt to unveil the agro-ecological system of a sub-Himalayan region (district Poonch) in India with special highlights on the diversity of horticultural fruit trees and their importance as a sustainable livelihood option. The paper examines the production and productivity of different horticultural fruits in different constituencies of the district and how they are affected due to variations in geographical conditions. It has been found that the district is agro-climatically favourable for the growing horticultural crops which may be helpful in providing sustainable livelihood opportunities for local communities. The study also finds out various problems like inadequate irrigation facility, predominant loose erodible soils, lack of awareness on conservation practices, critical technology gaps in specific areas and low adoption of modern agricultural and post-harvest technologies. There are other problems like inability of farmers to invest, lack of funding opportunities, market facility, packaging, storage and transportation.*

Keywords: Horticulture, Agro-Ecology, Fruit Gardening, Crop Intensity, Livelihood.

Introduction

India with diverse soil and climate comprising several agro-ecological regions provides ample opportunity to grow a variety of horticultural crops. These crops form a significant part of total agricultural produce in the country which covers fruits, vegetables, root and tuber crops, flowers, and ornamental, medicinal and aromatic plants, spices, condiments, plantation crops and mushrooms. Cultivation of these crops is labour intensive and generates lot of employment opportunities for the rural population. India, with more than 28.2 million tonnes of fruits and 66 million tonnes of vegetables is the second largest producer of fruits and vegetables in the world next only to Brazil and China (Economic Census 2005). Thus, cultivation of horticultural crops plays a vital role in the prosperity of the nation and is directly linked with the health and happiness of the people. The main aim of the paper is to display the potentials of agro-ecological system in the region under study with reference to horticultural diversity, as a means of sustainable habitat utilization and livelihood option for local community. The paper correlates the physical environment with socio-cultural and economic settings to envisage the potentials of horticultural activities in this sub-Himalayan pocket (i.e. district Poonch, Jammu & Kashmir, India). To overcome the constraints of management and promotion and the problems that hinders developmental activities of local communities, through horticultural sector. This paper also suggests the headway for improved management and conservation of biodiversity, and other natural resources for sustainable environmental development.

