# Factors Affecting Adoption of Improved Tomato Technologies in District Mardan

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## *Abstract*

*FAO in 2014 ranked 6th position to tomato among 15 vegetables in terms of world total annual production, it is an important vegetable which is rich in vitamin C and consumed in almost each house. The research was conducted in District Mardan of Khyber Pukhtunkhawa (KP) to analyze factors affecting adoption of improved tomato technologies in March-April 2016. District Mardan has three tehsils; Mardan, Takht Bhai, and Katlang. One tehsil i.e. Mardan was selected purposively on the basis of tomato cultivation. Two Union Councils (UC) i;e Babini and Fatima from the selected tehsil were randomly selected and two villages from each UC were randomly selected. Those tomato growers who got training from extension department were interviewed through well-structured interview schedule. Thus, making a total of 104 respondents. The results of the study show that majority (43%) of the respondents were young, literate (85%) having formal education up-to some extent, owner cultivator (49%), majority (81%) have total tomato cultivated area between 1-3 acres. Training was given to all the farmers, results of t-test showed that after getting training; tomato yield and income was increased. It is concluded that\ all the respondents adopted HYVs, high price of agricultural inputs, non-availability of cold storage, non- availability of certified vegetable seeds, pest and diseases incidence lack of agriculture credit facilities, improper/ defective marketing of produce, lack of fertilizers and lack of technical knowledge were the factors affecting adoption of improved tomato technologies in the study area.*

**Keywords:** adoption, extension agent, recommended technologies.

## Introduction

Globally annual production of fresh tomato is around 159 million tones. These 159 million tones are meant for the processing industry prior to be exported making it a productive commodity and world's leading vegetable for processing. During 2011 tomato production was 530 thousand tones recorded in Pakistan. (Khokhar, 2013).

Chohan and Ahmad (2008) confirmed that tomato has become one of the worlds widely grown and most admired vegetable. FAO (2014) listed 15 vegetables in which tomato placed in 6th position in term of total world annual production. Tomato is an important vegetable because of having a lot of nutritional worth and fairly low prices as compare to other vegetables. It is consumed in each house in different methods, like vegetables, ketchup, salad and new dishes etc.

Tomato plays an important role in the economy of Pakistan. Production and area under tomato in Pakistan has increased from 268.8 to 476.8 thousand tons, and 27.9 to 50 thousand ha from 2005-06 to 2015-116 respectively. On Average tomato yield of 10 years is about10.1 tones/ha; which is very low as compared to developed countries (GoP, 2015-16). Through the provision of high yielding varieties of seed (HYVs), improved production technology and sound knowledge of tomato farming maximum potential yield can be achieved

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(Ahmed, 2005; Ahmad et al., 2012). Low tomato yield per acre is due to the fact that farmers in the Pakistan are not adopting full package of recommended agricultural technologies and practices (Ahmad *et al.*, 2007).

Warm weather and plenty of sunshine is required for better tomato production. Foliar diseases results in tomato due to high humidity with high temperatures which affects its productivity and life span (Hafeez, 2001). Tomato is one of the major vegetable grown in Mardan district of KP. The climate and soil condition of Mardan does have the potential to yield high production. It helps the farmers to get maximum income and also a source of employment for them. Presently the farmers are not getting the potential yield from tomato. Resultantly their economic condition is not up to the mark. In a situation like this, the dissemination of modern technologies is necessary for the awareness of farmers. The present study was designed to analyze the factors affecting adoption of improved technologies regarding tomato cultivation in district Mardan.

**Objectives of this research paper are to study:**

1. The prevailing conditions regarding tomato cultivation in the study area.
2. The factors affecting adoption of improved technologies of tomato in the study area.

## Materials and Methods

Tomato is one of the major vegetable grown in Mardan district of KP. The climate and soil condition of Mardan does have the potential to yield high production. It helps the farmers to get maximum income and also a source of employment for them. Presently the farmers are not getting the potential yield from tomato. District Mardan was the universe of the study. District Mardan has three tehsils; Mardan, Takht Bhai, and Katlang. One tehsil i.e. Mardan was selected purposively on the basis of tomato cultivation. Two Union Councils (UC) i;e Babini and Fatima from the selected tehsil were randomly selected and two villages from each UC were randomly selected. Those tomato growers who got training from extension department were interviewed through well-structured interview schedule. The association of different variables were tested by using Chi- Square Test. Paired sample T-test was used to test the difference of yield and income of tomato growers before and after training.

