**Figure S 1**

Total annual rainfall and mean annual maximum and minimum Temperature (0C) of NSNP (source: Ethiopian Methodological Agency, 2022)

|  |  |
| --- | --- |
| **Table S 1** Satellite imageries used for LUC analysis of the study( source: USGS, 2023) |   |
| Satellite (Sensor type)  | Path/Raw | Resolution | Acquisition Date | Source  |
| Landsat 5 (TM) | 169/056 | 30 \* 30 m | 28/01/1986 | USGS |
| Landsat 7 (ETM+) | 169/056 | 30 \* 30 m | 02/01/2002 | USGS |
| landsat 8 (OLI) | 169/056 | 30 \* 30 m | 20/12/2020 | USGS |

**Table S 2** Descriptions for land use types

|  |  |
| --- | --- |
| **LU Types** | **Description** |
| Cultivated land (CL) | It includes all areas primarily used for production food/commercial/ and rural houses.  |
| Forest land (FL) | Includes areas covered by broad leaved natural forests along river courses with a tree canopy of more than 10% |
| Wood land (WL) | This includes areas covered by dense woodland with trees’ height range from 8 up to 20 m and open woodland (Wooded grassland) which dominated by grasses and herbs  |
| Bush /Shrub (BS) | Areas covered with intricate mixture of small shrub and bushes with the range of 2 up to 7m height.  |
| Grass land (GL)  | Include areas which covered by grasses that are using for wild animals and livestock grazing  |
| Water area (WA) | The landscapes of the park covered by the water (rivers and parts of lakes) |

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| **Table S 3** Sample size of accuracy assessment for the classified image of 1986, 2002 and 2020 |
| **LU Type** | **Year** |
| **1986** | **2002** | **2020** |
| \*FL | 50 | 50 | 50 |
| BS | 86 | 123 | 211 |
| WL | 252 | 241 | 133 |
| GL | 112 | 84 | 78 |
| WA | 128 | 128 | 139 |
| \*CL | 50 | 50 | 50 |
| **Total sample size**  | **678** | **676** | **661** |

\* The calculated sample size of FL and CL was less than 50. Thus, considering the rule of thumb of Congalton & Green, 2008, the Sample size for these land types raised to 50

|  |
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| **Table S 4** Confusion matrix for the classified land us maps (all values in %) |
|  |   |  | **year** |  |  |  |
| **Land Use type** |  | **1986** |  | **2002** | **2020** |  |
|  | **PA** | **UA** | **PA** | **UA** | **PA** | **UA** |
| FL | 89.58 | 86.00 | 95.56 | 86.00 | 95.92 | 94.00 |
| SB | 84.27 | 87.21 | 95.08 | 94.31 | 98.54 | 95.73 |
| WL | 95.14 | 93.25 | 93.88 | 95.44 | 91.55 | 97.74 |
| GL | 88.33 | 94.64 | 87.78 | 94.05 | 92.31 | 92.31 |
| WA | 100.00 | 98.44 | 100.00 | 100.00 | 100.00 | 100.00 |
| CL | 93.75 | 90.00 | 100.00 | 92.00 | 95.83 | 92.00 |
| OA |  | **92.92** |  | **94.97** |  | **96.22** |
| Khat |  | **90.84** |  | **93.52** |  | **95.20** |

PA= Producers’ accuracy; UA= Users’ Accuracy; OA= Overall Accuracy and Khat = Kappa coefficient

