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Analysis of the status of major vegetables in Bajura, Nepal

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ABSTRACT

The favourable climatic condition of Nepal has endowed it for cultivation of greater than 50 vegetable crops and making vegetable sector a dominating sector in terms of area and production after cereals. The time series secondary data of major vegetables grown in Bajura district for area (ha), production (MT) and yield (MT/ha) of total 18 years period from 1999/2000 to 2016/17 was extracted from statistical information on Nepalese Agriculture published by MoALD, publications of VDD (Vegetable Development Directorate), Annual Agriculture Development Program and Statistics Book (AADPSB) published by AKC (Agriculture Knowledge Center) Bajura and beyonds. Other reliable sources of information were also scrutinized for extracting secondary data for the completion of research. MK-Test was used for detecting monotonic trend in the time series and simple linear regression was performed to test a linear trend. MS-Excel software was used for statistical analysis and Linear trend analysis model was used for data interpretation using slope and intercept parameters. The result illustrated that the increment in the rate of vegetable production was higher (258.44 MT/year) than cultivated area (24.599 ha/year) throughout the analyzed period (1999/2000 to 2016/17). Concurrently, the yield of major vegetables was also in increasing trend. Similarly, the recent trends (2012/13 to 2016/17) showed that the yield of Cruciferous crops, Solanaceous crops, Malvaceous crops, Umbelliferae crops and Cucurbitaceous crops was in increasing trend with markable fluctuations in cultivated area and production. This research can be a useful tool for horticulturists and other concerned authorities for further research and amelioration of the status of major vegetables in Bajura district.

KEYWORDS

Nepal, Bajura, Trend Analysis, Major Vegetables, Yield, Cultivated Area, Production

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Agriculture and forestry sectors contribute 28.89% of the total GDP of Nepal with 5.25% annual growth rate of GDP by these two sectors (MoALD, 2016/17). The total cultivable area of Nepal is 2,641,000 ha in which irrigable area is 1,766,000 ha and total irrigated area is 1,392,177 ha (MoALD, 2016/17). Vegetables are the most grown crops in Nepal after cereals. There are more than 247 cultivated vegetable crops globally and more than 50 crops are common in Nepal. Since, Nepal is endowed with the favourable climatic condition; it is possible to grow almost all types of vegetables in Nepal (Awasthi, 2007). The total area of vegetable cultivation in Nepal in F/Y 2016/17 was 277,393 ha with production of 3,749,802 MT and yield of 13,518 kg/ha (MoALD, 2016/17). The average area of cultivation, production and yield of vegetable of Nepal from year 2012/13 to 2016/17 was 265292.2 ha, 3,596,328 MT, 13,548.2 kg/ha respectively (MoALD, 2016/17). Vegetable sector ranks third in the composition of AGDP in agricultural realm with a score of 9.71% in Nepal. According to the year, 2016/17 the most cultivated and produced vegetables in Nepal was cauliflower and cabbage

followed by tomato with production 534141 MT, 485199 MT, 400,674 MT, respectively (MoALD, 2016/17). In the year 2016/17, the vegetable cultivation area in Bajura district was 751 ha with a production of 7855 MT. The vegetable cultivated area was dominated by cabbage and radish followed by cucumber with the production of 715 MT, 650 MT and 630 MT respectively in the year 2016/17 (AADPSB, 2073/74). The favourable climatic condition has endowed the Bajura district for commercial vegetable cultivation. Major vegetables grown here can be categorized as Cruciferous which include cauliflower, cabbage, broccoli and radish; Solanaceous include chilli, brinjal and tomato; Malvaceous include okra; Cucurbitaceous include pumpkin, squash, bitter gourd, cucumber; Alliaceae includes onion; Umbelliferae includes carrot.

Bajura district lies in remote region lacking direct access to modern suitable infrastructures with poverty stricken farming families and exacerbated by enduring significant climate change (Pandey, 2015). It is revealed from the research that Bajura district is food in secured for at least six to nine months of a year which is exacerbated by climate induced natural disasters such as flood, landslide and drought (Chaulagain, 2019). Bajura district was ranked 75th in HDI in 2014. The household percentage having food sufficiency for 3, 6, 9 and 12 months are 38.7, 27.4, 7.6 and 4.40 respectively. The population growth rate of this district is 2.15 % so; the demand for food is increasing dramatically. The demand of food for the district is 30,160 MT but, produced food is 23,664 MT which makes the district food deficit by 6496 MT annually. It is the first ranker among 30 foods in secured districts of Nepal with poverty 64% of its total population (AADPSB, 2073/74).

