



An Analysis of Vegetables and Fruits Production Scenario in Nepal

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Authors' contributions

This work was carried out in collaboration between all authors. Author GP designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SB, BP and KB managed the analyses of the study. Authors BG and AT managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2017/36442

Editor(s):

(1) Rusu Teodor, Department of Technical and Soil Sciences, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania.

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(2) George Nanos, University of Thessaly, Greece.

Complete Peer review History: <http://www.sciencedomain.org/review-history/21494>

Case Study

Received 28th August 2017
Accepted 11th September 2017
Published 20th October 2017

ABSTRACT

Agriculture contributes on an average one third to total Gross Domestic Product. It is the major source of employment for the majority of people in Nepal. Productivity of vegetables is in increasing trends after 1991/92 up to 2015/16 but fruits productivity is in decreasing trend after 2009/10. Summer fruits share above 62% of total fruit area and production while terai region share more than third fourth of total summer fruits both in area and production. Mango and banana are the most dominant summer fruits in terms of area and production. Citrus fruit share about 22% of total fruit area and production while hilly region is dominant in terms of citrus growing area and production. Mandarin types of citrus occupy around two third of total citrus growing area and production. Winter

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fruits share 15.5% and 13% of total fruit area and production respectively. Hills and mountain region share 99.2% of total winter fruits production. More than half of the total winter fruits area and production is share by apple and pear.

Keywords: Agriculture; vegetables; fruits and Nepal.

1. INTRODUCTION

Agriculture is the backbone of Nepalese economy. Agriculture contributes on an average 33 percent to GDP and employs 65.7 Percent of the labor force in Nepal [1]. Among 147,181,000 hectare of lands 3091000 hectare is cultivated i.e. only 21%. Nepal's agriculture is still heavily dependent on rainfalls. Only 44% of the cultivated land has irrigation facility [2]. Limited irrigation and unreliability of rainfalls have resulted in fluctuating trends in the agricultural production. Fruit and spices crops share about 7.04% to agricultural GDP. Among this Mango, Banana, Apple, Orange and Spices share about 1.56%, 0.4%, 0.42%, 0.97% and 1.79% respectively. Vegetables and nursery share about 9.71% to total agricultural gross domestic product [3].

Dieticians and nutritionists suggested that the per capita daily requirement of vegetables is 300 gm. But vegetable consumption of Nepalese people is very low compared to the recommended dose, hence it is seen that deficiency of 60% in relation to the vegetable production and the demand is increasing day by day due to the major shift by people living in the country to healthy food [4]. Government of Nepal has prioritized the production of off season vegetables, among them the cultivation of tomato, cauliflower and cabbage are the most popular and the most profitable [5].

Export share of summer fruits is 96% followed by citrus fruit 3% and winter fruits 1% by volume while by values summer fruits covers almost 100% and citrus and winter fruits are insignificant amount. On other side share of summer fruits is 59% followed by citrus fruits 16% and winter fruits 25% by volume while by values cover 65% followed by citrus fruits 14% and winter fruits 21% [6]. WHO has recommended at least 400 gram of fruit and vegetable for healthy life [7].

1.1 Objectives of the Study

- To understand the current trend of fruit and vegetable production and productivity,

- To suggest further study regarding on fruit and vegetable production and marketing in Nepal.

2. MATERIALS AND METHODOLOGY

2.1 Data Collection and Analysis

Time series agricultural data for fruits in Nepal is collected from the data books published by MoAD for 16 years period from 2000/01 to 2015/16 and for vegetables for 25 years period from 1991/92 to 2015/16.

The methods of data analysis followed from [8].

TY= Total yield; TP= Total production; TA=Total area; n= No. of year

(Annual average yield) AAY is calculated to identify the years of vegetable crops which has production below average as in equation 1.