## Results and Discussion

### Age of the respondents

Age affects the behavior, ways of thinking and helps in exploring the vision and understanding of an individual (Iqbal and Nawab, 2013). Table 1 indicates age of the sample respondents. Out of 104 respondents in the study area 43% of the respondents were from age group of 18-30 years, 30% of the respondents were of the age group of 41 and above years, and the remaining 27% were from 31-40 years.

These results varies from those of Din (2015) who pointed out that 52% of the respondents have age between 15-30 years. It is important to note that majority 43% of tomato growers were from the youth pool during interview, ultimately proving the fact that younger have greater power and ability of adoption to a certain technique and technology application regarding tomato farming than elders.

**Table 1. Distribution of sample respondents on the basis of age**

| Villages | 18-30 years | 31-40 years | 41 and above years | Total |
|---|---|---|---|---|
| Babeni | 8(53) | 2(14) | 5(33) | 15 |
| Hamza Khan | 10(30) | 9(27) | 14(42) | 33 |
| Platoona | 11(58) | 5(26) | 3(16) | 19 |
| Sadar Kali | 16(43) | 12(33) | 9(24) | 37 |
| Total | 45(43) | 28(27) | 31(30) | 104 |

Source: Field data survey 2016

Note: Values in parenthesis are percentages

**Literacy status of the respondents**

Education affects the level of learning, adoption, intellectual, and understanding directly or indirectly (Iqbal and Nawab, 2013). Data depicted in Table 2 depicted the literacy status of the respondents, 85% of the respondents were literate, while 15% were illiterate. Out of total literate 11% were having educational level up to primary, 34% respondents were middle, 22% and 18% respondents were having education up to metric and intermediate level respectively. It is important to note that none of the respondent were having education above intermediate level.

These results are in line with the study conducted by Din (2015), who found that illiterate respondents were 11% and the remaining 79% respodents were literate.

**Table 2. Distribution of sample respondents on the basis of literacy status**

| Villages | Illiterate | Literate | Total | If literate , Level of literacy | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | Primary | Middle | Metric | Inter | |
| Babeni | 0 | 15(100) | 15 | 3(20) | 3(20) | 6(40) | 3(20) | 15 |
| Hamza Khan | 6(18) | 27(82) | 33 | 4(12) | 12(37) | 7(21) | 4(12) | 27 |
| Platoona | 4(21) | 15(79) | 19 | 0 | 7(37) | 4(21) | 4(21) | 15 |
| Sadar Kali | 6(16) | 31(84) | 37 | 5(13) | 13(35) | 6(17) | 7(19) | 31 |
| Total | 16(15) | 88(85) | 104 | 12(11) | 35(34) | 23(22) | 18(18) | 88 |

Source: Field survey 2016

Note: Values in parenthesis shows percentages

**Land holdings of respondents**

Land holdings have vital role for the farmers in adoption, diffusion and owning improved technologies for improved agricultural outcomes. The larger the size of land holding, the rate of adoption and of superior technologies will be high (Belay *et al*., 2012)

Table 3 indicates that majority 86% of the respondents were having land holding between 1-5 acres, 8% of the respondents were having land holding below 1 acre and the remaining 6% of respondents were having land holding above 5 acre. These results found similar with those of Din (2015), where land holding size between 1-5 acres were 59% respondents and the remaining 41% respondents were classed below 1 acre and above 5 acres.

**Table 3. Frequency distribution of the sample respondents according to size of land holding**

| Villages | Below 1 acre | -5 acres | Above 5 acres | Total |
|---|---|---|---|---|
| Babeni | 0(0) | 15(100) | 0(0) | 15 |
| Hamza Khan | 4(12) | 27(82) | 2(6) | 33 |
| Platoona | 0(0) | 16(84) | 3(16) | 19 |
| Sadar Kali | 4(11) | 32(86) | 1(3) | 37 |
| Total | 8(8) | 90(86) | 6(6) | 104 |

Source: Field survey data 2016

Note: Values in parenthesis are percentages

**High yielding varieties**

Table 4 shows data regarding adoption of high yielding varieties. All the respondents reported that they were growing different high yielding varieties. The second portion of the table shows that 48 respondents reported that Sahel were grown as a HYV, 30 respondents reported that they grew success as a HYV, 6 respondents reported that Best American were grown as a HYV, 10 respondents reported that they grew SiS as a HYV, 11 reported that they grew Cosmic as a HYV, 24 respondents reported that HT-100 were grown as a HYV, 8

reported that Best California was grown as a HYV and the remaining 9 respondents reported that H-646 were grown as a HYV in the study area. It is important to note that the respondents adopted different HYVs at the same time.

The results of the study is in contrast with Awan et al. (2012) who reported that Variety Roma was ideal variety followed by Rio Grind and variety Heirloom in the study area.