It has been proved that vegetable sector plays a tremendous role in backing the national economy as a whole. The scanty evidences of the trend study of the major vegetables in Nepal reflect that the vegetable commercialization in Nepal is still lagged behind for priority. The wanting trend study and resulting repercussions, thus, deter us from shifting traditional vegetable farming to modern robust commercialization state. It has been revealed that trend analysis of a particular region is very crucial for farmers, policy makers etc. to take necessary action for the maintenance of the future production and demands (Borse, 2020). So, there should be a thorough and meticulous study of the trend of major vegetables in Bajura district. This study can be a stepping stone for concerned authorities for making the policies and for prompt implementation of programs for ameliorating the status of major vegetables and their robust commercialization in Bajura district.

Objective of Study

1. To know the status of major vegetables and to analyze the trend in area, production and yield for major vegetables in Bajura, Nepal.
2. To suggest further study regarding the status of major vegetables in Bajura district.

Study Site

The site for this study is Bajura district located in Sudurpaschim Pradesh of Nepal. The total area of this district is 230037 square hectares. Total population of this district is 134,912 (male; 65806 and female; 69106) with households 24908. It is divided into 5 rural municipalities and 4 municipalities. Wards 4 (Toli) and 9 (Dhadali) of Triveni municipality are important commercial vegetable growing areas and lie in vegetable block under PMAMP implemented by Agriculture Knowledge Center (AKC), Bajura.

Research Methodology

The time series secondary data of major vegetables grown in Bajura district for area (ha), production (MT) and yield (kg/ha) of total 18 years from 1999/2000 to 2016/17 was extracted from statistical information on Nepalese agriculture published by MoALD, publications of Vegetable Development Directorate (VDD) and Annual Agriculture Development Program and Statistics Book (AADPSB) published by AKC (Agriculture Knowledge Center), Bajura and beyond. Similarly, other reliable sources of information were also scrutinized for extracting secondary data for the completion of research.

Mann-Kendall test (MK-test) is a non-parametric model used in detection of trend (Mann, 1945). This non-parametric test suggests significant trend in a time series (Kendall, 1955). MK-test assess if there is monotonic upward/downward trend of a variable of interest over time. A monotonic upward (downward) trend means that the variable consistently increasing or decreasing through time.

The XLSTAT software was added in MS-excel. The XLSTAT software which embedded MK-test was used to test whether there is a trend or no trend in the time series.

The test was interpreted as:

Null hypothesis: There is no trend in the series

Alternate hypothesis: There is a trend in the series

If the computed P-value (Probability value) is lower than the significance level alpha=0.05, one should reject null hypothesis and accept alternate hypothesis *i.e.* there is a trend in the series. If the computed P-value is greater than significance level alpha=0.05, one should accept the null hypothesis and reject alternate hypothesis *i.e.* there is no trend in the series.

The simple linear regression was performed to test a linear trend by assigning a variable of interest to dependent variable and time factor as an independent variable.

The test was interpreted as:

If the computed P-value is less than or equal to significance level alpha =0.05, there is a linear trend. If not, there is no meaningful trend (Remy *et al*., 2005).

MS-excel software was used for statistical analysis and linear trend analysis model was used for data interpretation using slope and intercept parameters (for area and production). Data analysis method for yield was adopted from (Bhandari, 2012).

AAY (Annual Average Yield) was calculated to identify the years of vegetable crops which has production below and above the average yield as given in the below formula:

AAY for Vegetables= (Total Yield of 1999/2000 + Total Yield of 2000/01 +……..+ Total Yield of 2016/17)/ Number of Years.

Results and discussion

The computed P-value for area and production of major vegetables in Bajura district was (<0.0001) and (0.000) respectively which verified that there was a monotonic trend in the series. The Excel Regression line that appeared to best fit the data for cultivated area for major vegetables in Bajura was linear with R square value 0.6148. The regression line was slightly above or below the centre for the most data points which represented the best fitted data. We had a linear trend at a P-value 0.000117. Since, this P-value was less than 0.05; the linear trend test was statistically significant. The Regression results showed that the rate of vegetable cultivation area was increasing at the statistically significant rate of 24.599 ha per year (slope) annually, starting from a rate of 251.2 ha per year (intercept) in 1999/2000. Linear trend line of the cultivated area (fig 1) for major vegetables in Bajura district illustrated that there was a slow and steady increase in the cultivated area for major vegetables in Bajura district except in the year 2000/01, 2003/04, 2011/12, 2012/13, 2015/16 where area decreased by 13%, 49%, 33%, 4% and 15 % respectively. The cultivated area increased with 17.61% in 2016/17 as compared to 1999/2000.

