**Tables List**

**PERCEPTIONS OF CLIMATE CHANGE AND DETERMINANTS OF ADAPTATION DECISIONS OF SMALLHOLDER MAIZE (Zea mays L.)**

**Journal name: GeoJournal**

*Table 1: Description of the study districts*



*Source: District Agricultural offices and GIS.*

***Table 2****: Sample size of the respondent HHHs for the study area.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **SN** | **Zone** | **District** | **Kebele** | **No of**  **HHHs** | **No of respondents**  **using the PPS method** | **Percent** |
| 1 | North  western | Tselemti | Seqotta Silasse | 191 | 17 | 6.8 |
| Serako | 135 | 12 | 4.8 |
| Medhane Alem | 168 | 15 | 6.0 |
| Tsa’eda Qerni | 168 | 15 | 6.0 |
| Medebay  Zana | Mes’hil | 146 | 13 | 5.2 |
| Debre Kerbe | 124 | 11 | 4.4 |
| Nefasit | 124 | 11 | 4.8 |
| Bahra | 135 | 12 | 4.4 |
| 2 | Central | Na’eder  Adet | May Timket | 168 | 15 | 6.0 |
| Addi Selam | 135 | 12 | 4.8 |
| Siekha | 157 | 14 | 4.8 |
| Dag’na | 135 | 12 | 5.6 |
| Qolla  Tembien | Merere | 135 | 12 | 4.8 |
| Worqamba | 146 | 13 | 5.2 |
| Begashekha | 157 | 14 | 5.6 |
| Adha | 124 | 11 | 4.4 |
| 3 | Eastern | Kilte  Awla’elo | Abraha Atsbeha | 146 | 13 | 5.2 |
| Mesanu | 101 | 9 | 3.6 |
| Tahtay Addi Kisandid | 112 | 10 | 4.0 |
| La’elay Addi Kisandid | 101 | 9 | 3.6 |
| **Total** | **3** | **5** | **20** | **2807** | **250** | **100** |

***Source****: Agricultural offices of each district (2020). Key: PPS= Probability Proportional to Size  Sampling; HHHs = Household heads*

*Table 3: Description of the dependent and independent variables used in the econometric MNL model*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable**  **Name** | **Description** | **Measurement** | **Type** | **Effect** |
| **Dependent:** | | | | |
| CLI | Crop-livestock integration | 1 if HH adopted CLD, 0 otherwise | Dummy |  |
| VAR | Use of improved crop variety | 1 if HH uses VAR, 0 otherwise | Dummy |  |
| CCTPHD | Changing CTPHD | 1 if HH shifts to CCTPHD, 0 otherwise | Dummy |  |
| IRR | Irrigation | 1 if HH uses IRR, 0 otherwise | Dummy |  |
| SWC | Soil and water conservation | 1 if HH chooses SWC, 0 otherwise | Dummy |  |
| NFA | Non-farm activities | 1 if HH involved in NFA, 0 otherwise | Dummy |  |
| **Independent:** | | | | |
| *Socioeconomics variables:* | | | | |
| Age | Age of the respondent | years | Continuous | **±**\* |
| Gender | Gender of the respondent HHH | (1= male, 0 = female) | Dummy | **±**\* |
| Education | Educational level of the HHH | years (grade levels) | Continuous | **+** |
| Family | Family (household) size | number | Continuous | **±**\* |
| Income | Annual income | ETB | Continuous | **+** |
| *Household assets:* | | | | |
| Farm | Farm size | ha | Continuous | **+** |
| TLU | Livestock ownership | number | Continuous | **+** |
| *Institutional/policy variables:* | | | | |
| Extension | Access to extension contact | (1= yes, 0 = no) | Dummy | **+** |
| Credit | Access to credit services | (1= yes, 0 = no) | Dummy | **+** |
| *Climate variable:* | | | | |
| ClimInfo | Access to climate information | (1= yes, 0 = no) | Dummy | **+** |