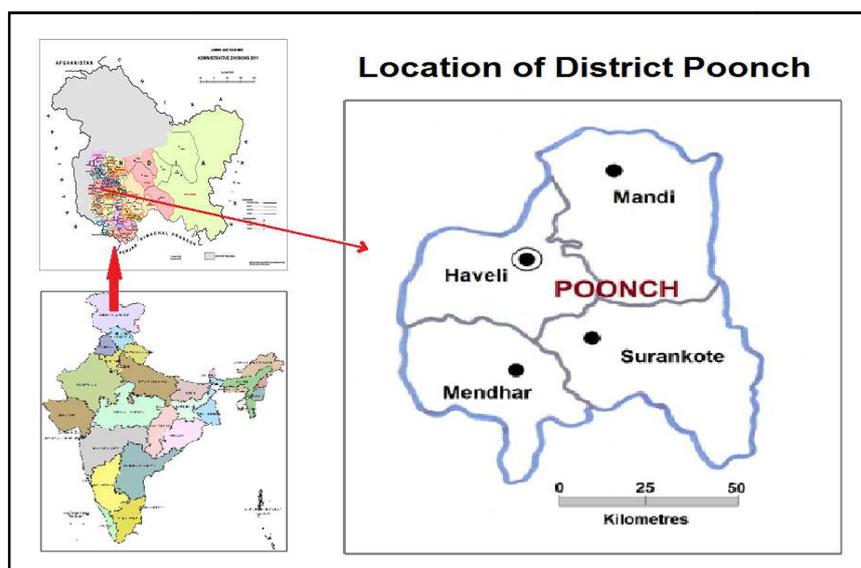
Database and Methodology

The present study has been based mainly upon secondary data (2010-11) made available by various government departments at district level such as district's Chief Horticulture Office (CHO), Agricultural, Forestry and Irrigation, to obtain information about area and production various crops grown in the region during 2010 and 2011. The work also incorporated the data and information from some international and national agencies namely; Food and Agricultural Organization (FAO) of the United Nations, National Horticultural Board (NHB), National Horticulture Mission (NHM), National Bank for Agriculture and Rural Development (NABARD) and the State Agricultural Production Department. Besides, some primary information was acquired through intimate contacts with the farmers in local communities of the region, and acknowledgements of their problems like, irrigation supply, pest/disease, farm mechanization etc. Interviews were also conducted with horticulture officer and review out their completed project works and gathered information about the future plans and schemes related to the development of horticulture in the district or region.

Study Area

Poonch is one of the remotely located district of India lies in the state of Jammu & Kashmir (Figure 1). Geodetically, it is situated between 33° 25' to 34° North Latitude and 73° 25' to 74° 33' East Longitude. The district Poonch came into existence in the year 1967. The average mean sea level of the land of Poonch is 981 metres (3218 feet) and it spreads over an area of 1674 sq. km. or 0.7 million hectares. Pir Panjal range of mountains separates Poonch valley from main Kashmir valley. For a long time the only road connection between the two valleys was from the city of Jammu. But, now with the completion of Mughal Road (connecting Buziiaz in Poonch district to Shopian in Kashmir region) there is a direct connectivity between the two.

Figure 1: Maps indicating location of the study area



Source: National Informatics Centre, district Poonch and Census of India.

Agro-ecological conditions in Poonch district

Structurally, Poonch is a hilly and mountainous district barring few-low lying valleys. The territory is comprised of three physiographic zones which include the valley plains, the foothills and the Lesser Himalayas. Here climate exerts a profound influence on the socio-cultural and economic life of the inhabitants. The climate reflects humid sub-tropical (monsoon type) to temperate type. The summer temperature generally does not cross 31 degrees, while the winters are cool and chilly characterized with rainfall as a result of western disturbances.