(Annual average yield) AAY for vegetables =

$$\frac{\text{Total yield 1991/92} + \text{Total yield 1992/93} + \dots + \text{Total yield 2015/16}}{\text{No. of years}} \quad (1)$$

To do this statistical analysis of yield, Microsoft excel program was used. Table and line graph was used to interpret the results. Mann Kendall test is used to determine the trend of climatic variables.

3. RESULTS AND DISCUSSION

3.1 Vegetable

The area of vegetables is continuously increasing since 1991/92 in Nepal (Fig. 1). However, the production of vegetables is increasing at faster rate than increment in area. Production increases attributed to the favorable climatic condition, availability of seed and fertilizers, improved management practices, mechanization in vegetables farming along with area expansion. The percentage increase in area, production and productivity of the vegetables in 2015\16 compared to 1991/92 is

100%, 248% and 74%, respectively. Production of vegetables was increased with 118043 mt per year while area was increased with 6160.8 ha per year from 1991/92 to 2015/16. Average productivity of vegetables from 1991/92 to 2015/16 was 11.09 mt/ha.

The annual average total yield of vegetables for 25 years period from 1991/92 to 2015/16 is 11092 kg ha⁻¹. The total yield is below average in the years 1991/92, 1992/93, 1993/94, 1994/95, 1995/96, 1996/97, 1997/98, 1998/99, 1999/00, 2000/01, 2001/02, 2002/03 and 2003/04 which is 8028 kg ha⁻¹, 8391 kg ha⁻¹, 8523 kg ha⁻¹, 8623 kg ha⁻¹, 9194 kg ha⁻¹, 9266 kg ha⁻¹, 9664 kg ha⁻¹, 9578 kg ha⁻¹, 9996 kg ha⁻¹, 10518 kg ha⁻¹, 10792 kg ha⁻¹, 10844 kg ha⁻¹ and 10952 kg ha⁻¹ respectively. Total yield is above average in the years 2004/05, 2005/06, 2006/07, 2007/08, 2008/09, 2009/10, 2010/11, 2011/12, 2012/13, 2013/14, 2014/15 and 2015/16 which is 11421 kg ha⁻¹, 11537 kg ha⁻¹, 11977 kg ha⁻¹, 12200 kg ha⁻¹, 12233 kg ha⁻¹, 12777 kg ha⁻¹, 13124 kg ha⁻¹, 13463 kg ha⁻¹, 13400 kg ha⁻¹, 13419 kg ha⁻¹, 13412 kg ha⁻¹ and 13992 kg ha⁻¹ respectively.

3.2 Fruits

In Nepal both area and production of fruits is continuously increasing since 2000/01 but production was found decline in 2011/12 (Fig. 2). Production again start to increase after 2012/13 but lesser increment than area increases due to which productivity of fruits decreases in recent years. Increase in production is attributed by favorable climatic condition, availability of

planting stocks and fertilizers, improved management practices, mechanization in fruit farming along with area expansion. The percentage increase in area, production and decrease in productivity of the fruits in 2015\16 compared to 2000/01 is 129%, 100% and 12.7%, respectively. Production of fruit was increased at the rate of 41061 mt per year while area increases at the rate of 4830.5 ha per year from 1991/92 to 2015/16. Average productivity of fruits from 2000/01 to 2015/16 was 9.7 mt/ha.

Fruits categorized into three types

1. Citrus fruits
2. Summer fruits
3. Winter fruits

3.3 Summer Fruits

The area and production of summer fruits is continuously increasing since 2000/01 in Nepal but production decline in 2011/12 (Fig. 3). Production again start to increase after 2012/13 but lesser increment than area increases due to which productivity of summer fruits decreases in recent years. The percentage increase in area, production and decrease in productivity of the summer fruits in 2015\16 compared to 2000/01 is 165%, 128.5% and 13.9%, respectively. Production of summer fruits increase at the rate of 30140 mt per year while area increases at the rate of 3290.5 ha per year from 1991/92 up to 2015/16. Average productivity of summer fruits from 2000/01 to 2015/16 was 9.77 mt/ha.