Similarly, the excel regression line that appeared to best fit the data for production for major vegetables in Bajura was Linear with R square value 0.68. The Regression line was slightly above or below the centre for the most data points which represented the best fitted data. We had a linear trend at a P-value 0.0000205. Since, this P-value was less than 0.05; the linear trend test was statistically significant. The Regression results showed that the rate of vegetable production was increasing at the statistically significant rate of 258.44 metric ton per year (slope) annually, starting from a rate of 1628.1 metric ton per year (intercept) in 1999/2000. Linear trend line of the production (fig 2) for major vegetables in Bajura district illustrated that there was a slow and steady increase in the production for major vegetables in Bajura district except in the years 2000/01, 2002/03, 2003/04, 2010/11, 2012/13 and 2015/16 where production decreased by 12%, 21%, 49%, 18%, 4% and 7%, respectively. The production increased with 120.64% in 2016/17 as compared to 1999/2000.

The average yield from 1999/2000 to 2016/17 was 8345.50 kg/ha. The annual average total yield of major vegetables for 18 years period from 1999/2000 to 2016/17 was 8345.50 kg/ha. The total yield was below average in years 2002/03, 2003/04, 2004/05, 2005/06, 2006/07, 2007/08, 2010/11 which was 7143 kg/ha, 7145 kg/ha, 7143 kg/ha, 7223 kg/ha, 7223 kg/ha, 7159 kg/ha, 4068 kg/ha respectively. The total yield was above average in years 1999/2000, 2000/01, 2001/02, 2008/09, 2009/10, 2011/12, 2012/13, 2013/14, 2014/15, 2015/16, 2016/17 which was 8900 kg/ha, 9000 kg/ha, 9000 kg/ha, 9202 kg/ha, 9201kg/ha, 8815 kg/ha, 8839 kg/ha, 9506 kg/ha, 9207 kg/ha, 10231.53 kg/ha and 10467.63 kg/ha respectively.

