**Appendices**

Appendix A. Reservoir and Ponds Information in the SWAT model

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sub-basin** | **principle surface area (ha)****PND\_PSA** | **principle volume (10^4 m3)****PND\_PVOL** | **emergency spillway surface area (ha)****PND\_ESA** | **emergency spillway volume (10^4 m3)****PND\_EVOL** | **drainage area (ha)** | **sub-basin area (ha)** | **drainage area/ sub-basin area****PND\_FR** |
| 1 | 1.52 | 3.05 | 2.29 | 4.57 | 45.7 | 1214.17 | 0.04 |
| 2 | 2.65 | 5.31 | 3.98 | 7.96 | 79.6 | 694.81 | 0.11 |
| 3 | 1.09 | 2.18 | 1.64 | 3.27 | 32.7 | 2112.78 | 0.02 |
| 4 | - | - | - | - | - | - | - |
| 5 | 4.84 | 9.69 | 7.27 | 14.53 | 145.3 | 570.03 | 0.25 |
| 6 | 20 | 40.30 | 30 | 62.45 | 724.5 | 784.94 | 0.92 |
| 7 | 2.06 | 4.11 | 3.08 | 6.17 | 61.7 | 625.04 | 0.10 |
| 8 | 1.93 | 3.86 | 2.90 | 5.79 | 57.9 | 817.80 | 0.07 |
| 9 | 6.29 | 12.59 | 9.44 | 18.88 | 37.74 | 37.74 | 1.00 |
| 10 | 0.84 | 1.67 | 1.26 | 2.51 | 25.1 | 697.89 | 0.04 |
| 11 | 12.62 | 25.24 | 18.93 | 37.86 | 57.45 | 57.45 | 1.00 |
| 12 | 0.04 | 0.07 | 0.06 | 0.11 | 1.1 | 23.70 | 0.05 |
| 13 | 20 | 41.71 | 30 | 62.56 | 925.6 | 2822.14 | 0.33 |
| 14 | 7.54 | 15.09 | 11.31 | 22.63 | 226.3 | 571.50 | 0.40 |
| 15 | 7.94 | 15.89 | 11.92 | 23.83 | 238.3 | 882.17 | 0.27 |
| 16 | 4.37 | 8.73 | 6.55 | 13.10 | 131.0 | 1823.63 | 0.07 |
| 17 | - | - | - | - | - | - | - |
| 18 | 5.37 | 10.73 | 8.05 | 16.10 | 161.0 | 1185.20 | 0.14 |
| 19 | 20 | 40.48 | 30 | 62.73 | 727.3 | 1139.11 | 0.64 |
| 20 | 20 | 40.68 | 30 | 62.02 | 730.2 | 2560.27 | 0.29 |
| 21 |  | - | - | - | - | - | - |
| 22 | 11.80 | 23.60 | 17.70 | 35.40 | 354.0 | 1574.00 | 0.22 |
| 23 | 5.96 | 11.92 | 8.94 | 17.88 | 178.8 | 1596.47 | 0.11 |
| 24 | 1.42 | 2.84 | 2.13 | 4.25 | 42.5 | 773.11 | 0.06 |
| 25 | 8.95 | 17.89 | 13.42 | 26.84 | 268.4 | 1665.47 | 0.16 |
| 26 | 3.77 | 7.53 | 5.65 | 11.30 | 113.0 | 1415.00 | 0.08 |
| 27 | 1.85 | 3.69 | 2.77 | 5.54 | 55.4 | 560.79 | 0.10 |
| 28 | 0.04 | 0.07 | 0.05 | 0.11 | 1.1 | 53.39 | 0.02 |
| 29 | 3.18 | 6.36 | 4.77 | 9.54 | 95.4 | 952.56 | 0.10 |
| 30 | 3.26 | 6.51 | 4.89 | 9.77 | 97.7 | 888.28 | 0.11 |
| 31 | 0.26 | 0.52 | 0.39 | 0.79 | 7.9 | 218.01 | 0.04 |
| 32 | 0.15 | 0.30 | 0.23 | 0.45 | 4.5 | 64.24 | 0.07 |
| 33 | 7.42 | 14.85 | 11.14 | 22.27 | 222.7 | 753.34 | 0.30 |
| 34 | 6.19 | 12.39 | 9.29 | 18.58 | 185.8 | 1328.45 | 0.14 |
| 35 | - | - | - | - | - | - | - |
| 36 | 2.48 | 4.96 | 3.72 | 7.44 | 74.4 | 919.52 | 0.08 |
| 37 | - | - | - | - | - | - | - |
| 38 | - | - | - | - | - | - | - |
| 39 | 1.51 | 3.02 | 2.27 | 4.53 | 45.3 | 904.65 | 0.05 |
| 40 | 0.07 | 0.14 | 0.11 | 0.21 | 2.1 | 217.57 | 0.01 |
| 41 | 1.83 | 3.66 | 2.74 | 5.49 | 54.9 | 655.48 | 0.08 |
| 42 | 0.09 | 0.18 | 0.13 | 0.27 | 2.7 | 198.45 | 0.01 |
| 43 | 2.42 | 4.83 | 3.62 | 7.25 | 72.5 | 748.99 | 0.10 |

