Production Potentials and Technology Practices for Potato and Tomato Cultivation in Arsi Zone, Ethiopia

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Abstract

Vegetable crops have high potential towards food security, local industries, natural resources conservation and market stability. However, many vegetables are untapped resources that can be improved and utilized towards better livelihood of people. Thus, the study was undertaken to assess potato and tomato vegetables production potentials and technology practices of Ziway-Dugda and Tiyo Districts during 2022. Data were collected from 400 households in ten kebeles of both districts and analyzed using SPSS version 22. The study results revealed that the farmers in the study areas produced various crops in addition to tomato and potato and produced average yields of tomatoes (621 qha^{-1}) and potatoes (46 qha^{-1}) and got better revenues (116,994 and 41,290 Birr) by selling the two vegetables produced during 2020/21 cropping seasons, respectively. Many farmers in the study areas had potentials and inputs for production of tomato and potato crops. However, some farmers in the study areas had not got the various potentials and resources to be productive in vegetables cultivation. Also many farmers in the study districts had implemented different pre-harvest production practices like cultivation tools and methods, planting spaces, staking of tomato, earthing up of potato, and irrigation practices and rotation cultivation. However, the study results showed that there are unused production practices for tomato and potato cultivation by some farmers. Thus, it is possible to conclude that there are many production potentials, inputs, services, production practices and technologies used by farmers for better vegetables production even though some farmers were not practiced improved production and management technologies that needs future interventions to capacitate them.

Keywords: Farming practices, management strategies, potato, production potentials, tomato, Tiyo, Ziway-Dugda

Introduction

Horticultural crops especially vegetables and fruits can contribute to food and nutritional security demands in Ethiopia by providing healthy and sustainable foods for consumers due to their rich source of vitamins, minerals and antioxidants (Emana *et al*., 2015). Ethiopia can benefit considerably from vegetable and fruit production as the country has favourable agro-ecologies and soil for growing diverse vegetable and fruit crops such as tomato, onion, potato, mango and avocado (Hunde, 2017). Some nutritional deficiencies like vitamin A and C, and iron can be corrected by use of selected vegetable and root crops as well as fruits; and vegetables

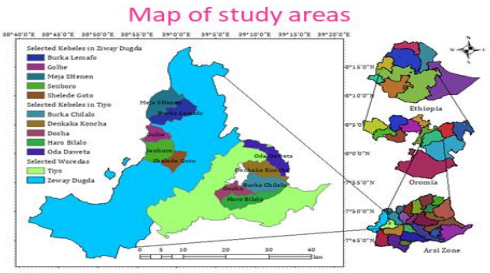
not only form an essential part of a well-balanced diet, but the flavor, aroma, color, and anti-oxidant activities also make them important in human diet and appetite (WHO, 2013). Despite the existence of huge opportunities, the vegetable sector is still underdeveloped due to inadequate farmers' skill in production and management of vegetable production like low technical practices in using production potentials, agronomic, fertilization, management and irrigation technologies and poor knowledge in applying improved agronomic practices and inputs; shortage of practice oriented training systems in production, management, processing and marketing of vegetables; and lack of organized systems in vegetable marketing to boost producers bargaining power in price negotiations (Kasso and Bekele, 2018). Thus, there was a need to identify potentials, inputs and services limiting production and productivity of vegetables; to know a production status of the local farmers for further capacitating producers' skills and knowledge; and to recommend better intervention strategies for vegetables production in some districts of Arsi zone, Oromia-Ethiopia. Even though the zone is an ideal place for market oriented horticultural crops, the sector is subsistence and low level of development in access and utilizing modern production and management technologies, market, and improved variety hinders productivity (Mekonen, 2012).

Objective

The study was aimed to determine production potentials and practices of technologies used for potato and tomato vegetables productivity improvement in Tiyo and Ziway-Dugda Districts of the country.

Methodologies

This study was conducted in 10 kebeles from both Tiyo and Ziway-Dugda Districts of Arsi Zone, Oromia Regional State-Southeastern Ethiopia in two potential vegetable crops producing districts. A multistage sampling technique was used to select representative potato and tomato producers in the study areas. Primary data were collected from producers using semi-structured interview guided questionnaires developed in KOBO Software using tablet computer.



Statistical package for social science (SPSS) version 22 was used for computing data recorded by KOBO. Percentages, means, Standard deviation, and tabulated in the process of examining and describing production potentials, resources, inputs, services and technologies practices in the study areas.

Results and Discussion

There was a significant difference between potato and tomato producers with regards to the sex, marital and education of household respondents.