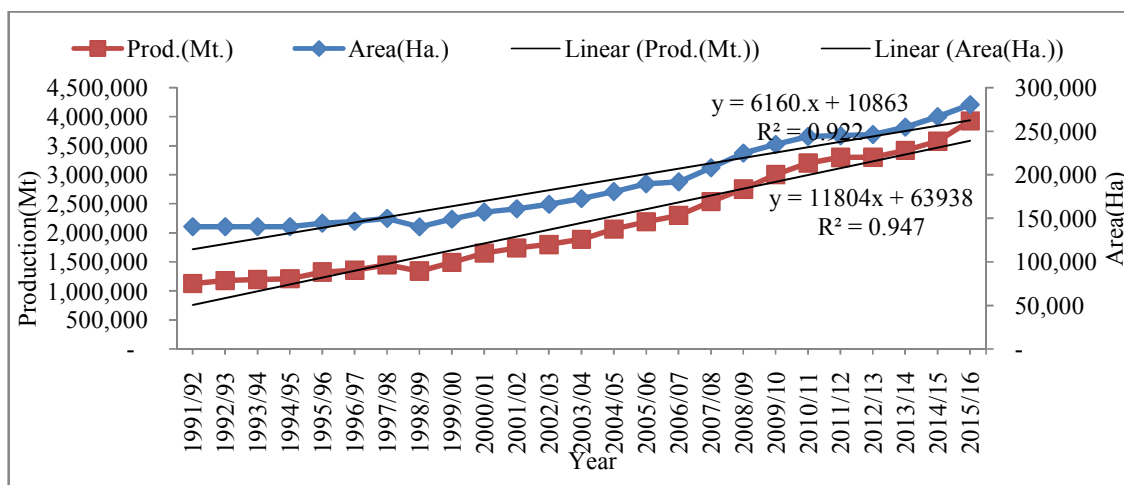


Fig. 1. Vegetable production trend in Nepal
Source: (MoAD, 2015/16)

Table 1. Overall scenario of fruit production in Nepal (2015/16)

Fruit type	Productive area (Ha)	Production (Mt)	Yield (Mt/Ha)
Citrus	24854	218447	8.8
Summer	68608	631224	9.2
Winter	17125	126790	7.4
Total	110587	976461	8.8

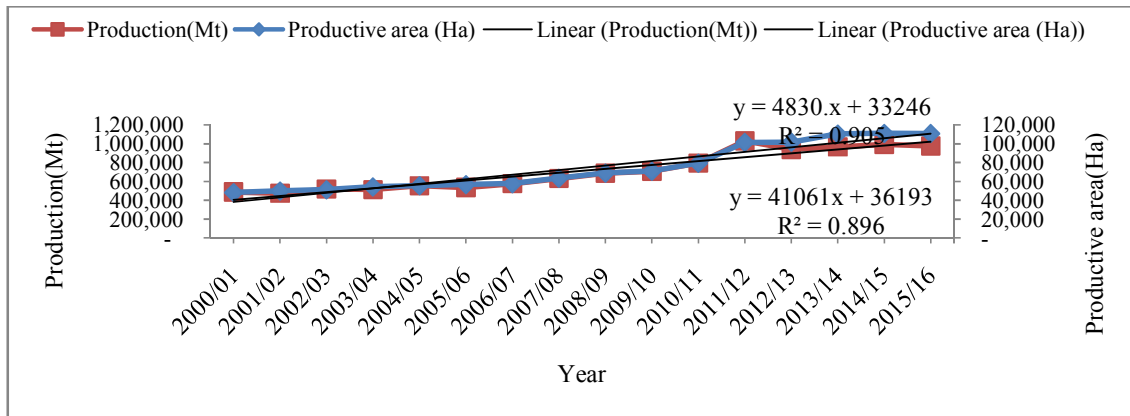


Fig. 2. Fruit production trend in Nepal

Source: (MoAD, 2015/16)