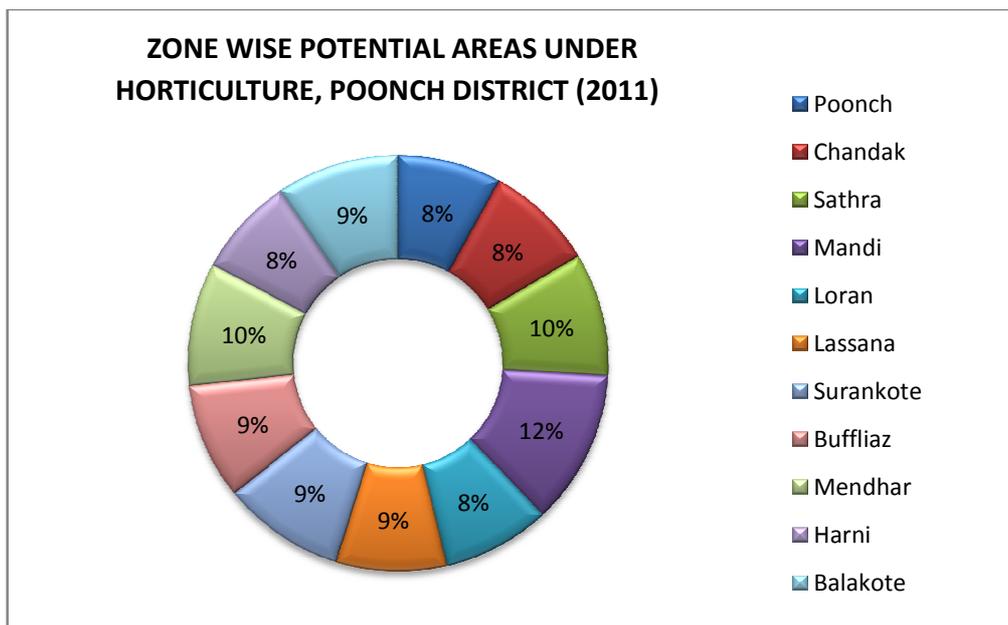
Snowfall is uncommon but may occur in December and January. Rainfall is 669 millimeters (26.3 in) in the wettest months. The drainage of the district is quite significant with distribution of several perennial river streams and *nalas* (seasonal rivulets). The soils are very much diverse because of geological variation, terrain condition, water availability and vegetative cover. The soils in the district are originated from alluvial, residual and glacial activities. Broadly, two types of soil viz. sub-mountainous soil in the southern parts and meadow soil over the northern parts of the district. Due to the presence of favourable geographical and agro-ecological conditions, Poonch district is bestowed with a rich biodiversity of forest and wild life. Forest in the district covers an area about 951 sq. km. which 4.7 percent of the total state forest area (i.e. 20230 sq. km.). There are vast areas of natural carpet vegetation which include grasslands, meadows, wild flower patches, ferns mosses and lichens. Throughout the region of Poonch, there is a handsome diversity of trees (fruit and non-fruit), bushes, and creepers. Among the timber species there are many varieties including walnut, deodar, oak, maple, poplar, birch, firs, spruce, teak, pines etc., which grows to gigantic size and girth. The other species are wild olives, figs, wild pomegranates, acacias etc. The fruit species are apple, walnut, pecan nut, pear, plum, citrus species etc. As per the Annual Report, 2011-12 of *Krishi Vigyan Kendra* (Agricultural Science Centre), district Poonch, about 87 percent of the farmers were associated with agriculture and 65 per cent came under marginal category. Majority of fields in the district are situated across the hilly slopes. Overall cropping intensity of the district is about 166 per cent whereas double cropped area is 0.052 million ha. Average size of land holdings is quite low as it is only 0.2 hectare in the district. The initial land-use pattern in the district was purely agriculture. It has changed over a period of time to agri-horticultural and silvi-pastoral. Area under fruit and vegetable cultivation has marginally increased.

The district Poonch is full of natural resources which are of great economic potential. The physiographic location imposes a number of constraints, particularly in agriculture and allied sectors. Most of the district is rain fed, as only 13.35 per cent of area is having assured irrigation. There are limits to increasing production through expansion of cultivable land. Hence, the emphasis has to be laid on increasing productivity levels, besides, diversification towards high value crops. Among the food-grains, the main crops are maize, wheat and rice. Besides, other crops like barley, sorghum, pulses, oilseeds, minor millets, vegetables, fodder, aromatic and medicinal plants and flowers are also grown in the region. Mushroom culture and apiculture sectors can also be undertaken on large scale as the district is bestowed with suitable conditions (Asif and Mushtaq. 2013).

Results and discussion

Poonch district is blessed by nature with varying agro climatic conditions thus making it suitable for growing of wide variety of crop plants and fruit crops under sub tropical, intermediate and temperate zones. The peculiar geographical situation and inadequacy of infrastructure in the district has restricted the development of horticulture and the possibility of land productivity. It occupies an important position in the farming system of the state. Besides, the state has suitable climatic zones for growing temperate, sub-tropical and tropical fruits throughout the year. The fruits include apple, pear, peach, plum, apricot, cheery, walnut, citrus, kiwi, persimmon, olive etc (NHB 2011 & NHM 2014). Poonch district also offers tremendous potential for export of various processed fruits and walnuts, honey, etc.

Figure 2: Percentages of zone wise potential area under horticulture, 2011



The total available potential area in the district is 35000 hectares under horticulture. The district is divided into 11 zones; among which Mandi has the largest share of potential area i.e. 12 percent while the Mendhar and Sathara contribute 10 per cent each. The zones like Lassana, Surankote, Buffliaz and Balakote possess the share of 9 percent. The lowest 8 per cent is shared by four zones namely; Poonch, Chandak, Loran and Harni.

