Table 1: the socioeconomic characteristics of the sample households

|  |  |  |
| --- | --- | --- |
| Characteristic | Number | Percent |
| Credit |  |  |
|  | Yes  | 56 | 35 |
|  | No  | 104 | 65 |
| Training in marketing  |  |  |
|  | Yes  | 12 | 7.50 |
| No  | 148 | 92.50 |
| Training in production |  |  |
|  | Yes | 44 | 27.50 |
| No  | 116 | 72.50 |
| Watering at night |  |  |
|  | Yes | 42 | 26.25 |
| No  | 118 | 73.75 |
| Watering at evening |  |  |
|  | Yes  | 57 | 35.63 |
| No  | 103 | 64.37 |
| Watering at noon |  |  |
|  | Yes  | 10 | 6.25 |
| No  | 150 | 97.75 |
| Watering at morning |  |  |
|  | Yes | 124 | 77.50 |
| No  | 36 | 22.50 |
| Fair water distribution service (FWTRD) |  |  |
|  | Yes  | 16 | 10 |
| No  | 144 | 90 |
| Irrigation water users association service (IWUAS) |  |  |
|  | Yes  | 84 | 52.50 |
|  | No  | 76 | 47.50 |
| Cooperative  |  |  |
|  | Yes  | 45 | 28.13 |
| No  | 115 | 71.87 |
| Off-farm  |  |  |
|  | Yes  | 6 | 3.75 |
| No  | 154 | 96.25 |
| Watering frequency(per 15 days ) | Number  | Percent  |
| Two times | 51 | 31.88 |
| Three times | 80 | 50 |
| Four times | 29 | 18.12 |
| Total  | 160 | 100 |
| **Characteristics**  | **Unit**  | **Mean** | **Std. Dev.** |
| Level of Education | Years  | 2 | 1.25 |
| Age of HH head | Years  | 41.28 | 9.19 |
| FMS | Numbers  | 5.59 | 1.95 |
| Total livestock unit | TLU | 7.21 | 3.89 |
| EXTF  | Numbers  | 1.87 | 1.83 |

Source: Computed from Field Survey Data, 2015/16

Table 2: Summary Statistics of Variables for Stochastic Production Function Analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Number | Mean | Std. Dev |
| Output (kg/Ha) | 160 | 8,543.12 | 5,345.88  |
| Plot size (Ha) | 160 | 0.37 | 0.31  |
| Labor (Man-day/Ha) | 160 | 170.47  | 202.61  |
| Seedling (kg/Ha) | 160 | 4.66 | 5.35 |
| DAP (kg/Ha) | 160 | 138.79 | 144.71 |
| Urea(kg/Ha) | 160 | 102.33  | 133  |
| Oxen (oxen-day/Ha) | 160 | 20.16  | 16.31 |

Source: Computed from Field Survey Data, 2015/16

Table 3: VIF of the Explanatory Variables of the Stochastic Frontier Production Function Model

|  |  |  |
| --- | --- | --- |
| Variables | $$VIF$$ | $${1}/{VIF}$$ |
| LnUREA | 2.94 | 0.34 |
| LnPlot | 2.66 | 0.38 |
| LnDAP | 2.59 | 0.39 |
| LnODE | 2.41 | 0.41 |
| LnMDE | 2.37 | 0.42 |
| LnSEEDLING | 1.57 | 0.64 |
| Mean VIF | 2.42 |  |

Source: Computed from Field Survey Data, 2015/16

Table 4: VIF for the continuous variables used to technical inefficiency model (n=160)

|  |  |  |
| --- | --- | --- |
| Variables | $$VIF$$ | $${1}/{VIF}$$ |
| Age | 1.52 | 0.65 |
| FMS | 1.51 | 0.66 |
| Level of Educ | 1.28 | 0.78 |
| TLU | 1.24 | 0.81 |
| WATERF | 1.20 | 0.83 |
| EXTF | 1.05 | 0.95 |
| Mean VIF | 1.30 |  |

Source: Computed from Field Survey Data, 2015/16

Table 5: Contingency coefficients for hypothesized discrete explanatory variables (n=160)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Off | Coop | IWUAS | FWTRD | WTRG | WTRN | WTREG | WTRNT | TRNGP | TRNGM | CREDT |
| Off | 1 | 0.023 | 0.056 | 0.066 | 0.106 | 0.051 | 0.009 | 0.178 | 0.026 | 0.056 | 0.130 |
| Coop |  | 1 | 0.355 | 0.069 | 0.004 | 0.047 | 0.028 | 0.296 | 0.287 | 0.033 | 0.220 |
| IWUAS |  |  | 1 | 0.302 | 0.151 | 0.166 | 0.054 | 0.455 | 0.031 | 0.081 | 0.016 |
| FWTRD |  |  |  | 1 | 0.119 | 0.086 | 0.100 | 0.177 | 0.166 | 0.355 | 0.104 |
| WTRG |  |  |  |  | 1 | 0.108 | 0.473 | 0.049 | 0.130 | 0.074 | 0.203 |
| WTRN |  |  |  |  |  | 1 | 0.084 | 0.152 | 0.157 | 0.073 | 0.134 |
| WTREG |  |  |  |  |  |  | 1 | 0.029 | 0.107 | 0.014 | 0.263 |
| WTRNT |  |  |  |  |  |  |  | 1 | 0.174 | 0.046 | 0.267 |
| TRNGP |  |  |  |  |  |  |  |  | 1 | 0.335 | 0.157 |
| TRNGM |  |  |  |  |  |  |  |  |  | 1 | 0.186 |
| CREDIT |  |  |  |  |  |  |  |  |  |  | 1 |