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| **Table S 5** Vulnerability indices for LUC  |
| Landuse type | Gain/persistence  | Loss/persistence |  |  Net change/ persistence  |
|   | A | B | C |   | A | B | C |   | A | B | C |
| FL | 0.33 | 0.26 | 0.25 |  | 0.67 | 0.81 | 1.26 |  | -0.34 | -0.55 | -1.01 |
| BS | 1.01 | 1.18 | 2.37 |  | 0.43 | 0.24 | 0.36 |  | 0.58 | 0.94 | 2.01 |
| WL | 0.36 | 0.29 | 0.32 |  | 0.40 | 1.22 | 1.33 |  | -0.04 | -0.93 | -1.01 |
| GL | 0.29 | 0.42 | 0.44 |  | 0.70 | 0.47 | 0.96 |  | -0.41 | -0.05 | -0.53 |
| WA | 0.05 | 0.13 | 0.15 |  | 0.04 | 0.00 | 0.00 |  | 0.02 | 0.13 | 0.15 |
| CL | 1.14 | 0.73 | 1.65 |  | 0.26 | 0.30 | 0.17 |  | 0.88 | 0.43 | 1.48 |

A= from 1986 to 2002, B from 2002 to 2020 and C from 1986 to 2020

**Table S 6 Statistical outputs of intensity analysis of LUC from 1986 to 2020**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |   | Table A  | Interval level of LUC Intensity analysis |   |   |   |
|  | Time Interval  | Interval area change  | Intensity | Uniform Intensity | Uniform Area Change | Hypothesized Error | Commission Error | Omission Error |
|  | 1986-2002 | 26.5030 | 1.6564 | 1.7299 | 27.6779 | 1.1748 | 0.0000 | 4.2447 |
|  | 2002-2020 | 32.3124 | 1.7951 | 1.7299 | 31.1376 | 1.1748 | 3.6359 | 0.0000 |

|  |  |  |
| --- | --- | --- |
|  | **Table B Category level of LUC Intensity analysis( A= Gain and B = Loss)** |  |
|   | **A= Category level(Gain)** |   |   |   |   |   |   |
| Time interval | LU type | Annual Gain(Pixel) | Gain Intensity | Uni, Intensity | Uni. Annual Gain | Hyp. Annual Error | Com. Intensity | Omi. Intensity | Hypo.d Error(%) |
|  | BS | 2884.2500 | 3.2044 | 1.6564 | 988.5400 | 1895.7100 | 65.7263 | 0.0000 | 7.3226 |
|  | CL | 306.3125 | 3.3233 | 1.6564 | 97.2719 | 209.0406 | 68.2442 | 0.0000 | 7.3226 |
| 1986-2002 | FL | 430.7500 | 1.5285 | 1.6564 | 479.8010 | 49.0510 | 0.0000 | 10.2232 | 7.3226 |
|  | GL | 862.0625 | 1.3961 | 1.6564 | 1080.7861 | 218.7236 | 0.0000 | 20.2375 | 7.3226 |