Table 1: Characteristics of sample households by sex, marital status and literacy level

Characteristics	Tiyo District (Potato) (N=209)		Ziway-Dugda District (Tomato) (N=191)		χ^2 –Value	Total sample (N=400)	
	N	%	N	%		N	%

Sex of respondent:	Female	55	26.3	19	10	17.73***	74	18.5
	Male	154	73.7	172	90		326	81.5
	Total	**209**	**100**	**191**	**100**		**400**	**100**
Marital status:	Married	197	94	166	87	12.07***	363	90.75
	Widowed	6	3	5	2.6		11	2.75
	Single	4	2	19	10		23	5.75
	Divorced	2	1	1	0.5		3	0.75
	Total	**209**	**100**	**191**	**100**		**400**	**100**
Literacy level:	Can't read and write	16	7.7	12	6.3	0.301	28	7
	Can read and write	193	92.34	179	93.71		372	93
	Total	**209**	**100**	**191**	**100**		**400**	**100**

Source: Baseline survey data computation result (2022)

There was a significant difference between farmers in Ziway-Dagda (Tomato) and in Tiyo (Potato) in the two crops cultivation, land use and cost incurred in the study areas which has impact on productivity of crops.

Table 2: Years of experience and land allocated to potato (Tiyo) and tomato (Ziway-Dugda) production in the last cropping season of 2020/21 (Descriptive Statistics)

Factors	Crops	N	Min.	Max.	Mean	Std. Deviation
-Experience in production (Years)	-Tomato	191	1.00	40.00	7.0	6.92
	-Potato	209	1.00	60.00	14.0	9.88
	-Total respondent	400				
-Land amount rented to cultivate (ha)	-Tomato	52(191)	0.125	5.50	1.37	1.32
	-Potato	69(209)	0.063	4.00	0.53	0.73
	-Total respondent	121(400)				
-Total area used during 2020/21 cropping season (ha)	-Tomato	191	0.125	20.00	2.07	2.04
	-Potato	209	0.250	6.00	1.78	2.05
	-Total respondent	400				
-Money paid for rented land (Birr)	-Tomato	52(191)	2500	140800	31640.38	31528.22
	-Potato	69(209)	0.00	50000	12750.73	12490.41
	-Total respondent	121(400)				

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Tomato production, consumption and income

The total amount of tomato crop produced, allocated for consumption and supplied to the market for revenue by selling produces by the producers was differed in terms of quantity and level of returns.

Table 3: Average yield of tomato production, consumption and marketing in the Ziway-Dugda district in the cropping year of 2020/21(Descriptive Statistics)

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Amount of tomato harvested (Quintal)	191	5	1600	182.12	296.66
Amount of tomato sold from the harvested (Quintal)	191	3	1435	150.96	256.61
Amount of tomato kept for household consumption from harvested (Quintal)	191	0	100	3.17	8.27
Amount of tomato wasted at field and during transportation to market (Quintal)	191	1	350	28.00	47.49
Average tomato selling price (Birr per quintal	191	50	5000	1143.21	603.42
Total revenue from sale of tomato (Birr)	191	1800	2583000	184276.32	351750.87

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Potato production, consumption and income

The total amount of potato crop produced, allocated for consumption and supplied to the market for return by selling produces by the producers was varied in terms of quantity and returns.

Table 4: Average yield of potato production, consumption and marketing in the Tiyo district in the cropping year of 2020/21(Descriptive Statistics)

Variables/Items	N	Min.	Max.	Mean	Std. Deviation
Amount of potato harvested (Quintal)	209	8	248	64.36	41.67
Amount of sold from the harvested potato (Quintal)	209	3	248	45.49	35.46
Amount potato wasted at field and during transportation to market (Quintal)	209	0	20	5.21	4.45
Amount of harvested potato kept for household consumption (Quintal)	209	0	20	3.40	3.20
Average potato selling price (Birr per quintal)	209	100	3000	944.53	369.53
The farmer's total revenue generated from sell of potato (E.Birr)	209	1200	297600	44163.59	42667.68

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Access and utilization of tomato and potato planting materials

The main types of planting materials used for production of tomato and potato crops were both local and improved seeds and seedlings in the study areas; however, their amounts were varied significantly based on the type of crop and availability of planting materials across farmers.