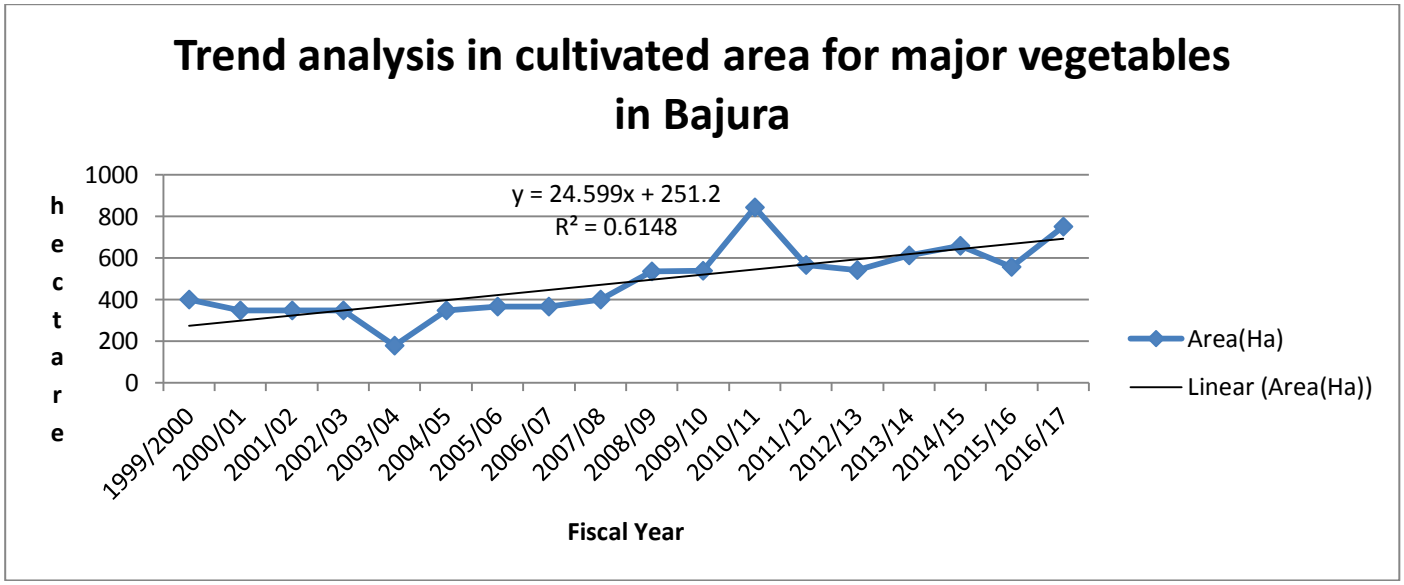

Fig 1. Trend analysis in cultivated area for major vegetables in Bajura

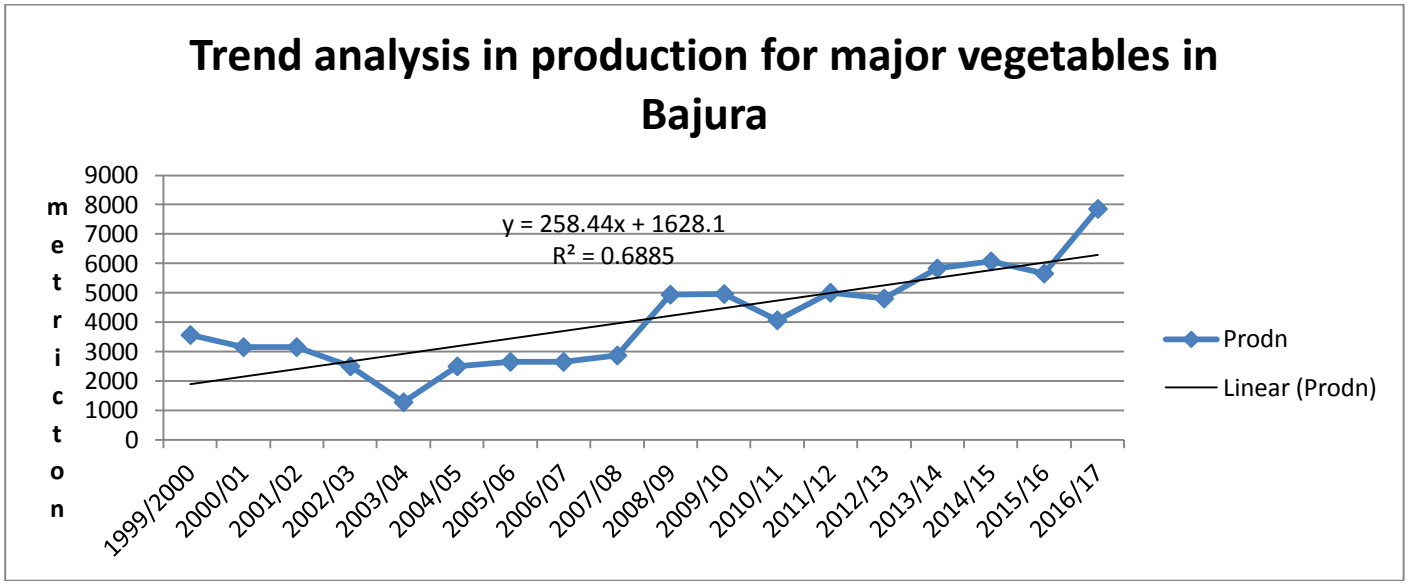

Fig 2. Trend analysis in production for major vegetables in Bajura

The yield decreased by 21%, 1%, 48% and 3 % in the year 2002/03, 2007/08, 2010/11 and 2014/15, respectively. Similarly, the yield increased in the years 2000/01, 2008/09, 2011/12, 2013/14, 2015/16, 2016/17 by 1%, 22%, 45%, 7%, 10% and 2%, respectively.

Cruciferous Crops

The major Cruciferous crops under the study were cauliflower, cabbage, radish and broccoli. The average cultivated area of cauliflower, cabbage, radish and broccoli for 5 years period from 2012/13 to 2016/17 was 56.8 ha, 53.8 ha, 56.4 ha and 11.4 ha, respectively. Similarly, the average production of cauliflower, cabbage, radish and broccoli for 5 years period from 2012/13 to 2016/17 was 573.1 MT, 580.8 MT, 547 MT and 108.6 MT, respectively. The average yield of cauliflower, cabbage, radish and broccoli for 5 years period from 2012/13 to 2016/17 was 10.1 MT/ha, 10.8 MT/ha, 9.8 MT/ha, 9 MT/ha, respectively. The total yield of cauliflower was below average in the years 2012/13, 2013/14, 2014/15 and above average in the years 2015/16 and 2016/17. Similarly, the total yield of cabbage was below average in the years 2012/13 and above average in the years 2013/14, 2014/15, 2015/16, 2016/17.