|  | WA | 304.7500 | 0.3244 | 1.6564 | 2007.2805 | 1702.5305 | 0.0000 | 84.8178 | 7.3226 |
|  | WL | 2829.6875 | 1.6005 | 1.6564 | 2964.1331 | 134.4455 | 0.0000 | 4.5357 | 7.3226 |
|  | BS | 4875.5000 | 3.0300 | 1.7951 | 1939.9247 | 2935.5752 | 60.2108 | 0.0000 | 11.8673 |
|  | CL | 286.2222 | 2.3257 | 1.7951 | 189.7571 | 96.4651 | 33.7029 | 0.0000 | 11.8673 |
| 2002-2020 | FL | 223.7222 | 1.1396 | 1.7951 | 413.8588 | 190.1366 | 0.0000 | 45.9424 | 11.8674 |
|  | GL | 956.9445 | 1.6056 | 1.7951 | 1123.8763 | 166.9319 | 0.0000 | 14.8532 | 11.8674 |
|  | WA | 686.0000 | 0.6469 | 1.7951 | 2485.0354 | 1799.0355 | 0.0000 | 72.3948 | 11.8674 |
|  | WL | 1227.2778 | 1.2104 | 1.7951 | 2103.2405 | 875.9626 | 0.0000 | 41.6482 | 11.8674 |
| B= Category level(Loss) |   |   |   |   |   |   |   |
|  | LU types | number of elements | Loss Intensity | Uni. Intensity | Uni. Annual Loss | Hypo. Annual Error | Com. Intensity | Omi. Intensity | Hypo. Error(%) |
|  | BS | 1144.0000 | 1.8402 | 1.6564 | 988.5402 | 155.4598 | 13.5891 | 0.0000 | 6.3600 |
|  | CL | 67.1250 | 1.2454 | 1.6564 | 97.2719 | 30.1469 | 0.0000 | 30.9924 | 6.3600 |
| 1986\_2002 | FL | 895.0000 | 2.5134 | 1.6564 | 479.8009 | 415.1991 | 46.3910 | 0.0000 | 6.3600 |
|  | GL | 2075.2500 | 2.5570 | 1.6564 | 1080.7860 | 994.4640 | 47.9202 | 0.0000 | 6.3600 |
|  | WA | 209.3750 | 0.2266 | 1.6564 | 2007.2805 | 1797.9055 | 0.0000 | 89.5692 | 6.3600 |
|  | BS | 937.2778 | 1.0412 | 1.7951 | 1939.9247 | 1002.6469 | 0.0000 | 51.6848 | 14.0794 |
|  | CL | 114.6667 | 1.2438 | 1.7951 | 189.7571 | 75.0904 | 0.0000 | 39.5719 | 14.0794 |
| 1986\_2002 | FL | 698.8333 | 2.4795 | 1.7951 | 413.8588 | 284.9745 | 40.7786 | 0.0000 | 14.0793 |
|  | GL | 1076.0555 | 1.7427 | 1.7951 | 1123.8765 | 47.8209 | 0.0000 | 4.2550 | 14.0794 |
|  | WA | 13.3889 | 0.0143 | 1.7951 | 2485.0356 | 2471.6467 | 0.0000 | 99.4612 | 14.0794 |
|   | WL | 5415.4443 | 3.0633 | 1.7951 | 2103.2402 | 3312.2041 | 61.1622 | 0.0000 | 14.0793 |