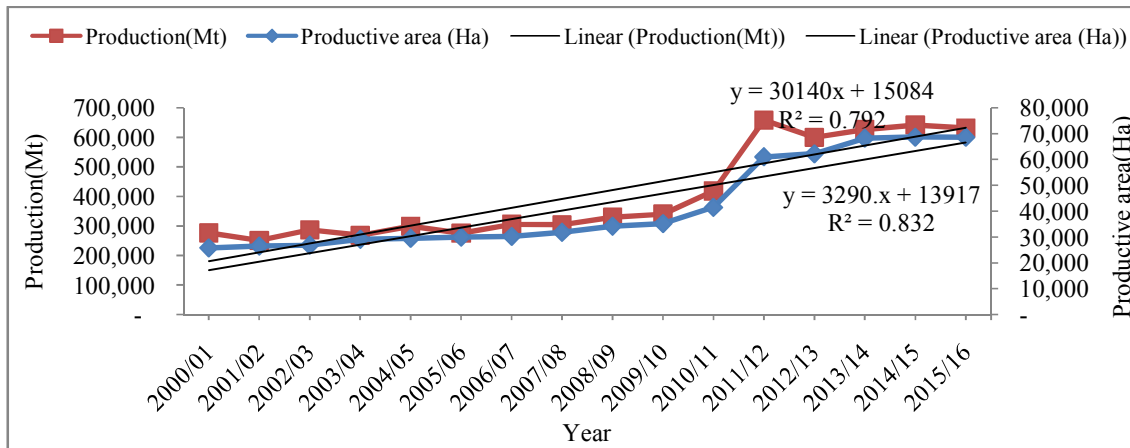


Fig. 3. Summer fruit production trend in Nepal

Source: (MoAD, 2015/16)

Summer fruits are grown under 62% of total fruit growing area and production share by summer fruits is nearly 65%. Terai region shares about 78% of total summer fruits area and production. More than 75% of total fruit area and production is share by mango and banana. Summer fruits mainly grown in Nepal are mango, banana, papaya, litchi, jackfruit, guava, pineapple and others (coconut and areca nut).

Mango alone share about 56% of total summer fruit area and 42% of total summer fruit

production. Highest productive area and production lies in eastern and central region. Eastern and central region share about 73% of area and production of total summer fruits area and production. Highest productivity occurs in western development region (8.3 mt/ha) whereas average productivity of country in 2015/16 is 6.9 mt/ha. Mango alone share more than 85% of total summer fruit area and production in terai region. Highest mango producing districts are Sarlahi, Siraha, Saptari, Rautahat and Jhapa. Banana shares about 21% of total summer fruit

area and 37% of total summer fruit production. Terai region only shares about 70% of area and 80% of production of total banana production. Eastern development region shares about 46% of area and 52% of total banana production. Highest productivity occurs in eastern development region (18.6 mt/ha) whereas average productivity of country in 2015/16 is 16.5 mt/ha. Highest banana area and production occurs in Saptari, Jhapa, Morang, Kailali, Sunsari and Rautahat districts. More than 55% of total papaya production occurs in terai region followed by hills i.e. more than 36% in term of both area and production of total papaya cultivated area and production in country. Highest productivity occurs in central development region (16.2 mt/ha) whereas average productivity of country in 2015/16 is 13.1 mt/ha. Highest papaya production occurs in Parsa, Rautahat, Dang, Morang and Kanchanpur. Around 50% of guava area and production occurs in hilly region. Eastern and central development region share about 53% of area and 50% of total guava production in Country. Highest productivity occurs in far western development region (9.01 mt/ha) whereas average productivity of country in 2015/16 is 8.3 mt/ha. Highest guava area and