Pattern of land use under Horticulture

In general, under the regime of agricultural ecosystem of Poonch district, horticulture represents the main economic activity. Administratively, the district is divided into three constituencies namely; Haveli, Surankote and Mendhar, and eleven developmental zones. These three constituencies not only possess the administrative function, but also are the main agro-ecological zones of the region. Haveli, being the largest constituency comprised of five zones (Poonch, Chandak, Sathara, Mandi and Loran) of horticultural importance. It has a large area of 14,000 hectares for horticultural potential, out of which 8,871 hectares has already been covered under horticulture plantation. The second constituency, Surankote (comprising Lassana, Surankote and Buffliaz) has a potential area of 9,500 hectares out of which 4,227 hectares have already been covered under plantation. Mendhar, the third constituency lies in the lower areas comprises three zones namely; Harni, Balakote and Mendhar, has a potential area of 11,500 hectares but, only 3,904 hectares) is covered under horticulture.

Table 1: Constituency wise potential area available for horticulture in Poonch district

Name of Constituency	Potential Area (in ha.)	Area Already Covered under Plantation (in ha.)	Area to be Covered in Future (in ha.)
Haveli	14,000	8,871	5,129
Surankote	9,500	4,227	5,273
Mendhar	11,500	3,904	7,596
Total	35,000	17,002	17,998

Source: Office of the Chief Horticulture Officer, Poonch District.

In this way, out of the total potential area (i.e.35,000 hectares, only less than a half area (i.e. 17,002 hectares) has been covered under horticultural plantation, and 17,998 hectares is still left to be covered in future. Thus there is immense potential of horticultural development in the district where large populace of unemployed youth is the main social concern and is bound to migrate.

Area and production of major horticultural crops

As shown in table 5.2 walnut (dry fruit) shares the highest area (48 percent, Figure 3) and production (13885.5 MT, 2011) among all the fruit crops of the district during both years (i.e. 2010 and 2011). Because of the introduction of new varieties during past years, there is substantial increase in the production of walnut i.e. from 8050 MT (2010) to 13885.85 MT (2011). However, the area under walnut plantation shows a very little increase i.e. 2.7 percent. Pear is the second important crop of Poonch (shares 10 percent area), which is mainly confined to the lower areas of the district.

Table 2: Area, production and yield of major horticultural crops in Poonch district

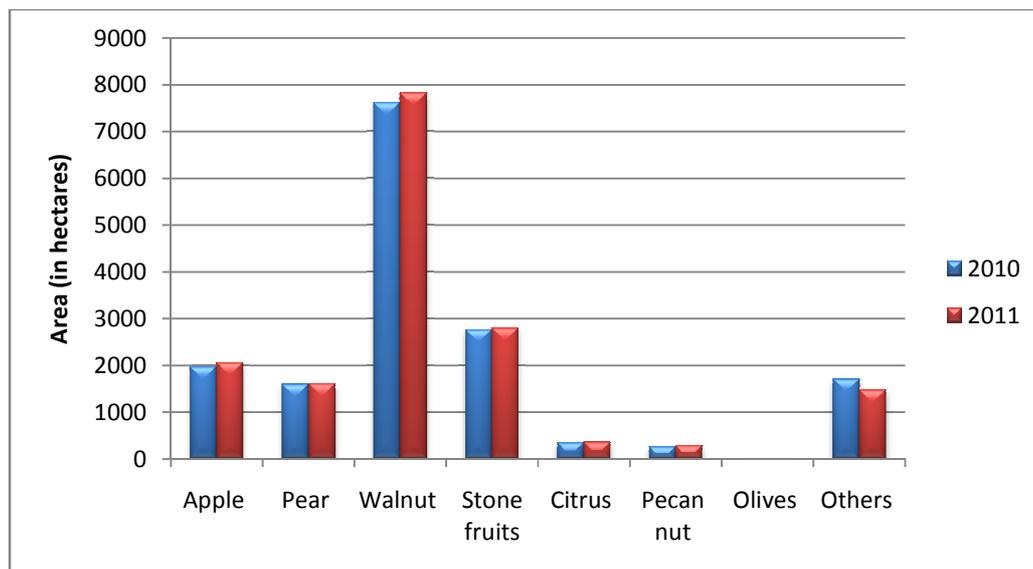
Fruit Crop	2010			2011		
	Area (in ha.)	Production (in MT)	Yield (qn./ha)	Area (in ha.)	Production (in MT)	Yield (qn./ha)
Apple	1973	3240	16.42	2062.20	2544.43	12.33
Pear	1594	6920	43.41	1607.30	6171.00	38.39
Walnut	7621	8050	10.56	7827.20	13885.85	17.74
Stone fruits	2765	1800	6.5	2794.80	1848.40	6.61
Citrus	346	600	17.34	359.80	624.00	17.34
Pecan nut	260	5.5	0.21	284.20	5.60	0.19
Olives	14	0	0	14	-	0
Others	1710	675.50	3.95	1476.70	706.00	4.78
Total	16023	21285.50	13.28	16426.20	25785.28	15.69