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| **Table C Transition level of LUC Intensity analysis( A= Transition to "n" category B =Transition From 'm' category )** |
|   |   |   | **A= Transit to 'n' category**   |   |   |   |
| Time Interval | Transitions to  | from |  Ann. Transition | Tran. Intensity | Uni. Intensity | Uni. Annual Transition | Hypo. Annual Error | Com. Intensity | Omm. Intensity | Hypo. Error |
| 1986 - 2020 |  | CL | 0.6250 | 0.0116 | 0.7252 | 44.1362 | 43.5112 | 0.0000 | 98.5839 | 4.3020 |
|  | BS | FL | 222.3125 | 0.6243 | 0.7252 | 262.9466 | 40.6341 | 0.0000 | 15.4534 | 4.3020 |
|  |  | GL | 181.5000 | 0.2236 | 0.7252 | 641.9845 | 460.4845 | 0.0000 | 71.7283 | 4.3020 |
|  |  | WA | 58.5625 | 0.0634 | 0.7252 | 750.4545 | 691.8920 | 0.0000 | 92.1964 | 4.3020 |
|  |  | WL | 2421.2500 | 1.3220 | 0.7252 | 1184.7283 | 1236.5217 | 51.0690 | 0.0000 | 4.3020 |
|  |  | BS |  20.1875 | 20.1875 | 0.0325 | 0.0674 | 42.1336 | 21.9461 | 0.0000 | 52.0870 |
|  | CL | FL | 237.3750 | 0.6666 | 0.0674 | 21.6728 | 215.7022 | 90.8690 | 0.0000 | 0.7504 |
|  |  | GL | 9.5625 | 0.0118 | 0.0674 | 55.1894 | 45.6269 | 0.0000 | 82.6733 | 0.7504 |
|  |  | WA | 0.0000 | 0.0000 | 0.0674 | 62.9617 | 62.9617 | 0.0000 | 100.0000 | 0.7504 |
|  |  | WL | 39.1875 | 0.0214 | 0.0674 | 124.3550 | 85.1675 | 0.0000 | 68.4874 | 0.7504 |
|  |  | BS | 221.0000 | 0.3555 | 0.1015 | 60.5067 | 160.4933 | 72.6210 | 0.0000 | 0.6743 |
|  | FL | CL | 38.2500 | 0.7096 | 0.1015 | 4.9309 | 33.3191 | 87.1080 | 0.0000 | 0.6743 |
|  |  | GL | 31.7500 | 0.0391 | 0.1015 | 83.2325 | 51.4825 | 0.0000 | 61.8538 | 0.6743 |
|  |  | WA | 73.1250 | 0.0791 | 0.1015 | 94.1646 | 21.0396 | 0.0000 | 22.3434 | 0.6743 |
|  |  | WL | 66.6250 | 0.0364 | 0.1015 | 187.9153 | 121.2903 | 0.0000 | 64.5452 | 0.6743 |
|  |  | BS | 40.3125 | 0.0648 | 0.2276 | 145.3255 | 105.0130 | 0.0000 | 72.2606 | 1.0267 |
|  | GL | CL | 7.5625 | 0.1403 | 0.2276 | 12.4465 | 4.8840 | 0.0000 | 39.2399 | 1.0267 |
|  |  | FL | 111.1250 | 0.3121 | 0.2276 | 79.9159 | 31.2091 | 28.0840 | 0.0000 | 1.0267 |
|  |  | WA | 31.8750 | 0.0345 | 0.2276 | 217.0965 | 185.2215 | 0.0000 | 85.3176 | 1.0267 |
|  |  | WL | 671.1875 | 0.3665 | 0.2276 | 407.2781 | 263.9094 | 39.3190 | 0.0000 | 1.0267 |
|  | WA | BS | 64.9375 | 0.1045 | 0.0829 | 51.3745 | 13.5630 | 20.8860 | 0.0000 | 0.5104 |
|  |  | CL | 0.0000 | 0.0000 | 0.0829 | 4.5301 | 4.5301 | 0.0000 | 100.0000 | 0.5104 |
|  |  | FL | 12.3125 | 0.0346 | 0.0829 | 29.7622 | 17.4497 | 0.0000 | 58.6304 | 0.5104 |