Appendix B. Soil characteristics for each soil ID (SSURGO database)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **MUID** | **SEQN** | **SNAM** | **S5ID** | **Texture** |
| 381869 | 508001 | Acme | OK015 | SICL-BR |
| 381870 | 508004 | Grant | OK015 | L-L-SIL-L-BR |
| 381871 | 508011 | Binger | OK015 | FSL-SCL-BR |
| 381872 | 508018 | Binger | OK015 | FSL-SCL-BR |
| 381873 | 508023 | Binger | OK015 | FSL-SCL-BR |
| 381874 | 508024 | Binger | OK015 | FSL-SCL-BR |
| 381875 | 508025 | Binger | OK015 | FSL-SCL-BR |
| 381876 | 508027 | Cyril | OK015 | FSL-L |
| 381879 | 508036 | Darnell | OK015 | FSL-FSL-BR |
| 381881 | 508040 | Dougherty | OK015 | LFS-LFS-SCL-FSL-LFS |
| 381882 | 508045 | Dougherty | OK015 | LFS-LFS-SCL-FSL-LFS |
| 381883 | 508052 | Eufaula | OK015 | FS-FS-FS |
| 381884 | 508058 | Eufaula | OK015 | LFS-FS-FS |
| 381887 | 508073 | Gracemont | OK015 | FSL-FSL-L |
| 381888 | 508077 | Grant | OK015 | L-L-SIL-L-BR |
| 381889 | 508078 | Grant | OK015 | L-L-SIL-L-BR |
| 381890 | 508079 | Grant | OK015 | L-L-SIL-L-BR |
| 381891 | 508080 | Grant | OK015 | L-L-SIL-L-BR |
| 381894 | 508088 | Konawa | OK015 | LFS-SCL-LFS |
| 381895 | 508093 | Konawa | OK015 | LFS-SCL-LFS |
| 381897 | 508095 | Ironmound | OK015 | FSL-L-BR |
| 381898 | 508097 | Ironmound | OK015 | FSL-L-BR |
| 381901 | 508107 | Minco | OK015 | VFSL-SIL-SIL |
| 381902 | 508110 | Minco | OK015 | VFSL-SIL-SIL |
| 381903 | 508111 | Minco | OK015 | SIL-SIL-SIL |
| 381904 | 508112 | Noble | OK015 | FSL-FSL |
| 381905 | 508118 | Noble | OK015 | FSL-FSL |
| 381908 | 508130 | Pond Creek | OK015 | FSL-SICL-L |
| 381909 | 508136 | Pond Creek | OK015 | FSL-SICL-L |
| 381910 | 508142 | Pond Creek | OK015 | SIL-SICL-L |
| 381911 | 508148 | Pond Creek | OK015 | SIL-SICL-L |
| 381912 | 508154 | Pond Creek | OK015 | SIL-SICL-L |
| 381913 | 508155 | Port | OK015 | SIL-SIL-L |
| 381914 | 508162 | Port | OK015 | SIL-SIL-L |
| 381915 | 508168 | Pulaski | OK015 | FSL-FSL-SR LFS L |
| 381916 | 508174 | Ironmound | OK015 | L-L-BR |
| 381918 | 508181 | Minco | OK015 | SIL-SIL-SIL |
| 381920 | 508192 | Darnell | OK015 | FSL-FSL-BR |
| 381921 | 508194 | Lovedale | OK015 | FSL-SCL-SL-S |
| 381922 | 508200 | Lovedale | OK015 | FSL-SCL-SL-S |
| 381928 | 508213 | Water | OK015 | water |
| 381929 | 508214 | Woodward | OK015 | SIL-SIL-BR |
| 382310 | 507114 | Carey | OK039 | SIL-SICL-L-BR |
| 382316 | 507133 | Cornick | OK039 | SIL-BR-BR |
| 382325 | 507160 | Grant | OK039 | L-L-L-L-BR |
| 382326 | 507161 | Hardeman | OK039 | FSL-FSL |
| 382327 | 507162 | Lucien | OK039 | VFSL-VFSL-BR |
| 382328 | 507164 | Minco | OK039 | VFSL-VFSL-VFSL |
| 382332 | 507173 | Pond Creek | OK039 | FSL-SIL-SICL-SIL |