**\****Cannot be signed a priori (+ or -);* CTPHD: crop type and/or planting and/or harvesting date

*Table 4: Descriptive statistics on the characteristics of the maize HHHs in Tigray, (N= 250).*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Farmers’**  **Characteristics** | **Respondents’**  **Categories** | **Maize farmers** | | **Range** | | **Mean** | **SD** |
| **N** | **%** | **Min.** | **Max.** |
| Gender | Male | 224 | 89.6 | - | - | - | - |
| Female | 26 | 10.4 |
| Age | 35 and below | 42 | 16.8 | 22 | 81 | 48.16 | 11.91 |
| 36-45 | 64 | 25.4 |
| 46-55 | 82 | 32.8 |
| >55 | 62 | 24.8 |
| Formal  Education | Illiterate | 75 | 30 | 0 | 14 | 3.74 | 3.45 |
| 1-4 years schooling | 83 | 33.2 |
| 5-8 years schooling | 66 | 26.4 |
| 9-12 years schooling | 21 | 8.4 |
| above 12 years schooling | 5 | 2.0 |
| Marital status | Single | 6 | 2.4 | - | - | - | - |
| Married | 225 | 90 |
| Divorced | 9 | 3.6 |
| Widowed | 7 | 2.8 |
| Separated | 3 | 1.2 |
| Family  size | Small (below 4) | 47 | 18.8 | 2 | 12 | 6.32 | 1.92 |
| Medium (5-8) | 178 | 71.2 |
| Large (>8) | 25 | 10.0 |
| Main  source of income | Crop production | 33 | 13.2 |  |  |  |  |
| Mixed farming | 200 | 80.0 |
| Casual labor | 6 | 2.4 |
| Petty trade | 3 | 1.2 |
| Salary | 3 | 1.2 |
| TGM | 5 | 2.0 |
| Farmland  size (ha) | no farm land | 3 | 1.2 | 0 | 3 | 1.27 | 0.59 |
| <1ha | 144 | 57.6 |
| 1-2ha | 90 | 36.0 |
| 2-5ha | 13 | 5.2 |
| Oxen  (number) | 0 | 45 | 18.0 | 0 | 5 | 1.56 | 1.07 |
| 1 | 65 | 26.0 |
| 2 | 112 | 44.8 |
| 3 | 13 | 5.2 |
| 4 | 12 | 4.8 |
| 5 | 3 | 1.2 |
| TLU  (number) | No TLU | 8 | 3.2 | 0 | 24.56 | 6.04 | 4.37 |
| 1-10 | 209 | 83.6 |
| 11-20 | 30 | 12.0 |
| > 20 | 3 | 1.2 |

***Source****: Field survey, 2019 (Authors’ construct). TGM: Traditional gold mining; TLU: Tropical livestock unit.SD: Standard deviation; HHHs: Household heads*

***Table 5****. Farmers’ perceptions (%) on the trends of annual and seasonal temperature by districts (N=250).*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| District | Annual temperature | | | Main season temperature | | |
| Increase | Decrease | Same | Increase | Decrease | Same |
| Tselemti | 94.92 | 3.39 | 1.69 | 88.9 | 8 | 3.1 |
| Medebay Zana | 85.11 | 10.64 | 4.26 | 89.2 | 7.4 | 3.4 |
| Na’eder Adet | 92.45 | 5.66 | 1.89 | 91.4 | 6.6 | 2 |
| Qolla Tembien | 90.00 | 8.00 | 2.00 | 86.1 | 4.1 | 9.8 |
| Kilte Awla’elo | 68.29 | 19.51 | 12.20 | 68.8 | 12.8 | 18.4 |
| χ2 | 11.87 ns | | | 11.04 ns | | |

*Table 6. Major climate change adaptation strategies practiced by maize farmers in Tigray (N=250).*

|  |  |  |  |
| --- | --- | --- | --- |
| **Adaptation**  **practice** | **Freq.** | **%** | **Actual adaptation activities** |
| Crop-livestock integration | 60 | 24 | Inter and intra diversifying of crops and livestock, e.g., intercropping, crop rotation, alley cropping, strip cropping; rearing of cattle, shoats, equines, and poultry. |
| Use of improved varieties | 52 | 20.8 | Use of improved crop varieties (early maturing, high yielding, and drought-tolerant, in such an order), |
| Changing crop type/planting date | 42 | 16.8 | Use of other crops (e.g. planting sorghum instead of maize or vice versa) and/or adjusting the planting date based on the goodness of the rain. |
| Irrigation | 39 | 15.6 | Dry season gardening |
| SWC practices | 23 | 9.2 | Terracing, manuring. tillage (e.g., ‘*gusya'*, ‘*Terwah*’ and contour plowing), tie-ridging, hoeing. etc. as water harvesting techniques |
| Involvement off-farm activities | 16 | 6.4 | Local brewing (*Siwa*, *mies*), TGM, pottery, wage labor, church service, cultural hair dressing, guarding, petty trade, house construction, traditional singer, charcoal making, etc. |
|  |  |  |  |

***Key***: *TGM = Traditional gold mining; SWC= Soil and water conservation; ‘Siwa and mies (local alcoholic drinks); ‘terwah’ = local trenching on cropped land.*