|  |  | GL | 198.6875 | 0.2448 | 0.0829 | 65.5387 | 133.1488 | 67.0141 | 0.0000 | 0.5104 |
|  |  | WL | 28.8125 | 0.0157 | 0.0829 | 153.5445 | 124.7320 | 0.0000 | 81.2351 | 0.5104 |
|  |  | BS | 797.5625 | 1.2830 | 1.0225 | 603.9872 | 193.5752 | 24.2708 | 0.0000 | 4.1005 |
|  | WL | CL | 20.6875 | 0.3838 | 1.0225 | 61.8474 | 41.1599 | 0.0000 | 66.5507 | 4.1005 |
|  |  | FL | 311.8750 | 0.8758 | 1.0225 | 374.3242 | 62.4492 | 0.0000 | 16.6832 | 4.1005 |
|  |  | GL | 1653.7500 | 2.0377 | 1.0225 | 668.7076 | 985.0424 | 59.5640 | 0.0000 | 4.1005 |
|  |  | WA | 45.8125 | 0.0496 | 1.0225 | 1120.8209 | 1075.0084 | 0.0000 | 95.9126 | 4.1005 |
| 2002 -2020 |  | CL | 7.7778 | 0.0844 | 1.3182 | 156.9035 | 149.1257 | 0.0000 | 95.0430 | 9.7617 |
|  | BS | FL | 191.6111 | 0.6799 | 1.3182 | 427.4708 | 235.8597 | 0.0000 | 55.1756 | 9.7617 |
|  |  | GL | 439.3333 | 0.7115 | 1.3182 | 930.4294 | 491.0961 | 0.0000 | 52.7817 | 9.7617 |
|  |  | WA | 4.2222 | 0.0045 | 1.3182 | 1622.1942 | 1617.9720 | 0.0000 | 99.7397 | 9.7617 |
|  |  | WL | 4232.5557 | 2.3942 | 1.3182 | 1738.5194 | 2494.0361 | 58.9250 | 0.0000 | 9.7616 |
|  |  | BS | 9.5 | 9.5000 | 0.0106 | 0.0635 | 57.7211 | 48.1656 | 0.0000 | 83.4453 |
|  | CL | FL | 119.5000 | 0.4240 | 0.0635 | 16.7248 | 102.7752 | 86.0040 | 0.0000 | 0.4639 |
|  |  | GL | 29.3333 | 0.0475 | 0.0635 | 39.3292 | 9.9959 | 0.0000 | 25.4159 | 0.4639 |
|  |  | WA | 0.0000 | 0.0000 | 0.0635 | 60.3526 | 60.3526 | 0.0000 | 100.0000 | 0.4639 |
|  |  | WL | 127.8333 | 0.0723 | 0.0635 | 112.0951 | 15.7382 | 12.3110 | 0.0000 | 0.4639 |
|  |  | BS | 88.0556 | 0.0979 | 0.0518 | 46.2594 | 41.8518 | 47.4980 | 0.0000 | 0.1888 |
|  | FL | CL | 1.4444 | 0.0157 | 0.0518 | 4.8089 | 3.3645 | 0.0000 | 69.9632 | 0.1888 |
|  |  | GL | 27.5556 | 0.0446 | 0.0518 | 32.0403 | 4.4847 | 0.0000 | 13.9971 | 0.1888 |
|  |  | WA | 8.6667 | 0.0092 | 0.0518 | 49.0601 | 40.3934 | 0.0000 | 82.3346 | 0.1888 |
|  |  | WL | 97.9444 | 0.0554 | 0.0518 | 91.5541 | 6.3903 | 6.5244 | 0.0000 | 0.1888 |
|  |  | BS | 97.7778 | 0.1088 | 0.2404 | 221.7136 | 123.7691 | 0.0000 | 55.8239 | 1.4752 |
|  | GL | CL | 57.2222 | 0.6207 | 0.2404 | 20.5723 | 36.6499 | 64.0480 | 0.0000 | 1.4752 |
|  |  | FL | 51.1667 | 0.1815 | 0.2404 | 68.4899 | 17.3232 | 0.0000 | 25.2931 | 1.4752 |
|  |  | WA | 0.1667 | 0.0002 | 0.2404 | 235.9929 | 235.8262 | 0.0000 | 99.9294 | 1.4752 |
|  |  | WL | 750.4445 | 0.4245 | 0.2404 | 410.1783 | 340.2662 | 45.3410 | 0.0000 | 1.4752 |