**Table 5. Distribution of sample respondents on the basis of high yielding varieties**

| Villages | HYV adoption | | Total | High yielding varieties(HYVs) | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yes | No | | Sahel | Success | Best American | Sis | Cosmic | Ht-100 | Best California | H-646 | |
| Babeni | 15 | 0 | 15 | 12 | 2 | 2 | 3 | 0 | 5 | 1 | 0 | 25 |
| Hamza Khan | 33 | 0 | 33 | 17 | 6 | 1 | 1 | 3 | 5 | 4 | 3 | 40 |
| Platoona | 19 | 0 | 19 | 11 | 7 | 0 | 1 | 7 | 0 | 0 | 1 | 16 |
| Sadar Kali | 37 | 0 | 37 | 18 | 15 | 4 | 5 | 1 | 14 | 3 | 5 | 65 |
| Total | 104 | 0 | 104 | 48 | 30 | 6 | 10 | 11 | 24 | 8 | 9 | 146 |

Source: Field survey data 2016

Note: The total may not tally due to multiple answers by the respondents

**Tomato pest/ diseases attack**

Table 6 show data regarding pest/ diseases of tomato crop in the study area. Majority i.e. 74 respondents reported leaf mold disease (*Fulviafulva)*, 64 reported Gray leaf spot disease (*Stemphyliumsolani)*, 50 respondents reported Verticillium wilting disease (*Verticilliumalbo-atrum)*, while 37 reported root- knot nematodes (*Meloidogyne* spp), 46 respondents reported septoria leaf spot disease (*Septorialycopersici)*, 23 respondents reported bacterial canker, while remaining 40 respondents reported gray mold (*Botrytis cinerea*) disease attak on tomato in the study area.

**Table 6. Distribution of sample respondents on the basis of tomato pest/ diseases attack**

| **Villages** | Gray Leaf spot | Verticilim Wilting | Root -knot Nematodes | Septoria leaf | Bacterial canker | Gray mold | Leaf Mold | **Total** |
|---|---|---|---|---|---|---|---|---|
| Babeni | 5 | 10 | 7 | 3 | 4 | 9 | 14 | 52 |
| Hamza Khan | 22 | 16 | 14 | 19 | 3 | 12 | 27 | 113 |
| Platoona | 17 | 9 | 6 | 9 | 4 | 2 | 8 | 55 |
| Sadar Kali | 20 | 15 | 10 | 15 | 12 | 17 | 25 | 114 |
| Total | 64 | 50 | 37 | 46 | 23 | 40 | 74 | 334 |

Source: Field survey data 2016

Note: The total may not tally due to multiple answers by the respondents

**Preventive measures of tomato pest/ diseases**

Data regarding preventive measures of tomato pest/ diseases are given in Table 7, shows that majority of the respondents 104 reported that they used pesticide/ fungicides spray as a precautionary measure, 38 respondents reported that they used irrigation as a

precautionary measure, and 35 respondents reported that they used hoeing/ inter culturing as a preventive measurement in the study area. Results of the study is quite alarming, all the respondents use fungicide/pesticide spray and the use of IPM is very low in the study area. There is a need to train the farmers regarding IPM in the study area in order to reduce the residual effect in tomato.

**Table 7. Distribution of sample respondents on the basis of preventive measures**

| Villages | Irrigation | Spray/insecticide and pesticide | Hoeing | Total |
|---|---|---|---|---|
| Babeni | 6 | 15 | 6 | 27 |
| Hamza Khan | 12 | 33 | 12 | 57 |
| Platoona | 7 | 19 | 7 | 33 |
| Sadar Kali | 13 | 37 | 10 | 60 |
| Total | 38 | 104 | 35 | 177 |

Source: Field survey data 2016
Note: The total may not tally due to multiple answers by the respondent

**Sources of agricultural information regarding tomato**

Table 8 shows major sources of agriculture information, 67 respondents reported that extension department gave them information regarding tomato cultivation, none of them obtained agricultural information from the TV and Radio, 28 respondents reported that the source of agricultural information was the NGOs, 45 respondents reported that fellow farmers were major source of agricultural information, only one respondent reported printed material as a source of information, the remaining 53 respondents reported that they gained information from demonstration plots by private sectors in the study area.