Source: Office of the Chief Horticulture Officer, Poonch District.

Apple is the third important fruit crop in terms of both area (shares 12 percent area) and production (2,544.43 MT). There is a setback with apple crop that, its area has been increased from 1973 hectares to 2,062.2 during the last one year, but the production had decreased from 3,240 MT to 2,544.43 MT. Also the yield of apple had decreased from 16.42 qn. /hectare to 12.33 qn. /hectare during the same period of time (Table 3 and Figure 3). This is because of the attack of diseases and pests, and the due to the climate change i.e. the increase in temperature as well as decreased snowfall. The stone fruits comprised of peach, plum and apricot which comes at fourth rank with 17 percent area, while their production was 1848.4 MT during 2011. However, stone fruits show a little increase in the production i.e. 48 MT. during 2011 as compared with 2010. The area also increased from 2765 hectares during 2010 to 2794.8 hectares in the year 2011.

Poonch region has a specialty in the cultivation and production of citrus fruits, which is confined to almost all parts of the district having different cultivars at different altitudes (DHPM 2002). During 2011, its production was 624 MT from the area of 359.80 hectares (shares 2 percent) resulting a yield of 17.34 qn. /hectare. Pecan nut is another dry fruit after walnut which shows a very little production i.e. 5.6 MT from an area of 284.2 hectares (shares 2 percent) during 2011. The most probable reason are that, most of the pecan nut trees are confined to unorganized sector or to wilder areas and they yield very little fruits. There are also several fruits in the category of others which belong to indigenous type as well as local fruits of minor importance. This category possesses an area of 1,476.7 hectares and yields an average production of 706 MT in the year 2011 as reported by the Office of the Chief Horticulture Officer of Poonch District.

Figure 3: Area under major horticultural crops in Poonch district, 2010-2011



Olive plantation is a new miracle plantation under horticulture, encouraging the farmers as it is a high remunerative crop which could be commercialized. They are trying their best seeking future scope in the region (DHPM 2002). There are some areas in the Mendhar constituency where agro- physical conditions resemble somewhat with the Mediterranean region. Olive plantation has been introduced (14 hectares, 2011) to the region with good varieties of plants. However, region is bestowed with the handsome vegetative cover of wild olive trees which are uneconomic and non-remunerative. This has strike the idea for commercial plantation of olives and paves the way for future development of plantation, and hope to the farmers and unemployed youth. As mentioned in the Table 3, till date 14 hectares of land have already been covered for this purpose. Efforts are going on to increase the area more and more by facilitating the farmers with training and funding schemes in the selected areas of the region.