| 382333 | 507179 | Pond Creek | OK039 | SIL-SIL-SICL-SIL |
| 382334 | 507185 | Pond Creek | OK039 | SIL-SIL-SICL-SIL |
| 382339 | 1170380 | Quinlan | OK039 | SIL-SIL-BR |
| 382341 | 507217 | Lovedale | OK039 | FSL-FSL-SCL-FSL |
| 382342 | 507218 | St. Paul | OK039 | SIL-SICL-SICL-SICL-SIL |
| 382343 | 507224 | St. Paul | OK039 | SIL-SICL-SICL-SICL-SIL |
| 382344 | 507225 | St. Paul | OK039 | SIL-SICL-SICL-SICL-SIL |
| 382345 | 507227 | Water | OK039 | water |
| 382348 | 507230 | Woodward | OK039 | SIL-SIL-BR |
| 382349 | 507231 | Woodward | OK039 | SIL-SIL-BR |
| 382350 | 507238 | Woodward | OK039 | SIL-SIL-BR |
| 382351 | 507241 | Quinlan | OK039 | SIL-SIL-BR |
| 384993 | 508521 | Clairemont | OK149 | SIL-SIL |
| 384994 | 508527 | Cordell | OK149 | SICL-SICL-GRV-SICL-BR |
| 384995 | 508528 | Cordell | OK149 | SICL-SICL-GRV-SICL-BR |
| 384996 | 508530 | Cornick | OK149 | SIL-BR-BR |
| 384997 | 508532 | Devol | OK149 | LFS-FSL-LFS |
| 384998 | 508538 | Devol | OK149 | LFS-FSL-LFS |
| 385003 | 508496 | Altus | OK149 | FSL-FSL-SCL-SCL |
| 385004 | 508565 | Dill | OK149 | FSL-FSL-BR |
| 385005 | 508567 | Dill | OK149 | FSL-FSL-BR |
| 385007 | 508575 | Dougherty | OK149 | LFS-LFS-SCL-FSL-LFS |
| 385011 | 508590 | Hardeman | OK149 | FSL-FSL |
| 385012 | 508596 | Hardeman | OK149 | FSL-FSL |
| 385013 | 508597 | Hardeman | OK149 | FSL-FSL |
| 385018 | 508601 | Pond Creek | OK149 | FSL-SICL-SIL |
| 385019 | 508607 | Pond Creek | OK149 | FSL-SICL-SIL |
| 385020 | 508613 | Port | OK149 | SIL-SICL-SIL |
| 385021 | 508619 | Eda | OK149 | LFS-LFS-LFS |
| 385023 | 508622 | Quinlan | OK149 | L-L-BR |
| 385024 | 508624 | Quinlan | OK149 | L-L-BR |
| 385026 | 508626 | Quinlan | OK149 | L-L-BR |
| 385027 | 508628 | Quinlan | OK149 | FSL-L-BR |
| 385028 | 508630 | Reinach | OK149 | SIL-SIL |
| 385030 | 508637 | Lovedale | OK149 | FSL-SCL-FSL-FSL |
| 385031 | 508643 | Lovedale | OK149 | FSL-SCL-FSL-FSL |
| 385032 | 508644 | St. Paul | OK149 | SIL-SICL-SICL-SICL-SIL |
| 385033 | 508650 | St. Paul | OK149 | SIL-SICL-SICL-SIL |
| 385034 | 508656 | St. Paul | OK149 | SIL-SICL-SICL-SIL |
| 385036 | 508511 | Binger | OK149 | FSL-SCL-BR |
| 385037 | 508660 | Woodward | OK149 | SIL-SIL-BR |
| 385038 | 508661 | Woodward | OK149 | SIL-SIL-BR |
| 385039 | 508662 | Woodward | OK149 | SIL-SIL-BR |
| 385040 | 508663 | Woodward | OK149 | SIL-SIL-BR |
| 385041 | 508673 | Woodward | OK149 | L-SIL-BR |
| 385042 | 508675 | Woodward | OK149 | L-SIL-BR |
| 385044 | 508512 | Binger | OK149 | FSL-SCL-BR |
| 385045 | 508513 | Carey | OK149 | SIL-CL-L-BR |
| 385046 | 508514 | Carey | OK149 | SIL-CL-L-BR |
| 385047 | 508515 | Clairemont | OK149 | SIL-SIL |
| 385048 | 508682 | Water | OK149 | water |