Table 5: Types, sources and availability of planting materials of tomato and potato vegetables used in the production season of 2020/21

		Tomato		Potato	
Variables	**Items/Responses**	**Number**	**%**	**Number**	**%**
Type of planting materials used	Local seed	34	17.80	74	35.40
	Improved seed	129	67.54	133	63.64
	local seedling	7	3.67	1	0.48
	Improved seedling	21	10.99	1	0.48
	Total	**191**	**100**	**209**	**100**
Availability of improved varieties used	Available in enough quantity	103	53.93	101	48.32
	Not used improved variety	41	21.47	1	0.48
	Available but not enough	37	19.37	33	15.79
	Not available	10	5.23	74	35.41
	Total	191	100.0	209	100
Timely availability of improved varieties used	Yes	86	57.33	53	39.55
	No	64	42.67	81	60.45
	Total	**150**	**100**	**134**	**100**
Reasons for local varieties used	The cost of improved variety is expensive	19	46.34	22	29.33
	I am not aware of improved varieties	2	4.88	7	9.33
	local variety is pest resistant	1	2.44	11	14.67
	local varieties are longer shelf life	1	2.44	15	20.00
	Other & not using local variety	18	43.90	20	26.67
	Total	**41**	**100**	**75**	**100**
Sources of seeds or seedlings	Own saved	14	7.33	11	5.26
	Primary cooperatives	50	26.18	5	2.39
	Local market	92	48.17	58	27.75
	Neighbor farmers	11	5.76	85	40.67
	Non-Government Organizations	20	10.47	13	6.22
	Government Organizations	4	2.09	37	17.70

Total	**191**	**100**	**209**	**100**

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Fertilizers input utilization for tomato and potato crops production

Farmers in the study areas have been responded that majority of them had used chemical fertilizers for their tomato and potato vegetables production in the last cropping seasons. Thus, 190(99.48%) and 202(96.65%) of farmers have used chemical fertilizer for tomato and potato cultivation at Ziway-Dugda and Tiyo districts, respectively in the last cropping seasons (Table 6).

Table 6: Types of fertilizers utilized and time of application to tomato and potato crops production by farmers in the last cropping seasons (Frequencies)

Input	Response	Tomato		Potato	
		N	%	N	%
Chemical fertilizers applied for crop production	Yes	190	99.48	202	96.65
	No	1	0.52	7	3.35
Type of chemical fertilizer applied	NPS	43	22.63	178	88.12
	UREA	147	77.37	24	11.88
Time of Urea fertilizer applied for the crops	Half at planting and half at vegetative stage	84	44.21	6	25.00
	Half after establishment and the remaining at vegetative stage	54	28.42	14	58.33
	All at the time of planting	17	8.95	3	12.50
	All after establishment	2	1.05	1	4.17
	All at vegetative stage	31	16.32	0	0
	Others (when land is highly moisturized, after 2 weeks of planting, after three weeks of planting)	2	1.05	0	0
Time of NPS fertilizer applied for the crops	Half at planting and half at vegetative stage	27	14.14	25	14.05
	Half after establishment and the remaining at vegetative stage	25	13.09	13	7.30
	All at the time of planting	116	60.73	140	78.65
	All at vegetative stage	14	7.33	0	0
	All after establishment	4	2.09	0	0
	Other (NPS not used, used mulch, two weeks after planting)	5	2.62	0	0
Organic fertilizers applied: (compost, manure, ashes)	Yes	34	17.80	86	41.15
	No	157	82.20	123	58.85

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Production Practices and Technologies

Plant and row spacing practices in tomato and potato crops cultivation

Farmers have faced various problems in using exact plant and row spacing for Tomato and Potato production due to lack of various improved practices and technologies. Thus, the study showed utilization of various spacing for both crops by farmers to improve the productivity of their crops.

Table 7: Plant and row spacing used by farmers for tomato and potato crops production in the study areas during 2020/21 cropping season

			Frequencies			
S.No	**Production practices**		**Tomato**		**Potato**	
		Response	**N**	**%**	**N**	**%**

1	Use of specific spacing for vegetable crops production	Yes	188	98.43	198	94.74
		No	3	1.57	11	5.26

Descriptive analysis

		N	Min.	Max.	Mean	Std. Deviation
2	Plant spacing used for tomato crop (cm)	188	5	100	41	19.10
3	Row spacing used for tomato crop (cm)	188	10	100	62	24.89
4	Plant spacing used for potato crop (cm)	198	2	100	34	16.36
5	Row spacing used for potato crop (cm)	198	2	100	53	20.30

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Irrigation practices and water sources for vegetable crops production

The other production practice used by farmers in the study area was irrigation activities. Vegetable production requires irrigation in dry land regions, and irrigation is frequently used as insurance against drought in more humid regions. In areas having intermittent rain for five/six months, with little or none during the remainder of the year, irrigation is essential throughout the dry season and may also be needed between rainfalls in the rainy season. Majority of tomato farmers (94.76%) in Ziway-Dugda district and few potato farmers (4.78%) in Tiyo district have used irrigation for their crop production in the last cropping season; but very few respondents (5.24%) of tomato producers and majority (95.22%) of potato producers were not used irrigation practices for their crops (Table 8).