Productivity Status of Major Horticultural Crops

On examining the area, production and productivity of horticultural crops in Poonch district during 2005-06 and 2010-11, the comparison, shows a substantial increase in each fruit crop. However, the productivity of all crops is more or less same during both years, while it is not true in case of citrus. The productivity of citrus fruits has been increased from 0.765 MT/ha. (2005-06) to 1.730 MT/ha. (2010-11), which is due to increased acreage and production (Table 4). In the case of dry fruits, comprising walnut, pecan nut and almond, the graph of productivity also increased i.e. from 0.862 MT/ha. (2005-06) to 1.017 MT/ha. (2010-11). This is because of the increase in area and production of walnut during recent years. However, there is no current (2010-11) data available about the almond crop whose area and production is meager in the region.

Table 3: Area, Production and Productivity of Fruit crops in district Poonch

Fruit	2005-06			2010-11		
	Area (in Ha.)	Production (in MT)	Productivity MT/Ha.	Area (in Ha.)	Production (in MT)	Productivity in MT/Ha.
Apple	1411.10	2021	1.432	1973	3240	1.64
Pear	1412.80	6787	4.804	1594	6920	4.34
Apricot	873.59	41	0.047	882	100	0.11
Peach	497.49	430	0.864	597	500	0.83
Plum	947.08	1121	1.184	1286	1200	0.93
Cherry	29	1	0.034	-	-	-
Mango	1	0	-	-	-	-
Grapes	9.5	1	0.105	-	-	-
Citrus	222.15	170	0.765	346	600	1.73
Olive	20	-	-	14	-	-
Others	1179	424	0.359	1450	670	0.46
TOTAL	6629.7	10996	1.658	8146	13230	1.624
Dry Fruits						
Walnut	6307.7	5698	0.903	7621	8050.0	1.056
Pecannut	229.18	4.5	0.019	260	5.5	0.021
Almond	82.5	1	0.012	-	-	-
TOTAL	6619.3	5703.5	0.862	7923	8055.5	1.017
G. TOTAL	13249	16699.5	1.26	16023	21285.5	1.325

Source: Office of the Chief Horticulture Officer, Poonch District.

Olive plantation was first introduced in the year 2004 when 20 hectares of land was utilized for this purpose. In the subsequent years some of the experimental fields show a setback and the area under olive plantation decreased by 6 hectares. Now, new areas are in search for experiment purposes. At present the total area under olive plantation is 14 hectares. The area under orchards is far less in comparison to the area under agriculture. During 2010-11, the total area under agriculture was 19.13 percent; however, total land under the orchards was only 10.07 percent. The data shows that, still there is a huge area to be explored for the cultivation of horticultural crops. The agricultural land can be utilized for the purpose of horticulture, because the gestation period in the case of the major varieties of fruit trees is minimum 4-5 years. Moreover, the plantation of fruits trees along with crops like maize, vegetables, fodder, wheat and pulses does not affect crops during the gestation period. Thus it is quite possible that, even if the area under these crops does not increase or even remain stable, the area under fruits could increase. The district has largest potential for production of quality temperate horticultural crops. It has created a niche in production of apple, pears, and dry fruits i.e. pecan nut and walnut. Among temperate fruits, apple and walnut ranks first and second, respectively in area and production, covering 12 percent and 48 percent area, and 3,328 and 8,493 MT of production, respectively. Earlier, apples contributed a major share of total fruit production in the state. But recently a perceptible diversification of fruit has been seen in the walnut cultivation, which has a very high export potential. The potential for foreign exchange earnings on account of walnut and apple export is very good in future (DHPM 2002).

Constraints in Crop Production and Their Management

Horticultural crops are highly susceptible to plant related diseases and pests. In Poonch district, various crop related problems have occurred and causes severe damages to the crops. This has resulted in the downfall of the production and ultimately causes the economic loss to the farmers and gave rise to the discouragement. There are several crop related problems in the field of horticulture which are to be solved by the government with a participatory approach.