|  | WA | BS | 203.5000 | 0.2261 | 0.1875 | 167.5321 | 35.9679 | 17.6746 | 0.0000 | 0.7331 |
|  |  | CL | 13.4444 | 0.1458 | 0.1875 | 17.4157 | 3.9713 | 0.0000 | 22.8029 | 0.7331 |
|  |  | FL | 199.0556 | 0.7063 | 0.1875 | 47.7269 | 151.3286 | 76.0233 | 0.0000 | 0.7331 |
|  |  | GL | 63.3333 | 0.1026 | 0.1875 | 117.5781 | 54.2447 | 0.0000 | 46.1351 | 0.7331 |
|  |  | WL | 206.6667 | 0.1169 | 0.1875 | 335.7491 | 129.0824 | 0.0000 | 38.4461 | 0.7331 |
|  |  | BS | 538.1667 | 0.5978 | 0.4335 | 377.7089 | 160.4578 | 29.8156 | 0.0000 | 1.7494 |
|  | WL | CL | 34.7778 | 0.3772 | 0.4335 | 40.4035 | 5.6257 | 0.0000 | 13.9238 | 1.7494 |
|  |  | FL | 137.5000 | 0.4879 | 0.4335 | 120.8813 | 16.6187 | 12.0860 | 0.0000 | 1.7494 |
|  |  | GL | 516.5000 | 0.8365 | 0.4335 | 246.6104 | 269.8896 | 52.2530 | 0.0000 | 1.7494 |
|  |   | WA | 0.2222 | 0.0004 | 0.4335 | 441.6783 | 441.3450 | 0.0000 | 99.9245 | 1.7494 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |   |   |  | **B= Transit level of intensity analysis from 'M' category**   |   |   |
|  | Time Interval | Transitions from  | To |  Ann. Transition | Tran. Intensity | Uni. Intensity | Uni. Annual Transition | Hypo. Annual Error | Com. Intensity | Omm. Intensity | Hypo. Error |
|  | 1986 - 2002 |  | CL | 20.1875 | 0.2190 | 0.3093 | 28.9403 | 8.7528 | 0.0000 | 30.2400 | 1.4077 |
|  |  | BS | FL | 221.0000 | 0.7842 | 0.3093 | 80.1926 | 140.8074 | 63.7100 | 0.0000 | 1.4077 |
|  |  |  | GL | 40.3125 | 0.0653 | 0.3093 | 198.8237 | 158.5112 | 0.0000 | 79.7200 | 1.4077 |
|  |  |  | WA | 64.9375 | 0.0691 | 0.3093 | 302.2915 | 237.3540 | 0.0000 | 78.5100 | 1.4077 |
|  |  |  | WL | 797.5625 | 0.4511 | 0.3093 | 533.7519 | 263.8106 | 33.0700 | 0.0000 | 1.4077 |
|  |  | BS | 0.625 | 0.6250 | 0.0007 | 0.0149 | 13.4369 | 12.8119 | 0.0000 | 95.3400 |
|  |  | CL | FL | 38.2500 | 0.1357 | 0.0149 | 4.1160 | 34.1340 | 89.2300 | 0.0000 | 0.1188 |
|  |  |  | GL | 7.5625 | 0.0122 | 0.0149 | 9.2009 | 1.6384 | 0.0000 | 17.8000 | 0.1188 |
|  |  |  | WA | 0.0000 | 0.0000 | 0.0149 | 14.0252 | 14.0252 | 0.0000 | 100.0000 | 0.1188 |
|  |  |  | WL | 20.6875 | 0.0117 | 0.0149 | 26.3460 | 5.6585 | 0.0000 | 21.4700 | 0.1188 |
|  |  |  | BS | 222.3125 | 0.2470 | 0.2073 | 185.3792 | 36.9333 | 16.6100 | 0.0000 | 0.9139 |
|  |  | FL | CL | 237.3750 | 2.5754 | 0.2073 | 11.6198 | 225.7552 | 95.1000 | 0.0000 | 0.9139 |
|  |  |  | GL | 111.1250 | 0.1800 | 0.2073 | 128.5923 | 17.4673 | 0.0000 | 13.5800 | 0.9139 |