Appendix C.1. Conventional (reduced) tillage for dryland crops and pasture

|  |  |  |
| --- | --- | --- |
| **Crop** | **Date** | **Operation** |
| **Cotton** | 1.1 | Tillage operation (Disk Plow Ge23ft) |
| 3.15 | Tillage operation ( Disk Plow Ge23ft) |
| 5.15 | Tillage operation (Springtooth Harrow Ge15ft) |
| 6.1 | Tillage operation (Finishing Harrow Lt15ft)Pesticide Operation (Pendimehalin, 0.25 kg) |
| 6.10 | Fertilizer application (Elemental Nitrogen, 50 kg) |
| 6.11 | Plant |
| 7.1 | Tillage operation (Row Cultivator Ge15ft) |
| 11.15 | Harvest and kill |
| **Pasture** | 1.1 | Plant |
| 3.1 | Auto fertilization |
| 5.1 | Grazing operation (Beef-Fresh Manure, GRZ\_DAYS\*: 180, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Winter wheat** | 3.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 6.1 | Harvest and kill |
| 7.1 | Tillage operation (Chisel Plow Gt15ft) |
| 8.1 | Tillage operation (Offset Dis/heavduty Ge19ft) |
| 9.20 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 9.22 | Tillage operation (Disk Plow Ge23ft) |
| 9.24 | Tillage operation (Springtooth Harrow Lt15ft) |
| 9.25 | Plant |
| 12.1 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Grain sorghum** | 5.1 | Plant |
| 5.27 | Fertilizer application (Elemental Nitrogen, 150 kg) |
| 5.28 | Tillage operation (Springtooth Harrow Ge15ft, Disk Plow Ge23ft, Mecoprop Amine, 125), Pesticide Operation (Mecoprop Amine, 125 kg) |
| 10.18 | Tillage operation (Disk Plow Ge23ft) |
| 10.20 | Tillage operation (Springtooth Harrow Ge15ft) |
| 10.30 | Harvest and kill |
| **Alfalfa** | 4.1 | Harvest only |
| 5.15 | Harvest only |
| 7.1 | Harvest only |
| 8.29 | Fertilizer application (Elemental Nitrogen, 50 kg), (Elemental Phosphorous, 20) |
| 9.7 | Plant |
| 10.15 | Harvest only |
| **Hay** | 4.1 | Harvest only |
| 7.1 | Harvest only |
| 8.29 | Auto fertilization |
| 9.7 | Plant |
| 10.15 | Harvest only |
| **Rye** | 6.10 | Harvest only |
| 8.10 | Fertilizer application (Elemental Nitrogen, 80 kg), (Elemental Phosphorous, 35) |
| 9.20 | Plant |
| 9.15 | Grazing operation (GRZ\_DAYS\*: 150, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |

