Appendix

Appendix-I. Brief description of methods used for determining soil organic carbon pools and enzymatic activity in soil.

|  |  |  |
| --- | --- | --- |
| Soil property | Brief description | Reference |
| Total organic carbon (TOC) | Reacting with 1 N K2Cr2O7 solution at 150 °C for 1 h | Singh and Benbi (2018) |
| Potassium permanganate oxidizable carbon (KMnO4-C) | Oxidation with 33mM, KMnO4 solution for 24 h  | Blair *et al.,* (1995) |
| Water extractable organic carbon (WEOC)  | Shaking 10 g soil with 20 ml deionized water for 1 h | Singh and Benbi (2018a) |
| Hot water carbon (HWC) | Chromosulfuric acid digestion method | Singh and Benbi (2018b) |
| Dehydrogenase activity (DHA) | Triphenylformazan (TPF) produced by the reduction of 2, 3, 5-triphenyltetrazolium chloride (TTC). | Sharma *et al*., (2019) |
| Flourescein diacetate activity (FDA) | Fluorescein released by the hydrolysis of flourescein di-acetate | Sharma *et al*. (2019) |
| Alkaline phosphatase activity (Alk-P) | p-nitrophenyl method.  | Sharma *et al*. (2019) |
| Microbial biomass carbon (MBC) | Chloroform fumigation extraction method | Singh and Benbi (2018a) |
| Basal soil respiration (BSR) | Alkali trap method | Singh and Benbi (2018a) |

**Appendix-II. Loading values and percent contribution of soil properties at surface soil layer on the axis identified by the principal component analysis (PCA)**

|  |  |  |  |
| --- | --- | --- | --- |
|  Variables | PC1 | PC­2 | PC3 |
| Loading value | %Contribution  | Loading value | % Contribution | Loading value | % Contribution |
| Rice yield | 0.810 | 6.13 | -0.246 | 2.96 | 0.247 | 4.69 |
| Wheat yield | 0.550 | 2.83 | -0.243 | 2.87 | 0.644 | 31.8 |
| TOC | 0.944 | 8.34 | 0.158 | 1.21 | 0.074 | 0.421 |
| WEOC | 0.951 | 8.45 | 0.222 | 2.41 | 0.094 | 0.683 |
| HWC | 0.947 | 8.39 | 0.285 | 3.96 | -0.036 | 0.097 |
| KMnO4-C | 0.959 | 8.60 | 0.231 | 2.60 | 0.076 | 0.446 |
| Non-labile C | 0.958 | 8.58 | 0.233 | 2.64 | 0.067 | 0.346 |
| CMI | 0.841 | 6.61 | -0.066 | 0.214 | 0.188 | 2.716 |
| DHA | 0.661 | 4.08 | -0.325 | 5.15 | 0.152 | 1.77 |
| FDA | 0.726 | 4.92 | 0.623 | 18.9 | -0.175 | 2.36 |
| Alk-P | 0.614 | 3.53 | -0.575 | 16.1 | -0.411 | 12.9 |
| MBC | 0.914 | 7.81 | 0.398 | 7.74 | -0.040 | 0.120 |
| BSR | 0.680 | 4.32 | -0.471 | 10.8 | -0.524 | 21.0 |
| qCO2 | 0.958 | 8.57 | 0.202 | 1.98 | -0.192 | 2.84 |
| Qmic | -0.172 | 0.278 | -0.601 | 18.2 | -0.434 | 14.4 |
| BD | 0.954 | 8.50 | 0.207 | 2.08 | -0.204 | 3.19 |
| Eigen value |  | 10.7 |  | 2.04 |  | 1.30 |
| Variability (%) |  | 66.83 |  | 12.8 |  | 8.13 |
| Cumulative (%) |  | 66.83 |  | 79.6 |  | 87.7 |
| Weight |  | 0.76 |  | 0.15 |  | 0.09 |

Appendix-III. Inter-correlations between highly weighted variables under principal component analysis (PCA) (Acronyms: KMnO4-C=Potassium permanganate oxidizable C, WEOC=Water extractable organic C, TOC=Total organic C, FDA= Fluorescein diacetate, Alk-P= Alkaline phosphatise; qmic = microbial quotients; BSR= Basal soil respiration qCO2= respiratory and BD= Bulk density).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PC1 | KMnO4-C | Non labile-C | WEOC | TOC |
| KMnO4-C | 1 |  |  |  |
| Non labile-C | 0.999\*\* | 1 |  |  |
| WEOC | 0.996\*\* | 0.995\*\* | 1 |  |
| TOC | 0.970\*\* | 0.967\*\* | 0.978\*\* | 1 |
| PC2 | FDA | Alk-P | qmic |  |
| FDA | 1 |  |  |  |
| Alk-P | 0.633\*\* | 1 |  |  |
| Q mic | 0.366\*\* | 0.489\*\* | 1 |  |
| PC3 | BSR | Q CO2 | BD |  |
| BSR | 1 |  |  |  |
| qCO2 | 0.664\*\* | 1 |  |  |
| BD | 0.665\*\* | 1.00\*\* | 1 |  |

\* Significant at *p<*0.05, \*\*Significant at *p<*0.01

**Appendix-IV. Correlation matrix depicting relationship between different variables (Acronyms: BD: Bulk density, TOC: Total organic C, WEOC: Water extractable organic C, HWC: Hot water soluble C, KMnO4-C: Potassium permanganate oxidizable C, DHA: Dehydrogenase activity, FDA: Fluorescein diacetate, Alk-P: Alkaline phosphatase)**

|  | BD | TOC | WEOC | HWC | MBC | KMnO4-C | Non labile-C | DHA | FDA |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TOC | -0.277NS |  |  |  |  |  |  |  |  |
| WEOC | -0.818\*\* | 0.961 \*\* |  |  |  |  |  |  |  |
| HWC | -0.788\*\* | 0.986 \*\* | 0.977\*\* |  |  |  |  |  |  |
| MBC | -0.823\*\* | 0.983 \*\* | 0.971\*\* | 0.994\*\* |  |  |  |  |  |
| KMnO4-C | -0.813\*\* | 0.958 \*\* | 0.997\*\* | 0.986\*\* | 0.979\*\* |  |  |  |  |
| Non labile-C | -0.807\*\* | 0.957 NS | 0.997\*\* | 0.986\*\* | 0.979\*\* | 0.994\*\* |  |  |  |
| DHA | -0.074 NS | -0.186 NS | 0.496 NS | 0.529\* | 0.494 NS | 0.496 NS | 0.504\* |  |  |
| FDA | 0.148 NS | 0.262 NS | 0.258 NS | 0.283 NS | 0.234 NS | 0.276 NS | 0.282 NS | 0.685\*\* |  |
| Alk-P | 0.145 NS | -0.172 NS | -0.120 NS | -0.117 NS | -0.104 NS | -0.150 NS | -0.144 NS | 0.335 NS | 0.342 NS |

\*Significant at *p<*0.05, \*\*Significant at *p<*0.01, NS=Not significant

**Appendix-V. Percent contribution of selected soil quality indicators i.e. minimum data set (MDS) towards soil quality index (SQI) (Acronyms: KMnO4-C=Potassium permanganate oxidizable carbon, FDA=Fluorescein diacetate activity and BSR=Basal soil respiration).**