Technical and Financial Problems

There is need of training programmes and schemes in respect of all sorts of farm/orchard management to enhance the skill of the farmers (154 farmers trained during 2011). Increases the program of Mobile Van Demonstration (88 MVD conducted during 2011) to the farmers, in all parts of the district, about advancement and modern technologies in the field of horticulture. There should also the provision of on-farm training and farmers should be visited to the progressive areas (NABARD 2014). Small businesses could be emerged as significant avenues for the economic empowerment of women. Effective participation of women in these businesses is highly constrained by their limited access to financial resources, marketing links, technology, business networks, and information on investment opportunities. Effective policies and programs are needed in these areas to promote the participation of women in small businesses through self help groups (United Nations 1999).

Marketing and Transportation of Fruit Crops

The importance of good marketing can be conveniently considered from the four different perspectives economy of the region, the farmer, the product and the consumer (DHPM 2002). Horticultural products are perhaps most easily defined as what they are not. They are not cereals or the major industrial crops. Generally, but not exclusively, they are not staple crops (PDD 2000). One of the critical problems which the fruit cultivators are facing is that of the proper marketing. The fruit growers market their produce through various channels. The growers need help in access to markets, by being provided with good production advice and market information to strengthen their ability to negotiate. However, most of the small growers sell their produce to pre-harvest contractors. The co-operative marketing channels have not yet achieved an important place in marketing network in the state. In this connection rural markets are important places for transaction of agricultural commodities which also fulfils other basic needs of the rural people (PDD 2013). Every year large quantity of fruit crops in the region got damage due to non-availability of transport and access to remote orchards. Accessibility with proper roads and quick transport from farm to the market is necessary requirement of the region. It will help the farmers to send their fruits/crops to the market on time, as they are perishable in nature. Horticultural crops are also bulky and soft handy which again needs to transport properly (Asif and Mushtaq. 2013).

Post-Harvest Management and Storage of Fruit Crops

Post harvest management and proper packaging could prevent the post-harvest losses in the district at mass. About 40 per cent production gets rotted every year due to non-availability of training and skills in fruit-processing and proper packaging (MoFPI 2014). Only 6.32 MT (<1 per cent) of the total horticultural production was processed during 2011 in Poonch district. Processing in the form of various fruit products like preserves, jams, squashes, juices, canning, drying etc. can help in preventing these losses (MoFPI 2014). Empowerment of rural youth through promotion of agro-processing activities and encouraging group entrepreneurs for small agri-businesses (Asif & Rahman 2011) is also a need of the time. In return, it will provide employment to the local populace and farmers will get right prices of their produce. It will take the region towards the economic sustainability and self sufficiency (MoT 2014).

Conclusion

It has observed that, the topography and agro-climatic conditions in the study region limit the scope for the production of field crops and the available land is more suitable for the cultivation of horticulture crops. The cultivation of fruits plants per acre of land provides a comparatively larger volume of employment opportunities to the local people than the other agricultural crops. A significant level of increase in the labour absorption in apple cultivation over the last few years also reflects the importance of horticulture for the overall development of the area.

Proper resource management and development of improved cultivars for disease resistant and high quality crop varieties. Poonch district has a variety of agro-climatic conditions ranging from sub-tropical, sub-temperate, temperate and cold arid. Each agro-climatic region has its own potential to grow specific fruit, providing an opportunity to grow a variety of fruits during the major part of the year. Because of small and fragmented land holdings, more than 90 percent fruit growers fall under small and marginal categories and therefore, investment in modern technologies at individual level is quiet feasible. Adoption of rural marketing system may leads to some change because it provides a platform for employment, income, social change, and expansion of fruit and vegetable cultivation, but rural markets must bridges or linked with bigger markets and which is only possible when proper transportation network is provided. In addition, the processing of farm produce can also play an important role in conserving the farming systems and effective utilization of the produce.

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