\*AUTO\_NSTRS: Nitrogen stress factor of cover/plant triggers fertilization. This factor ranges from 0.0 to 1.0 where 0.0 indicates there is no growth of the plant due to nitrogen stress and 1.0 indicates there4 is no reduction of plant growth due to nitrogen stress.

\*GRZ\_DAYS: Number of consecutive days grazing takes place in the HRU

\*BIO\_EAT: dry weight of biomass consumed daily ((kg/ha)/day)

\* BIO\_TRMP: dry weight of biomass trampled daily ((kg/ha)/day)

\*MANURE\_KG: dry weight of manure deposited daily ((kg/ha)/day)

Appendix C.2. Conventional (reduced) tillage for irrigated crops and pasture

|  |  |  |
| --- | --- | --- |
| **Crop** | **Date** | **Operation** |
| **Cotton**  | 1.1 | Tillage operation (Disk Plow Ge23ft) |
| 3.15 | Tillage operation ( Disk Plow Ge23ft) |
| 5.15 | Tillage operation (Springtooth Harrow Ge15ft) |
| 6.1 | Tillage operation (Finishing Harrow Lt15ft)Pesticide Operation (Pendimehalin, 0.25 kg)Irrigation operation (IRR\_AMT\*, 33 mm) |
| 6.10 | Fertilizer application (Elemental Nitrogen, 50 kg) |
| 6.11 | Plant |
| 7.1 | Tillage operation (Row Cultivator Ge15ft)Irrigation operation (IRR\_AMT, 33 mm) |
| 7.8 till 9.15 (One irrigation per week) | Irrigation operation (IRR\_AMT, 33 mm) |
| 11.15 | Harvest and kill |
| **Pasture (Bermuda)** | 1.1 | Plant |
| 3.1 | Auto fertilization |
| 4.1 | Auto irrigation  |
| 5.1 | Grazing operation (Beef-Fresh Manure, GRZ\_DAYS\*: 180, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Winter wheat** | 3.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 4.3 | Auto irrigation |
| 6.1 | Harvest and kill |
| 7.1 | Tillage operation (Offset Dis/heavduty Ge19ft) |
| 8.1 | Tillage operation (Chisel Plow Gt15ft) |
| 9.20 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg)Auto irrigation |
| 9.22 | Tillage operation (Disk Plow Ge23ft) |
| 9.24 | Tillage operation (Springtooth Harrow Lt15ft) |
| 9.25 | Plant |
| 11.3 | Auto irrigation |
| 12.1 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Grain sorghum** | 5.1 | Plant |
| 5.27 | Fertilizer application (Elemental Nitrogen, 150 kg) |
| 5.28 | Tillage operation (Springtooth Harrow Ge15ft, Disk Plow Ge23ft, Mecoprop Amine, 125) |
| 6.1 | Auto irrigation initial |
| 10.18 | Tillage operation (Disk Plow Ge23ft) |
| 10.20 | Tillage operation (Springtooth Harrow Ge15ft) |
| 10.30 | Harvest and kill |

\*IRR\_AMT: Depth of irrigation water applied on HRU (mm)