Source: Computed from Field Survey Data, 2015/19

Table 6: Summary of the test of hypothesis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null hypothesis | Degree of freedom | $$LR$$ | $x^{2}$value | Decision |
| $$H\_{0}: γ=0$$ | 1 | 96.04 | 3.84 | Not accepted |
| $$H\_{0}: β\_{7}=…=β\_{27}=0$$ | 28 | 28.52 | 32.67 | Accepted |
| $$H\_{0}: δ\_{0}=…=δ\_{17}$$ | 17 | 87.22 | 27.59 | Not accepted |

At 5% significance level

Source: Computed from Field Survey Data, 2015/16

Table 7: MLE of the Parameters of the Cobb-Douglas stochastic production Frontier Function for tomato Producers

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Parameter | Ordinary least squares | Maximum likelihood estimate |
| Coefficient | t-ratio | Coefficient | t-ratio |
| Intercept | $$β\_{0}$$ | 8.90  | 60.20 | 9.72  | 59.38\*\* |
| LnODE | $$β\_{1}$$ | 0.009 | 1.78 | 0.01  | 3.12\*\* |
| LnMDE | $$β\_{2}$$ | 0.0004  | 1.09 | 0.0007 | 1.84\* |
| LnUREA | $$β\_{3}$$ | 0.0006  | 0.56 | 0.0006  | 0.92 |
| LnDAP | $$β\_{4}$$ | -0.00002  | -0.02 | -0.002  | -3.05\*\* |
| LnSEEDLING | $$β\_{5}$$ | 0.002  | 0.13 | 0.006  | 0.52 |
| LnPLOT | $$β\_{6}$$ | -0.68  | -3.46 | -0.67  | -4.33\*\* |
| Inefficiency effect model |
| Sigma-squared | $$σ^{2}$$ |  |  | 0.37  | 4.63\*\* |
| Gamma | $$γ$$ |  |  | 0.80 | 8.71\*\* |
| LL |  | -155.27 |  | -107.25 |  |
| LR |  |  |  | 96.06 |  |
| Return to scale |  |  |  | -0.66 |  |
| Total sample size | $$N$$ | 160 |  | 160 |  |

$\*\*,and\*$Represents significance at 1% and 10% probability levels, respectively

Source: Computed from Field Survey Data, 2015/16

Table 8: maximum likelihood estimates of factors affecting technical inefficiency source

|  |  |  |  |
| --- | --- | --- | --- |
| Variables  | Parameter  | Coefficient  | t-ratio |
| Intercept  | $$δ\_{0}$$ | -0.26  | -0.28 |
| AGE | $$δ\_{1}$$ | 0.03 | 2.49\*\* |
| EDUC | $$δ\_{2}$$ | -0.41  | -3.03\*\*\* |
| FMS | $$δ\_{3}$$ | 0.001  | 0.02 |
| TLU | $$δ\_{4}$$ | -0.11  | -2.51\*\* |
| OFFARM  | $$δ\_{5}$$ | 1.53  | 3.61\*\*\* |
| EXTNF | $$δ\_{6}$$ | 0.01  | 0.15 |
| COOP | $$δ\_{7}$$ | 0.35  | 1.36 |
| IWUAS | $$δ\_{8}$$ | -0.13  | -0.44 |
| FWTRD | $$δ\_{9}$$ | -3.58  | -1.57 |
| WTRMRNG | $$δ\_{10}$$ | -0.64  | -2.39\*\* |
| WTRNOON | $$δ\_{11}$$ | 0.23  | 0.66 |
| WTREVNG | $$δ\_{12}$$ | -0.17  | -0.72 |
| WTRNIGHT | $$δ\_{13}$$ | 0.18  | 0.59 |
| WTRF | $$δ\_{14}$$ | 0.43  | 2.78\*\*\* |
| TRNGP | $$δ\_{15}$$ | 0.002  | 0.008 |
| TRNGM | $$δ\_{16}$$ | 0.71  | 1.76\* |
| CREDIT | $$δ\_{17}$$ | 0.23  | 1.04 |
| Log likelihood function |  | -107.25 |  |

$\*\*\*, \*\*and\*$Represents significance at 1%, 5% and 10% probability levels, respectively

Table 9: Frequency Distribution of Technical Efficiency of irrigated Tomato producers

|  |  |  |
| --- | --- | --- |
| TE level | Frequency | Percentage |
| 0.01-0.10 | 2 | 1.25 |
| 0.10-0.20 | 9 | 5.63 |
| 0.20-0.30 | 24 | 15 |
| 0.30-0.40 | 21 | 13.12 |
| 0.40-0.50 | 16 | 10 |
| 0.50-0.60 | 17 | 10.62 |
| 0.60-0.70 | 14 | 8.75 |
| 0.70-0.80 | 17 | 10.62 |
| 0.80-0.90 | 25 | 15.63 |
| 0.90-1 | 15 | 9.38 |
| **Total** | **160** | **100** |
| **Mean** | **0.55** |  |
| **Minimum** | **0.09** |  |
| **Maximum** | **0.93** |  |

Source: Computed from Field Survey Data, 2015/16

Table 10: Tomato yield gap due to technical inefficiency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable  | Min | Max | Mean | Std. Dev. |
| Actual yield (kg/ha) | 788 | 24,000 | 8,543.12  | 5,345.88 |
| TE estimates | 0.09  | 0.93 | 0.55 | 0.25 |
| Potential/frontier yield (kg/ha) | 1,739.11 | 28,974.43 | 15,450.44  | 5,956.67 |
| Yield gap/loss (kg/ha) | 283.10 | 21,434.33 | 6,907.32  | 4,692.75 |

Source: Computed from Field Survey Data, 2015/16