*Table* ***7****: Major barriers to climate change adaptation actions by the maize farmers in Tigray (N=250).*

|  |  |  |
| --- | --- | --- |
| **Constraints** | **Yes (%) \*** | **No (%) \*** |
| Unpredictability of weather | 83.2 | 16.8 |
| Lack/limited farm land | 78 | 22 |
| Lack of capital | 84 | 16 |
| Access to seasonal weather information | 20.8 | 79.2 |
| Lack/inadequate farm labor | 68.2 | 31.8 |
| Access to water for irrigation | 13.4 | 86.6 |
| Poor soil fertility | 80.4 | 19.6 |
| High cost of farm inputs | 88.4 | 11.6 |

*\*The percentage total in a column is more than 100% because each respondent faced more than one barrier of climate change.*

***Table 8.*** *Parameter estimates of the MNL model for adaptation strategies practiced by households with livelihood factors as explanatory variables.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Indep.  Variable | **CLI** | | **VAR** | | **Changing CTPHD** | | **IRRIGATION** | | **SWC** | | **OFFARM** | |
| Coeff. | ME (dy/dx) | Coeff. | ME (dy/dx) | Coeff. | ME (dy/dx) | Coeff. | ME (dy/dx) | Coeff. | ME (dy/dx) | Coeff. | ME (dy/dx) |
| Sex | 0.893 | -0.108 | 1.501 | 0.052 | 2.206\*\* | 0.081 | 1.378 | 0.011 | 2.612\*\* | 0.072 | 2.197 | 0.024 |
| Age | 0.063\* | 0.010 | 0.014 | -0.002 | -0.077\*\* | -0.012 | 0.079\*\* | 0.010 | 0.014 | -0.001 | -0.069 | -0.003 |
| Education | -0.079 | -0.047 | 0.252\*\* | 0.037 | 0.176 | 0.006 | 0.204\* | 0.013 | 0.096 | -0.003 | 0.176 | 0.0027 |
| Family size | 0.299\* | 0.010 | -0.337\*\* | -0.001 | -0.419\*\* | 0.010 | 0.312 | 0.005 | -0.555\*\*\* | 0.019 | 0.528\*\* | 0.007 |
| Farm Size | 2.033\*\*\* | 0.172 | 1.206\* | 0.019 | 1.368\* | 0.012 | 1.269\* | 0.001 | 0.752 | -0.046 | 0.004 | -0.047 |
| Extension | -0.430 | 0.043 | -0.789 | -0.048 | -0.307 | 0.037 | -1.124 | -0.096 | 0.599 | 0.003 | 0.493 | 0.032 |
| TLU | 0.198\*\* | 0.005 | -0.118 | 0.015 | -0.254\*\*\* | -0.011 | -0.156\*\* | 0.002 | 0.279\*\*\* | 0.010 | -0.197\* | 0.001 |
| Income | 1.082\*\* | 0.084 | 0.619 | -0.028 | 0.324 | -0.049 | 1.080\*\* | 0.062 | 0.249 | -0.041 | 1.022\* | 0.012 |
| Climate Info. | 0.223 | 0.199 | -1.145 | 0.053 | 2.254\* | 0.168 | -1.221 | 0.020 | -1.409 | -0.006 | 3.074\*\* | 0.144 |
| Credit Acc. | 0.095 | -0.139 | 1.425\* | 0.165 | 2.092\*\* | 0.117 | 2.623\*\*\* | 0.198 | -1.114 | -0.265 | -0.131 | -0.035 |
| Constant | -12.588\*\* |  | -5.694 |  | 1.699 |  | -14.365\*\* |  | 2.612 |  | -3.029 |  |
| **Alternative variables:** Adaptationmethods (6)  **Base category:** No adaptation  **MNL model (Multinomial logistic regression) test:** No. of obs. = 250  LR chi2(60) = 210.65\*\*\*  Prob. > chi2 = 0.0000  Pseudo R2 = 0.2285  Log likelihood = -355.54878 | | | | | | | | | | | | |

\*\*\*, \*\* and \* indicate statistically significant at 1%, 5%, and 10%, respectively; ***ME***: marginal effect; ***Coeff***: regression coefficient; ***LR***: Likelihood ratio; **CLI:** crop-livestock integration (mixed farming); **VAR:** Use of improved crop variety; **CTPHD:** Crop type &/or planting/harvesting date; ***SWC***: soil and water conservation practices; **OFFARM**: involvement in off-farm activities.