Appendix C.3. No-till irrigated cotton with winter wheat as cover crop

|  |  |  |
| --- | --- | --- |
| **Crop** | **Date** | **Operation** |
|  | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 30 kg) |
|  | 04.03 | Auto Irrigation |
| **Winter wheat** | 06.1 | kill |
|  | 06.2 | Pesticide Operation (Pendimehalin, 0.25 kg) |
|  | 06.03 | Irrigation operation (IRR\_AMT, 33 mm) |
|  | 06.10 | Fertilizer application (Elemental Nitrogen, 150 kg) |
| **Cotton** | 06.11 | Plant |
|  | 07.1 till 09.15 one irrigation in per week | Irrigation operation (IRR\_AMT, 33 mm) |
| **Cotton** | 11.1 | Harvest and kill |
|  | 11.2 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
|  | 11.2 | Auto Irrigation |
| **Winter wheat** | 11.3 | Plant |
|  | 12.01 | Auto Irrigation |
| **Winter wheat** | 12.20 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |

Appendix C.4. Rotation of winter wheat with canola in dryland with no-till system

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Year** | **Date** | **Operation** |
| **Winter wheat** | Year 1 | 01.01 | Plant wheat |
| 06.01 | Harvest and kill |
| 09.20 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 09.25 | Plant wheat |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Winter canola** | Year 2 | 03.01 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 06.01 | Harvest and kill |
| 09.20 | Fertilizer application (Elemental Nitrogen, 38 kg)(Elemental Phosphorus, 15 kg) |
| 09.25 | Plant winter canola |
| **Winter wheat** | Year 3 | 04.01 | Fertilizer application (Elemental Nitrogen, 76 kg)(Elemental Phosphorus, 30 kg) |
| 06.10 | Harvest and kill |
| 09.01 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 09.25 | Plant wheat |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Winter canola** | Year 3 | 03.01 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 06.01 | Harvest and kill |
| 09.20 | Fertilizer application (Elemental Nitrogen, 38 kg)(Elemental Phosphorus, 15 kg) |
| 09.25 | Plant winter canola |

Appendix C.5. Rotation of winter wheat with irrigated canola with no-till system

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Year** | **Date** | **Operation** |
| **Winter wheat** | Year 1 | 01.01 | Plant wheat |
| 04.01 | Auto irrigation |
| 06.01 | Harvest and kill |
| 08.25 | Auto irrigation |
| 09.20 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 09.25 | Plant wheat |
| 11.11 | Auto irrigation |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Winter canola** | Year 2 | 03.01 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 04.03 | Auto irrigation |
| 06.01 | Harvest and kill |
| 09.20 | Fertilizer application (Elemental Nitrogen, 38 kg)(Elemental Phosphorus, 15 kg) |
| 09.25 | Plant winter canola |
| **Winter wheat** | Year 3 | 04.01 | Fertilizer application (Elemental Nitrogen, 76 kg)(Elemental Phosphorus, 30 kg) |
| 06.10 | Harvest and kill |
| 08.25 | Auto irrigation |
| 09.01 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 09.25 | Plant wheat |
| 11.03 | Auto irrigation |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Winter canola** | Year 3 | 03.01 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 04.03 | Auto irrigation |
| 06.01 | Harvest and kill |
| 09.20 | Fertilizer application (Elemental Nitrogen, 38 kg)(Elemental Phosphorus, 15 kg) |
| 09.25 | Plant winter canola |

Appendix C.6. Cover cropping of winter wheat with grain sorghum in dryland with no-till system

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Year** | **Date** | **Operation** |
| **Winter wheat** | Year 1  | 01.01 | Plant wheat |
| 06.01 | Harvest and kill |
| 10.01 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 10.01 | Plant wheat |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
|  | Year 2  | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 06.01 | Harvest and kill |
| **Grain Sorghum, Winter wheat** | Year 3  | 05.01 | Fertilizer application (Elemental Nitrogen, 150 kg) |
| 05.01 | Plant grain sorghum |
| 09.30 | Harvest and kill |
| 10.01 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg)Plant wheat |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
|  | Year 4  | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 06.01 | Harvest and kill |