production occurs in Kalali, Jhapa, Dhading, Taplejung and Khotang districts. More than 52% of total area and production of jackfruit lies under terai region. Around 58% of pineapple produces under terai region. Most of the pineapple area and production occurs under central development region. Highest productivity occurs in eastern development region (21.6 mt/ha) whereas average productivity of country in 2015/16 is 13.7 mt/ha. Highest pineapple area and production occurs in Jhapa, Sindhuli and Kaski districts. Most of the litchi area and production occurs in Central development region. Around 98% of total litchi area and production occurs in hills and terai region. Highest productivity occurs in eastern development region (8.7 mt/ha) whereas average productivity of country in 2015/16 is 7.4 mt/ha. Highest litchi area and production occurs in Parbat, Dhading, Morang, Bara and Nuwakot districts. Among total production of arecanut in Nepal, Jhapa district alone share about 68% of total area and production whereas Morang district share about 21% in terms of total area and production. Morang alone share about 54% of total area and 71% of total production of coconut.

Table 2. Overall scenario of summer fruit production in Nepal (2015/16)

Fruits	Area/Prodn/Yield	Development region				
		Eastern	Central	Western	Mid-Western	Far-Western
Mango	Area (Ha)	14654	13625	3507	5064	1535
	Prod. (Mt)	96161	102730	29170	27430	11137
	Yield (Mt/Ha)	6.6	7.5	8.3	5.4	7.3
Banana	Area (Ha)	6547	2588	2803	1396	978
	Prod. (Mt)	121790	38772	45450	13942	16242
	Yield (Mt/Ha)	18.6	15.0	16.2	10.0	16.6
Guava	Area (Ha)	823	630	491	347	419
	Prod. (Mt)	5986	5316	4307	2982	3779
	Yield (Mt/Ha)	7.3	8.4	8.8	8.6	9.0
Papaya	Area (Ha)	236	305	223	205	114
	Prod. (Mt)	2533	4959	2722	2383	1491
	Yield (Mt/Ha)	10.7	16.3	12.2	11.6	13.1
Jackfruit	Area (Ha)	311	443	591	315	266
	Prod. (Mt)	4572	6097	6618	2814	2242
	Yield (Mt/Ha)	14.7	13.8	11.2	8.9	8.4
Pineapple	Area (Ha)	218	411	304	32	7
	Prod. (Mt)	4712	5335	2780	386	78
	Yield (Mt/Ha)	21.6	13.0	9.1	12.1	11.1
Litchi	Area (Ha)	1123	2070	1188	493	110
	Prod. (Mt)	9805	14761	9593	2160	666
	Yield (Mt/Ha)	8.7	7.1	8.1	4.4	6.1
Others	Area (Ha)	4170	69	0	0	0
	Prod. (Mt)	19144	125	0	0	0
	Yield (Mt/Ha)	4.6	1.8	0	0	0

Table 3. Scenario of citrus fruit production in Nepal (2015/16)

Citrus	Productive area (Ha)	Production (Mt)	Yield (Mt/Ha)
Mandarian	16,248	146,690	9.03
Sweet orange	3,443	33,558	9.75
Lime	3,858	27,017	7.00
Lemon	595	4,941	8.30
Others	741	6,242	8.42
Total	24,885	218,448	8.78

3.4 Citrus

Total fruit grown areas and production share by Citrus is 22% of total fruit production in Country.

In Nepal among all citrus, mandarin types of citrus occupy 65.3% and 67.2% of total citrus growing area and production. Whereas sweet orange and lime are grown nearly in equally area but productivity of sweet orange is higher due to its higher production. Majority of mandarin type citrus grown in hills of western region in terms of both productive area and production. Highest mandarin type citrus production occurs in Kavre, Syangja, Gorkha, Kaski, Panchthar and Tanahu districts.

