

**Table 1** Adjusted parameters for different machine-learning methods.

| Models | Parameters       | alr1        | alr2        | clr1        | clr2        | clr3        | ilr1        | ilr2    | sand        | silt        | clay         | class       |
|--------|------------------|-------------|-------------|-------------|-------------|-------------|-------------|---------|-------------|-------------|--------------|-------------|
| KNN    | kmax             | 13          | 13          | 14          | 14          | 15          | 15          | 14      | 14          | 15          | 15           | 15          |
|        | distance         | 1           | 1           | 1           | 1           | 1           | 1           | 1       | 1           | 1           | 1            | 1           |
|        | kernel           | rectangular | rectangular | rectangular | rectangular | rectangular | rectangular | optimal | rectangular | rectangular | epanechnikov | rectangular |
| MLP    | size             | 5           | 5           | 5           | 5           | 5           | 5           | 5       | 10          | 10          | 10           | 5           |
| RF     | ntree            | 1000        | 1000        | 1000        | 1000        | 1000        | 1000        | 1000    | 1000        | 1000        | 1000         | 1000        |
|        | mtry             | 9           | 9           | 9           | 9           | 9           | 9           | 9       | 6           | 11          | 11           | 7           |
| SVM    | gamma            | 0.1         | 0.1         | 0.1         | 0.1         | 0.1         | 0.1         | 0.1     | 0.1         | 0.1         | 0.1          | 0.01        |
|        | cost             | 1           | 1           | 1           | 1           | 1           | 1           | 1       | 1           | 1           | 1            | 1           |
| XGB    | max_depth        | 3           | 3           | 3           | 3           | 3           | 3           | 3       | 3           | 4           | 3            | 4           |
|        | eta              | 0.1         | 0.1         | 0.1         | 0.1         | 0.1         | 0.1         | 0.1     | 0.05        | 0.05        | 0.05         | 0.1         |
|        | colsample_bytree | 0.6         | 0.6         | 1           | 0.8         | 0.6         | 0.6         | 1       | 0.6         | 0.6         | 0.6          | 0.8         |
|        | nrounds          | 20          | 30          | 40          | 40          | 30          | 20          | 30      | 30          | 30          | 30           | 30          |
|        | subsample        | 1           | 1           | 0.8         | 1           | 0.6         | 0.8         | 0.8     | 0.6         | 0.6         | 0.6          | 1           |
|        | gamma            | 0.6         | 1           | 0.7         | 0.4         | 0.7         | 0           | 0.3     | 0.8         | 0.8         | 0.8          | 0.1         |
|        | min_child_weight | 0.6         | 0.8         | 0.6         | 1           | 0.6         | 1           | 1       | 0.8         | 0.8         | 0.8          | 0.6         |