|  |  |  | WA | 12.3125 | 0.0131 | 0.2073 | 201.0110 | 188.6985 | 0.0000 | 93.8700 | 0.9139 |
|  |  |  | WL | 311.8750 | 0.1764 | 0.2073 | 368.3976 | 56.5226 | 0.0000 | 15.3400 | 0.9139 |
|  |  |  | BS | 181.5000 | 0.2016 | 0.5212 | 495.3341 | 313.8341 | 0.0000 | 63.3500 | 2.7793 |
|  |  | GL | CL | 9.5625 | 0.1037 | 0.5212 | 51.5430 | 41.9805 | 0.0000 | 81.4400 | 2.7793 |
|  |  |  | FL | 31.7500 | 0.1127 | 0.5212 | 157.3643 | 125.6144 | 0.0000 | 79.8200 | 2.7793 |
|  |  |  | WA | 198.6875 | 0.2115 | 0.5212 | 516.1185 | 317.4310 | 0.0000 | 61.5000 | 2.7793 |
|  |  |  | WL | 1653.7500 | 0.9354 | 0.5212 | 854.8900 | 798.8600 | 48.3050 | 0.0000 | 2.7793 |
|  |  | WA | BS | 58.5625 | 0.0651 | 0.0572 | 51.4330 | 7.1295 | 12.1700 | 0.0000 | 0.2249 |
|  |  |  | CL | 0.0000 | 0.0000 | 0.0572 | 5.3221 | 5.3221 | 0.0000 | 100.0000 | 0.2249 |
|  |  |  | FL | 73.1250 | 0.2595 | 0.0572 | 15.5968 | 57.5282 | 78.6700 | 0.0000 | 0.2249 |
|  |  |  | GL | 31.8750 | 0.0516 | 0.0572 | 35.3604 | 3.4854 | 0.0000 | 9.8500 | 0.2249 |
|  |  |  | WL | 45.8125 | 0.0259 | 0.0572 | 101.6627 | 55.8502 | 0.0000 | 54.9300 | 0.2249 |
|  |  |  | BS | 2421.2500 | 2.6900 | 1.1399 | 714.8076 | 1706.4424 | 70.4700 | 0.0000 | 5.9369 |
|  |  | WL | CL | 39.1875 | 0.4252 | 1.1399 | 119.7620 | 80.5745 | 0.0000 | 67.2700 | 5.9369 |
|  |  |  | FL | 66.6250 | 0.2364 | 1.1399 | 378.0380 | 311.4130 | 0.0000 | 82.3760 | 5.9369 |
|  |  |  | GL | 671.1875 | 1.0870 | 1.1399 | 711.1686 | 39.9811 | 0.0000 | 5.6200 | 5.9369 |
|  |  |  | WA | 28.8125 | 0.0307 | 1.1399 | 1303.2864 | 1274.4739 | 0.0000 | 97.7800 | 5.9369 |
|  | 2002-2020 | CL | 9.5000 | 0.0776 | 0.3135 | 40.3166 | 30.7610 | 0.0000 | 76.2900 | 1.0240 |
|  |  | BS | FL | 88.0556 | 0.4488 | 0.3135 | 59.9549 | 28.1562 | 31.9500 | 0.0000 | 1.0240 |
|  |  |  | GL | 97.7778 | 0.1643 | 0.3135 | 192.1606 | 94.2162 | 0.0000 | 49.0200 | 1.0240 |
|  |  |  | WA | 203.5000 | 0.1919 | 0.3135 | 340.1608 | 136.6608 | 0.0000 | 40.1754 | 1.0240 |
|  |  |  | WL | 538.1667 | 0.5308 | 0.3135 | 304.6882 | 233.4785 | 43.3800 | 0.0000 | 1.0240 |
|  |  |  | BS | 7.7778 | 0.0048 | 0.0256 | 41.3775 | 33.5997 | 0.0000 | 81.2029 | 0.1996 |
|  |  | CL | FL | 1.4444 | 0.0074 | 0.0256 | 5.0461 | 3.6017 | 0.0000 | 71.3752 | 0.1996 |
|  |  |  | GL | 57.2222 | 0.0960 | 0.0256 | 15.0751 | 42.1471 | 73.6500 | 0.0000 | 0.1996 |
|  |  |  | WA | 13.4444 | 0.0127 | 0.0256 | 27.2323 | 13.7879 | 0.0000 | 50.6305 | 0.1996 |