Table 8: Water sources and irrigation practices used for tomato and potato cultivation

			Tomato		Potato	
S.N^{o}	**Variables**	**Responses**	**N**	**%**	**N**	**%**
1	Irrigation use for crops production	Yes	181	94.76	10	4.78
		No	10	5.24	199	95.22
2	Water sources for irrigation of crops	Reservoir	1	0.55	1	10.0
		Pond	79	43.65	1	10.0
		Wells	30	16.57	1	10.0
		Spring	0	0	4	40.0
		River	67	37.02	1	10.0
		Lake	3	1.66	1	10.0
		Others (harvesting rain water)	1	0.55	1	10.0
3	Methods of irrigation water application	Furrow irrigation	168	92.82	7	70.0
		Flooding	6	3.31	2	20.0
		Drip irrigation	5	2.76	0	0
		Using watering can	2	1.11	1	10.0
		Sprinkler irrigation	0	0	0	0
		Others	0	0	0	0
4	Frequency of watering crops	Once in a week	64	35.36	3	30.0
		Once in two weeks	9	4.97	2	20.0
		Once in three weeks	1	0.55	1	10.0
		Whenever the soil is dry	45	24.86	1	10.0
		Whenever the plant shows wilting symptoms	12	6.63	1	10.0
		Whenever irrigation water is available	3	1.66	1	10.0
		Others (without fixing time based on water & labor availability)	47	25.97	1	10.0

5	Use of water pumping technologies	Yes	128	67.02	3	1.44
		No	63	32.98	206	98.56
6	Types of water pumping technologies used for watering crops	Diesel generators	115	89.84	3	100
		Manual pumping devices	11	8.60	0	0
		Solar pump	1	0.78	0	0
		Electric pumping	1	0.78	0	0

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Technologies used by farmers for vegetable crops production

Production practices and technologies required for vegetable crops growing in the field include cultivation; crop rotation; irrigation; application of fertilizers; control of weeds, diseases, and insects; protection against frost; and the use of various methods, tools and procedures for cultivations.

Table 22: Methods, tools or procedures used by farmers for cultivation of tomato and potato crops

		Yes		No		Total	
		N	%	N	%	N	%
Methods, tools or procedures used by farmers in the last cropping season	Crop rotation	341	85.25	59	14.75	400	100
	Seeds	259	64.75	141	35.25	400	100
	Mechanization	147	36.75	253	63.25	400	100
	Fertilizers	297	74.25	103	25.75	400	100
	Herbicides	198	49.50	202	50.50	400	100
	Fungicides	291	72.75	109	27.25	400	100
	Insecticides	225	56.25	175	43.75	400	100
	Row seeder	69	17.25	331	82.75	400	100
	Aybar BBM	18	4.5	382	95.5	400	100
	Animal Row seeder	62	15.5	338	84.5	400	100
	Improved storage bags(100kg, PICS-Bags)	34	8.5	366	91.5	400	100
	Mobile threshing	10	2.5	390	97.5	400	100
	Modern Diger(berken maresha)	54	13.5	346	86.5	400	100

Source: Data collected during 2022 by kobo software and analyzed using SPSS version 22

Conclusion:

There were many production potentials, inputs, services and practices used by farmers to produce better vegetables for both consumption and marketing to have improved livelihoods in the study areas even though some farmers are not within these ranges and need future capacitating.

Recommendations:

There are various constraints identified like absence of resources, lands, livestock, inputs, services, and lack of production and absence of practice and demonstration based skills and knowledge on cultivation of vegetables which need interventions in future by different actors.

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BIBLIOGRAPHY:

- Emana, B., Ketema, M., Mutimba, J.K. and Yousuf, J. 2015. Factors affecting market outlet choice of potato producers in Eastern Hararghe Zone, Ethiopia. *Journal of Economics and Sustainable Development*, *6*(15): 159-172.
- Wubet, G.K., Zemedu, L. and Tegegne, B. 2022. Value chain analysis of potato in Farta District of South Gondar Zone, Amhara National Regional State of Ethiopia. *Heliyon*, 8(3): 09142.