**Table 8. Distribution of respondents on the basis of source of agriculture information**

| Villages | Major source of agriculture information | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Agri Ext Dept | Radio/TV | NGOs | Fellow farmers | Print media | Demonstration Plot by private sector | |
| Babeni | 9 | 0 | 5 | 5 | 0 | 9 | 28 |
| Hamza khan | 21 | 0 | 7 | 12 | 0 | 12 | 52 |
| Platoona | 10 | 0 | 7 | 12 | 1 | 9 | 39 |
| Sadar kali | 27 | 0 | 9 | 16 | 0 | 23 | 75 |
| Total | 67 | 0 | 28 | 45 | 1 | 53 | 194 |

Source: Field survey data 2015
Note: The total may not tally due to multiple answers by the respondents

**Visit of the agriculture officer to the farmer's field**

Table 9 shows the data regarding extension staff visits to the farmer' field. Majority of the respondents i.e. 101 reported that agriculture staff visited their field, 4 respondents reported that district agriculture officer visited their field and share level of information and guidance on latest seed varieties and pesticides usage of tomato, similarly only 1 respondent

reported that SMS plant protection officer visited their field, 49 reported that agriculture extension officer visited their field, 21 reported that agriculture inspector visited their field and the remaining 89 respondents reported that field assistant visited their field in the study area.

**Table 9. Distribution of sample respondents on the basis of agriculture extension staff visit to the field**

| Villages | Agriculture Extension staff visit to the field | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Agri staff visit | DistAgri officer | SMS plant protection | Agri Ext Officer | Agri Inspector | Field assistant | |
| Babeni | 14 | 0 | 0 | 9 | 1 | 15 | 39 |
| Hamza khan | 31 | 2 | 0 | 19 | 6 | 25 | 83 |
| Platoona | 19 | 0 | 0 | 6 | 6 | 19 | 50 |
| Sadar kali | 37 | 2 | 1 | 15 | 8 | 30 | 93 |
| Total | 101 | 4 | 1 | 49 | 21 | 89 | 265 |

Source: Field survey data 2016

Note: Due to multiple answers by the respondents, the total may not tally.

**Factors affecting adoption of improved tomato technologies**

Data regarding major problems of tomato cultivation were given in Table 10. Majority i.e. 84 respondents reported high price of agricultural inputs, while 70 respondents reported that pest and diseases incidence were the major problem, 47 reported lack of agriculture credit facilities, 42 reported improper /defective marketing of produce, 56 reported non- availability of certified vegetable seeds, 19 reported lack of fertilizers and the remaining 14 respondents reported lack of technical knowledge as a major problem regarding tomato cultivation in the study area.

Our results are in line with Rahmat et al. (2018) who reported lack of funding and credit amenities as the most important constrains in non-adoption of precision farming. Ajagbe et al. (2014) also concluded insufficient funding, poor extension services, and exhausting tomato processing practices as the main constraints of tomato post-harvest techniques in the study area.

**Table 10. Distribution of sample respondents on the basis of factors affecting adoption of improved tomato technologies**

| Villages | Lack of agricultur e credit facilities | Defective marketing of Produce | Non availability of Certified vegetable seeds | High Cost of agriculture inputs | Pests and diseases incidence | Lack of fertilize Use | Lack of technical knowledge | Total |
|---|---|---|---|---|---|---|---|---|
| Babeni | 13 | 9 | 6 | 14 | 10 | 2 | 1 | 55 |
| Hamza Khan | 11 | 10 | 21 | 25 | 24 | 3 | 3 | 97 |
| Platoona | 9 | 9 | 9 | 15 | 10 | 6 | 1 | 59 |
| Sadar Kali | 14 | 14 | 20 | 30 | 26 | 8 | 9 | 121 |
| Total | 47 | 42 | 56 | 84 | 70 | 19 | 14 | 332 |

Source: Field survey data 2016

Note: The total may not tally due to multiple answers by the respondents

**Tomato yield and income comparison before and after extension recommendation**

To find out the mean significant difference of yield before and after training provided by the extension department a pair sampled t-test was applied and is shown in the Table 11. Results showed highly significant ($P \leq 0.05$) difference in the yield after getting training. The mean difference of yield observed was 338.596 kg/ acre. The fact behind such a productive result reflect the new and up to date information and skills provided by the extension department.

Results showed highly significant increase in the income of the respondents. The mean difference observed was 115832.01Rs. The reason behind this increase is due to high production of tomato after getting training from the extension department.

**Table 11. Yield and income comparison before and after extension recommendation**

| Crop | Variable | Before extension recommendations | | After extension recommendations | | t-value | p-value |
|---|---|---|---|---|---|---|---|
| Tomato | | Mean | SD | Mean | SD | | |
| | Yield kg/acre | 4051.62 | 861.365 | 4390.21 | 926.357 | -7.911 | .000* |
| | Income Rs | 471854.3 | 74730.23 | 587686.3 | 66300.6 | -6.919 | .000* |

**Association among age, education, and landholding size with problems faced by the farmers**

Table 12 shows the association among age, education, and the problem faced by the farmers. Results show non-significant association among problems faced by the famers with age and education. It can be concluded that irrespective of age and education farmers had the problems of certified seeds, lack of money and certified pesticides.