AppendixC.7. Cover cropping of winter wheat with irrigated grain sorghum with no-till system

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Year** | **Date** | **Operation** |
| **Winter wheat** | Year 1  | 01.01 | Plant wheat |
| 06.01 | Harvest and kill |
| 10.01 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 10.01 | Plant wheat |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
|  | Year 2 | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 04.01 | Auto irrigation |
| 06.01 | Harvest and kill |
| **Grain Sorghum, Winter wheat** | Year 3 | 05.01 | Fertilizer application (Elemental Nitrogen, 150 kg) |
| 05.01 | Plant grain sorghum |
| 06.01 | Auto irrigation |
| 09.30 | Harvest and kill |
| 10.01 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg)Plant wheat |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
|  | Year 4 | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 04.01 | Auto irrigation |
| 06.01 | Harvest and kill |

Appendix C.8. Cover cropping of winter wheat with cotton in dryland with no-till system

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Year** | **Date** | **Operation** |
| **Winter wheat** | 1 | 09.20 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg) |
| 09.25 | Plant |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Cotton** | 2 | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 06.01 | Harvest and kill wheat |
| 06.02 | Pesticide Operation (Pendimehalin, 0.25 kg) |
| 06.10 | Fertilizer application (Elemental Nitrogen, 50 kg) |
| 06.11 | Plant |
| 11.04 | Harvest and kill cotton |

Appendix C.9. Cover cropping of winter wheat with irrigated cotton with no-till system

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Year** | **Date** | **Operation** |
| **Winter wheat** | 1 | 09.20 | Fertilizer application (Elemental Nitrogen, 80 kg)(Elemental Phosphorus, 35 kg)Auto Irrigation |
| 09.25 | Plant |
| 11.03 | Auto Irrigation |
| 12.01 | Grazing operation (GRZ\_DAYS\*: 90, BIO\_EAT\*: 3, BIO\_TRMP\*: 0.47, MANURE\_KG\*: 1.5) |
| **Cotton** | 2 | 03.15 | Fertilizer application (Elemental Nitrogen, 80 kg) |
| 04.3 | Auto Irrigation |
| 06.01 | Harvest and kill wheat |
| 06.02 | Pesticide Operation (Pendimehalin, 0.25 kg)Irrigation operation (IRR\_AMT, 33 mm) |
| 06.10 | Fertilizer application (Elemental Nitrogen, 50 kg) |
| 06.11 | Plant |
| 07.1 till 09.15 one irrigation in per week | Irrigation operation (IRR\_AMT, 33 mm) |
| 11.04 | Harvest and kill cotton |

Appendix D. Global sensitivity analysis results of SWAT-CUP for streamflow

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Description** | **t-stat** | **p-value** |
| 6:R\_\_CN2.mgt | SCS Curve number adjustment for soil moisture condition II | 72.99 | 0.00 |
| 8:V\_\_ESCO.hru | Soil evaporation compensation factor | -55.38 | 0.00 |
| 5:V\_\_GW\_DELAY.gw | Groundwater delay [Days] | 51.67 | 0.00 |
| 4:V\_\_RCHRG\_DP.gw | Deep aquifer percolation fraction | 17.20 | 0.00 |
| 16:V\_\_CH\_N2.rte | Manning’s n value for the main channel | -12.20 | 0.00 |
| 15:R\_\_SOL\_AWC(..).sol | Available water capacity of soil layer (mm H2O/mm soil) | 9.43 | 0.00 |
| 14:V\_\_ALPHA\_BNK.rte | base flow alpha factor for bank | 3.32 | 0.00 |
| 10:V\_\_CH\_K1.sub | Effective hydraulic conductivity in tributary channel alluvium ((mmhr-1)) | -2.88 | 0.00 |
| 13:V\_\_TRNSRCH.bsn | Fraction of transmission losses partitioned to deep aquifer | 2.51 | 0.01 |
| 7:V\_\_ALPHA\_BF.gw | Baseflow Alpha Factor [Days] | 2.09 | 0.04 |
| 3:V\_\_REVAPMN.gw | Threshold depth of water in the shallow aquifer for "revap" to occur [mm] | -1.06 | 0.29 |
| 12:V\_\_EVRCH.bsn | reach evaporation adjustment factor | -0.96 | 0.34 |
| 17:V\_\_CH\_K2.rte | Main channel conductivity | -0.83 | 0.41 |
| 9:V\_\_EPCO.bsn | Plant uptake compensation factor | 0.75 | 0.46 |
| 11:V\_\_SURLAG.bsn | Surface runoff lag coefficient | -0.63 | 0.53 |
| 1:V\_\_GWQMN.gw | Threshold depth of water in the shallow aquifer required for return flow to occur (mm) | 0.60 | 0.55 |
| 2:V\_\_GW\_REVAP.gw | Groundwater "revap" coefficient | 0.14 | 0.89 |