The area and production of citrus fruits is continuously increasing since 2000/01 in Nepal but production starts to decline after 2010/11 (Fig. 4) due to which productivity of citrus fruits decreases after 2009/10 up to 2015/16. The percentage increase in area, production and decrease in productivity of the citrus fruits in 2015\16 compared to 2000/01 is 109%, 79.5% and 14%, respectively. Production of citrus fruits increases at the rate of 8193 mt per year while area increases at the rate of 1047.7 ha per year

from 1991/92 up to now. Average productivity of citrus fruits from 2000/01 to 2015/16 is 10.3 mt/ha.

3.5 Winter Fruits

The area of winter fruits is continuously increasing since 2000/01 in Nepal but production decline after 2011/12 (Fig. 5) due to which productivity of winter fruits decreases in recent years. The percentage increase in area, production and decrease in productivity of the winter fruits in 2015\16 compared to 2000/01 is 64%, 41.6% and 13.7%, respectively. Production of winter fruits increase at the rate of 2727.7 mt per year while area increases at the rate of 492.5 ha per year from 1991/92 up to now. Average productivity of summer fruits from 2000/01 to 2015/16 is 8.24 mt/ha.

Winter fruit share 15.5% of total fruit grown areas and production share by winter fruit is 13% of total fruit production in Country. Hill and mountain region shares about 99.2% of total winter fruits area and production. Winter fruits mainly grown in Nepal are apple, pear, peach, walnut, plum, hog plum and others (persimmon, pomegranate, apricot and Kiwi).

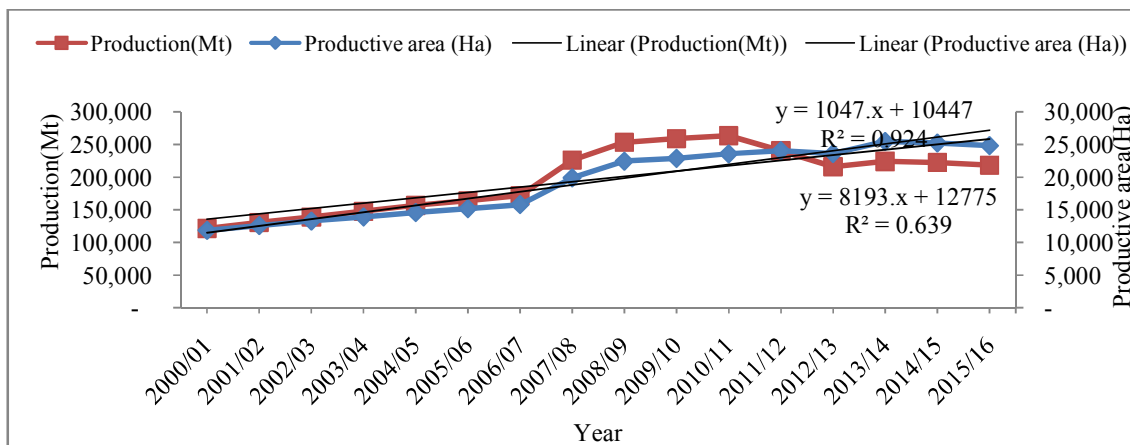


Fig. 4. Citrus fruit production trend in Nepal

Source: (MoAD, 2015/16)