Table 1. Cultivated area, production and yield of major vegetables in Bajura (1999/2000 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
1999/2000	400	3560	8900
2000/01	350	3150	9000
2001/02	350	3150	9000
2002/03	350	2500	7143
2003/04	179	1279	7145
2004/05	350	2500	7143
2005/06	367	2651	7223
2006/07	367	2651	7223
2007/08	402	2878	7159
2008/09	537	4942	9202
2009/10	539	4960	9201
2010/11	845	4068	4814
2011/12	568	5002	8815
2012/13	543	4799	8839
2013/14	614	5837	9506
2014/15	659	6066	9207
2015/16	557	5652	10231.53
2016/17	751	7855	10467.63

Source (MoALD and AADPSB)

Table 2. Cultivated area, production and yield of cauliflower in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	53	495	9
2013/14	58	582	10
2014/15	60	602	10
2015/16	63	661.5	10.5
2016/17	50	525	11

Source (MoALD and AADPSB)

Table 3. Cultivated area, production and yield of cabbage in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	46	460	10
2013/14	50	540	11
2014/15	53	583	11
2015/16	55	605	11
2016/17	65	715	11

Source (MoALD and AADPSB)

Table 4. Cultivated area, production and yield of radish in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	52	468	9
2013/14	52	504	10
2014/15	55	533	10
2015/16	58	580	10
2016/17	65	650	10

Source (MoALD and AADPSB)

Table 5. Cultivated area, production and yield of broccoli in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	15	141	9
2013/14	20	193	10
2014/15	20	193	10
2015/16	1	8	8
2016/17	1	8	8

Source (MoALD and AADPSB)

Table 6. Cultivated area, production and yield of okra in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	5	45	9
2013/14	5	50	10
2014/15	5	53	10
2015/16	5.5	55	10
2016/17	10	100	10

Source (MoALD and AADPSB)

Table 7. Cultivated area, production and yield of tomato in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	31	393	13
2013/14	34	418	12
2014/15	35	431	12
2015/16	40	504	12.6
2016/17	45	518	11.5

Source (MoALD and AADPSB)

Table 8. Cultivated area, production and yield of chilli in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	40	285	7
2013/14	41	298	7
2014/15	40	280	7
2015/16	41	292	7.1
2016/17	41	292	7

Source (MoALD and AADPSB)

Table 9. Cultivated area, production and yield of brinjal in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	12	108	9
2013/14	14	147	11
2014/15	15	158	11
2015/16	15	158	10.5
2016/17	25	263	11

Source (MoALD and AADPSB)

Table 10. Cultivated area, production and yield of carrot in Bajura (2012/13 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	20	120	6
2013/14	2	14	7
2014/15	2	14	7
2015/16	3	21	7
2016/17	5	35	7

Source (MoALD and AADPSB)

Table 11. Cultivated area, production and yield of onion in Bajura (2013/14 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2013/14	38	344	9
2014/15	38	345	9
2015/16	40	362	9.1
2016/17	45	428	10

Source (MoALD and AADPSB)

Table 12. Cultivated area, production and yield of cucumber in Bajura (2013/14 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	16	150	9
2013/14	17	166	10
2014/15	17	170	10
2015/16	20	200	10
2016/17	60	630	11

Source (MoALD and AADPSB)

Table 13. Cultivated area, production and yield of bitter gourd in Bajura (2013/14 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	6	36	6
2013/14	7	54	8
2014/15	7	54	8
2015/16	7.3	55.8	7.8
2016/17	15	120	8

Source (MoALD and AADPSB)

Table 14. Cultivated area, production and yield of pumpkin in Bajura (2013/14 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	11	165	15
2013/14	12	190	16
2014/15	13	188	15
2015/16	13	201	15.5
2016/17	45	675	15

Source (MoALD and AADPSB)

Table 15. Cultivated area, production and yield of squash in Bajura (2013/14 to 2016/17)

Fiscal Year	Area (ha)	Production (MT)	Yield (MT/ha)
2012/13	2	18	9
2013/14	2	21	11
2014/15	2	22	11
2015/16	35	42	12
2016/17	5	60	12

Source (MoALD and AADPSB)

Likewise, the total yield of radish was below average in the years 2012/13 and above average in the years 2013/14, 2014/15, 2015/16, 2016/17. Correspondingly, the total yield of broccoli was below average in the years 2015/16 and 2016/17 and above average in the years 2013/14 and 2014/15.