Appendix E.1. Cotton yield calibration parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Parameter definition** | **Default value** | **Calibrated value** |
| BIO\_E [(kg/ha)/(MJ/m2)] | Radiation use efficiency or biomass energy ratio | 15 | 14 |
| USLE\_C | Minimum value of USLE C factor for water erosion | 0.2 | 0.1 |
| HVSTI [(kg/ha)/( kg/ha)] | Harvest index for optimal growing season  | 0.4 | 0.3 |
| OV\_N | Manning’s “n” value for overland flow | 0.14 | 0.12 |
| BLAI (m2/m2) | Maximum potential leaf area index | 4 | 3 |
| FRGRW1(fraction) | Fraction of plant growing season to the first point on the optimal leaf area development curve | 0.15 | 0.14 |
| FRGRW2 (fraction) | Fraction of plant growing season to the second point on the optimal leaf area development curve | 0.5 | 0.3 |
| LAIMX1 (fraction) | Fraction maximum leaf area index to the first point on the optimal leaf area development curve | 0.01 | 0.005 |
| CNYLD (kg N/kg seed) | Normal fraction of nitrogen in yield | 0.015 | 0.018 |
| CPYLD (kg P/kg seed) | Normal fraction of Phosphorus in yield | 0.0025 | 0.0027 |

 Appendix E.2. Wheat, pasture, and grain sorghum yield calibration parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Winter wheat** | **Pasture** | **Grain sorghum** |
| **Default value** | **Calibrated value** | **Default value** | **Calibrated value** | **Default value** | **Calibrated value** |
| BIO\_E [(kg/ha)/(MJ/m2)] | 30 | 29 | 35 | 28 | 33.5 | 37 |
| USLE\_C | 0.03 | 0.02 | 0.003 | 0.003 | 0.2 | 0.2 |
| HVSTI [(kg/ha)/( kg/ha)] | 0.4 | 0.3 | 0.8 | 0.8 | 0.45 | 0.3 |
| OV\_N | 0.14 | 0.12 | 0.3 | 0.25 | 0.14 | 0.12 |
| BLAI (m2/m2) | 4 | 3 | 4 | 2.5 | 3 | 4.5 |
| FRGRW1(fraction) | 0.05 | 0.03 | 0.05 | 0.03 | 0.15 | 0.15 |
| FRGRW2 (fraction) | 0.45 | 0.35 | 0.49 | 0.35 | 0.5 | 0.5 |
| LAIMX1 (fraction) | 0.05 | 0.03 | 0.05 | 0.03 | 0.05 | 0.05 |
| CNYLD (kg N/kg seed) | 0.025 | 0.02 | 0.0234 | 0.0134 | 0.0199 | 0.02 |
| CPYLD (kg P/kg seed) | 0.0022 | 0.0018 | 0.0033 | 0.0022 | 0.0044 | 0.0032 |

Appendix F. Definition of modeling of crop rotation in SWAT

In rotation calculation, half of each HRU area was considered as one of the rotation crops and it was assumed that each year both crops would be planted in half of the field and the average of the sediment and surface runoff for those two scenarios was used in that year.