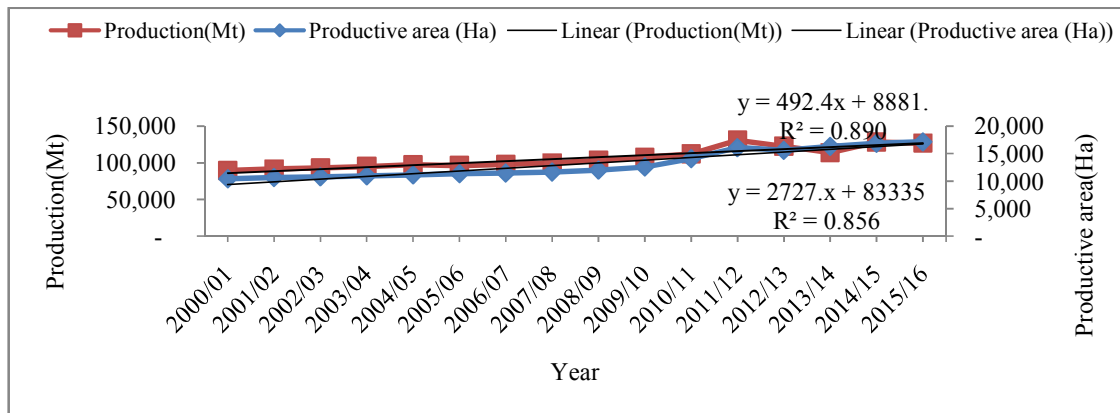


Fig. 5. Winter fruit production trend in Nepal

Source: (MoAD, 2015/16)

Table 4. Overall scenario of winter fruit production in Nepal (2015/16)

Fruits	Area/Prodn/Yield	Development region				
		Eastern	Central	Western	Mid-Western	Far-Western
Apple	Area (Ha)	542	283	509	3815	477
	Prod. (Mt)	3500	2121	6277	24857	4257
	Yield (Mt/Ha)	6.5	7.5	12.3	6.5	8.9
Pear	Area (Ha)	1040	892.5	740.5	518	365
	Prod. (Mt)	9956.2	9577	7889.3	3786.4	3515.6
	Yield (Mt/Ha)	9.6	10.7	10.7	7.3	9.6
Walnut	Area (Ha)	160	76	95	964	553
	Prod. (Mt)	631	284	418	3342	2927
	Yield (Mt/Ha)	3.9	3.7	4.4	3.5	5.3
Peach	Area (Ha)	410	310	367	542	319
	Prod. (Mt)	3075	2540	2417	2956	2292
	Yield (Mt/Ha)	7.5	8.2	6.6	5.5	7.2
Plum	Area (Ha)	340	300	283	333	203
	Prod. (Mt)	2722	2535	2037	2031	1688
	Yield (Mt/Ha)	8.0	8.5	7.2	6.1	8.3
Hog Plum	Area (Ha)	761	616	125	0	6
	Prod. (Mt)	4118	5198	1086	0	46
	Yield (Mt/Ha)	5.4	8.4	8.7		7.7
Others	Area (Ha)	362	364	117	138	159
	Prod. (Mt)	2712	3632	642	731	1095
	Yield (Mt/Ha)	7.5	10.0	5.5	5.3	6.9

More than 53% of total winter fruit area and production is share by apple and pear. Mid-western development region contributes about more than 60% of total apple area and production. 75% of total apple growing area and production share by mountain region. Among mountain districts high apple producing districts are Kalikot, Mustang, Rukum, Jumla and Mugu. Highest productivity occurs in western development region (12.3 mt/ha) whereas average productivity in country in 2015/16 is 8.3 mt/ha. Highest pear production and area lies in eastern development region followed by central

and western development region, which occupies more than 75% of area and production share. More than 53% of total winter fruit area and production is share by apple and pear. 70% of area and 81% of production among total winter fruits area and production lies under hills region. Similarly walnut, peach, plum, hog plum, and other fruits are dominant in mid hills in terms of both area and production. Highest area and production of walnut lies under mid-western development region. Peach and plum is around equally share by all development regions. Hog plum shares 90% of area and production under

eastern and central development region. Highest kiwi production occurs in central hills followed by eastern hills. Highest apricot production occurs in Central Mountain followed by far-western hills. Highest pomegranate production occurs in eastern hill region. Ilam district alone share 30% of area and 40% of total production of pomegranate in Nepal. Highest persimmon area and production occurs in central hill of Nepal (56% of total persimmon area and production).