Malvaceous Crop

The major Malvaceous crop under study was okra. The average cultivated area and production of okra for 5 years period from 2012/13 to 2016/17 was 6.1 ha and 60.6 MT respectively. The annual average yield was 9.8 MT/ha. The total yield was below average in the years 2012/13 and above average in the years 2013/14, 2014/15, 2015/16, 2016/17.

Solanaceous Crop

The major Solanaceous crops under study were tomato, chilly and brinjal. The average cultivated area for 5 years period from 2012/13 to 2016/17 for tomato, chilly and brinjal was 37 ha, 0.6 ha and 16.2 ha, respectively. The average production for tomato, chilly and brinjal for 5 years period from 2012/13 to 2016/17 was 452.8 MT, 289.4 MT and 166.8 MT, respectively. The average yield of tomato, chilly and brinjal for 5 years period from 2012/13 to 2016/17 was 12.22 MT/ha, 7.02 MT/ha and 10.5 MT/ha, respectively.

The total yield of tomato was below average in the years 2013/14, 2014/15 and 2016/17 was above average in the years 2012/13 and 2015/16. Similarly, the total yield of chilly was below average in the years 2012/13, 2013/14, 2014/15 and 2016/17 and was above average in the years 2015/16. Likewise, the total yield of brinjal was below average in the year 2012/13 and above average in the years 2013/14, 2014/15 and 2016/17.

Umbelliferae Crop

The major Umbelliferae crop under study was carrot. The cultivated area and production of carrot for 5 years period from 2012/13 to 2016/17 was 6.4 ha and 40.8 MT, respectively. The average yield of carrot was 6.8 MT/ha. The total yield was below average in the year 2012/13 and above average in the years 2013/14, 2014/15, 2015/16 and 2016/17.

Alliaceae Crop

The major Alliaceae crop under study was onion. The cultivated area and production of onion for 4 years period from 2013/14 to 2016/17 was 40.25 ha and 369.75 MT respectively. The average yield of onion was 9.3 MT/ha. The total yield was below average in the years 2013/14, 2014/15, 2015/16 and above average in the year 2016/17.

Cucurbitaceous Crop

The major Cucurbitaceous crops under study were cucumber, bitter gourd, pumpkin and squash. The average cultivated area for 5 years period from 2012/13 to 2016/17 for cucumber, bitter gourd, pumpkin and squash was 26 ha, 8.46 ha, 18.8 ha and 2.9 ha, respectively. The average production for cucumber, bitter gourd, pumpkin and squash for 5 years period from 2012/13 to 2016/17 was 263.2 MT, 63.96 MT, 283.8 MT and 32.6 MT, respectively. The average yield for cucumber, bitter gourd, pumpkin and squash was 10 MT/ha, 7.54 MT/ha, 15.3 MT/ha and 11 MT/ha, respectively.

The total yield of cucumber was below average in the year 2012/13 and above average in the year 2016/17. Similarly, the total yield of bitter gourd was below average in the year 2012/13 and above average in the years 2013/14, 2014/15, 2015/16 and 2016/17.

Likewise, the total yield of pumpkin was below average in the years 2012/13, 2014/15 and 2016/17 and above average in the years 2013/14 and 2015/16. Analogously, the total yield of squash was below average in the year 2012/13 and above average in the years 2015/16 and 2016/17.

Conclusion

The cultivation area and production increased slowly and steadily for major vegetables in Bajura throughout the analyzed period (1999/2000 to 2016/17). The vegetable production rate increased at higher rate of 258.44 MT/year than rate of cultivated area which was of 24.599 ha/year. Concurrently, the yield of major vegetable was also in increasing trend. The recent five years trend study (2012/13 to 2016/17) showed that the yield of cauliflower, cabbage and radish was in increasing trend for cruciferous crops. Similarly, the yield of okra was in increasing trend for Malvaceous crop.

Likewise, for Solanaceous crops the yield of brinjal was in increasing trend. Correspondingly, the yield of carrot was in increasing trend for Umbelliferae crops. Analogously, the yield of bitter gourd and squash was in increasing trend for cucurbitaceous crops. Further, research is needed for profound determination of the status of major vegetables in Bajura. More effective strategies should be adopted for increasing the cultivation area and production for major vegetables in Bajura as compared to their intercepts which was 251.2 ha/year and 1628.1 MT/year, respectively.

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