Table 12 also represents association of landholding with the problems, results show a significant association of landholding with the problems. The results of the study is in line with Belay et al. (2012) who concluded that landholding has linear co-relation with income and frequency of taking risk. Chaudhary (2006) reported that farmers with large landholding are more motivated towards adoption of innovations and have more opportunities to information sources and can afford to adopt new technologies as compared too small farmers.

**Table 12. Association among age, education and landholding size with problems**

| **Variables** | **Categories** | **Certified Seed** | | **Lack of Money** | | **Certified pesticides** | |
|---|---|---|---|---|---|---|---|
| | | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| **Age** | Young 18-30 | 23 | 22 | 27 | 18 | 18 | 27 |
| | Middle 31-40 | 19 | 9 | 15 | 13 | 17 | 11 |
| | Old 41 and above | 19 | 12 | 18 | 13 | 17 | 14 |
| | **$X^2$ value= 2.12$^{Ns}$ P-value=0.346** | | | | | | |
| **Education** | Illiterate | 10 | 6 | 11 | 5 | 9 | 7 |
| | Primary | 8 | 4 | 4 | 8 | 7 | 5 |
| | Middle | 18 | 17 | 22 | 13 | 15 | 20 |
| | Matric | 14 | 9 | 11 | 12 | 12 | 11 |
| | Intermediate | 11 | 7 | 12 | 6 | 9 | 9 |
| | **$X^2$ value =1.260$^{Ns}$ P-value=0.86** | | | | | | |
| **Land holding size** | Below 1 Acre | 6 | 2 | 6 | 2 | 5 | 3 |
| | 1-5 Acres | 49 | 41 | 48 | 42 | 43 | 47 |
| | Above 5 Acres | 6 | 0 | 6 | 0 | 4 | 2 |
| | **$X^2$ value =5.769** P-value=.056** | | | | | | |

*, ** represents significance level at 5 and 1 percent respectively

**Association among farmer education, land holds size with yield (kg/acre)**

Chi-square test was used to test any significant association among tomato yield, education and land hold size. Results are presented in Table 13, showed that there was non-significant association among tomato yield, education and land holding size.

It is concluded that tomato yield was not affected by education and landholding size. Other factors like sowing method, HYVs, fertilizers, and preventive measures against pest/diseases may affect the yield.

**Table1 13. Association among farmer education, land hold size with yield (kg/acre)**

| Variables | Categories | Yield of tomato(kg/acre) | | | |
|---|---|---|---|---|---|
| | | 2600-3560 | 3561-4300 | 4301-5200 | 5201-6200 |
| Education | Illiterate | 6 | 5 | 3 | 2 |
| | Primary | 3 | 4 | 3 | 2 |
| | Middle | 8 | 12 | 8 | 7 |
| | Matric | 5 | 6 | 7 | 5 |
| | Intermediate | 4 | 7 | 5 | 2 |
| | **$X^2$ value =3.440NS** | | **P-value=.992** | | |
| Landholding size | Below 1 acre | 0 | 3 | 3 | 2 |
| | 1-5 acres | 22 | 30 | 22 | 16 |
| | Above 5 acres | 4 | 1 | 1 | 0 |
| | **$X^2$ value =8.718NS** | | **P-value=.190** | | |

*, ** represents significance level at 5 and 1 percent respectively

## Conclusion

It is concluded that all farmers adopted high yielding varieties (especially Sahil). All respondents used fungicide/pesticide for the control of pest and diseases and the use of IPM is very low in the study area. The role of extension department in the study area was satisfactory. It is also concluded that yield and income of farmers was increased after adopting extension recommendations. Non-availability of certified seeds, cold storage, lack of money, prices and quality of pesticides were the major factors affecting the adoption of improved tomato cultivation in the study area.

**Recommendations**

The study suggested the following recommendations:

1. Agricultural inputs such as chemical fertilizers, insecticide and pesticide, high yielding and disease resistance variety, and modern agricultural machinery should be available at low prices and right time in local market.
2. The government should provide financial support to the small farmers in the form of low interest credit.
3. Farmers should also be trained regarding, IPM, new verities, and technologies. Cold storage facility for tomato should be provided for surplus amount of tomato for future use.
4. Local language programme may be telecasted on TV and radio regarding farmers' problems, tomato cultivation, tomato verities, and the use of new innovation of technologies on regular basis.
5. Extension field staff should make regular and frequent visits, and extend training programmes to other area.

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