|  |  |  | WL | 34.7778 | 0.0343 | 0.0256 | 25.9359 | 8.8419 | 25.4200 | 0.0000 | 0.1996 |
|  |  |  | BS | 191.6111 | 0.1191 | 0.1587 | 257.2863 | 65.6752 | 0.0000 | 25.5261 | 0.5266 |
|  |  | FL | CL | 119.5000 | 0.9710 | 0.1587 | 16.5950 | 102.9050 | 86.1100 | 0.0000 | 0.5265 |
|  |  |  | GL | 51.1667 | 0.0858 | 0.1587 | 95.8853 | 44.7187 | 0.0000 | 46.6377 | 0.5266 |
|  |  |  | WA | 199.0556 | 0.1877 | 0.1587 | 167.4305 | 31.6251 | 15.8800 | 0.0000 | 0.5265 |
|  |  |  | WL | 137.5000 | 0.1356 | 0.1587 | 161.6379 | 24.1379 | 0.0000 | 14.9333 | 0.5266 |
|  |  |  | BS | 439.3333 | 0.2730 | 0.2688 | 432.2020 | 7.1314 | 1.6200 | 0.0000 | 1.0312 |
|  |  | GL | CL | 29.3333 | 0.2383 | 0.2688 | 33.2743 | 3.9410 | 0.0000 | 11.8440 | 1.0312 |
|  |  |  | FL | 27.5556 | 0.1404 | 0.2688 | 54.0570 | 26.5015 | 0.0000 | 49.0250 | 1.0312 |
|  |  |  | WA | 63.3333 | 0.0597 | 0.2688 | 296.3560 | 233.0226 | 0.0000 | 78.6293 | 1.0312 |
|  |  |  | WL | 516.5000 | 0.5094 | 0.2688 | 260.1692 | 256.3308 | 49.6200 | 0.0000 | 1.0312 |
|  |  | WA | BS | 4.2222 | 0.0026 | 0.0038 | 6.0897 | 1.8675 | 0.0000 | 30.6665 | 0.0310 |
|  |  |  | CL | 0.0000 | 0.0000 | 0.0038 | 0.4660 | 0.4660 | 0.0000 | 100.0000 | 0.0310 |
|  |  |  | FL | 8.6667 | 0.0441 | 0.0038 | 0.7374 | 7.9292 | 91.4900 | 0.0000 | 0.0310 |
|  |  |  | GL | 0.1667 | 0.0003 | 0.0038 | 2.2567 | 2.0900 | 0.0000 | 92.6145 | 0.0310 |
|  |  |  | WL | 0.2222 | 0.0003 | 0.0038 | 3.8391 | 3.5057 | 0.0000 | 91.3173 | 0.0310 |
|  |  |  | BS | 4232.5557 | 2.6305 | 1.5106 | 1757.7269 | 2474.8289 | 58.4700 | 0.0000 | 9.6864 |
|  |  | WL | CL | 127.8333 | 1.0387 | 1.5106 | 207.5993 | 79.7659 | 0.0000 | 38.4230 | 9.6865 |
|  |  |  | FL | 97.9444 | 0.4989 | 1.5106 | 370.7367 | 272.7923 | 0.0000 | 73.5811 | 9.6865 |
|  |  |  | GL | 750.4445 | 1.2591 | 1.5106 | 956.3342 | 205.8898 | 0.0000 | 21.5291 | 9.6865 |
|  |  |   | WA | 206.6667 | 0.1949 | 1.5106 | 2123.0688 | 1916.4021 | 0.0000 | 90.2657 | 9.6865 |

FigUGE S 3 Habitat degradation: Picture **(A)** encroachment of invasive plants over degraded grazing land(left) & picture **(B)** grazing land /habitat/ changed to bare land **© NSNP Office**



**Fig. S 4** Shows the status of grass availability for wild animals on the undegraded (picture A) and degraded (picture B) parts of the grassland plan of NSNP



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**Figure S 5** Intermixing of wild and domestic animals in grazing field (left) and died Zebra by transmitted disease(right) **© NSNP Office**