4. CONCLUSION

The total yield of vegetables from 1991/92 up to 2015/16 is in increasing trend. Increment in production is more than increment in area of vegetables due to which productivity of vegetables is increasing in recent years. Increase in production attributed by the favorable climatic condition, availability of seeds and fertilizers, improved management practices, mechanization in vegetable and fruit farming along with area expansion. Both area and production of fruit is in increasing trends but increment of area is greater than increment in production due to which productivity of fruit decrease in recent years. Above 62% of total fruit area and production is share by summer fruits.

Terai region share about 78% of total summer fruits area and production. More than third forth of total summer fruit area and production is share by mango and banana. Citrus fruit share about 22% of total fruit area and production. Hilly region is dominant in terms of citrus growing area and production whereas mandarin types of citrus occupy around two third of total citrus growing area and production.

Winter fruits share 15.5% and 13% of total fruit area and production respectively. Hills and mountain region share 99.2% of total winter fruits production. More than half of the total winter fruit area and production is shared by apple and pear. Nepal has comparative advantage for fruits and

vegetables production thus helps to identify the major fruits growing area. This study helps to horticulturist to find out the reason why fruit production is in decreasing trends despite of its area expansion. Thus Government can give priorities to these areas. Raising the productivity is one of the priority policies of the government for alleviation of poverty in future.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Appendix 1. Summer fruit production in different ecological regions

Fruits	Area/Prod./Yield	Geographical belt		
		Terai	Hills	Mountain
Mango	Area (Ha)	33590	4481	314
	Prod. (Mt)	227894	35073	3361
	Yield (Mt/Ha)	6.8	7.8	10.7
Banana	Area (Ha)	10782	4159	371
	Prod. (Mt)	189764	41277	5155
	Yield (Mt/Ha)	17.6	9.9	13.9
Guava	Area (Ha)	1121	1402	187
	Prod. (Mt)	9858	10825	1688
	Yield (Mt/Ha)	8.8	7.7	9.0
Papaya	Area (Ha)	600	425	58
	Prod. (Mt)	8144	5214	779
	Yield (Mt/Ha)	13.6	12.3	13.4
Jackfruit	Area (Ha)	1014	868	39
	Prod. (Mt)	11719	10153	472
	Yield (Mt/Ha)	11.6	11.7	12.1
Pineapple	Area (Ha)	406	537	31
	Prod. (Mt)	7725	5103	463
	Yield (Mt/Ha)	19.0	9.5	14.9
Litchi	Area (Ha)	2793	2111	80
	Prod. (Mt)	18020	18452	522
	Yield (Mt/Ha)	6.5	8.7	6.5
Others	Area (Ha)	4047	192	0
	Prod. (Mt)	18739	530	0
	Yield (Mt/Ha)	4.6	2.8	-

Source: MoAD, 2015/16

Appendix 2. Winter fruit production in different ecological regions

Fruits	Area/Prod./Yield	Geographical belt		
		Terai	Hills	Mountain
Apple	Area (Ha)	0	1266	4360
	Prod. (Mt)	0	10128	30884
	Yield (Mt/Ha)	0	8.0	7.1
Pear	Area (Ha)	70	2523.5	962.5
	Prod. (Mt)	560	28138.9	6025.6
	Yield (Mt/Ha)	8.0	11.2	6.3
Walnut	Area (Ha)	0	980	906
	Prod. (Mt)	0	4305	3647
	Yield (Mt/Ha)	0	4.4	4.0
Peach	Area (Ha)	18	1307	623
	Prod. (Mt)	126	9560	3595
	Yield (Mt/Ha)	7.0	7.3	5.8
Plum	Area (Ha)	0	1043	432
	Prod. (Mt)	0	7945	2619
	Yield (Mt/Ha)	0	7.6	6.1
Hog Plum	Area (Ha)	0	1162	346
	Prod. (Mt)	0	6711	3737
	Yield (Mt/Ha)	0	5.8	10.8
Others	Area (Ha)	41	921	206
	Prod. (Mt)	107	6208	2431
	Yield (Mt/Ha)	2.6	6.7	11.8

Source: MoAD, 2015/16

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Peer-review history:
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