**Supplementary Materials**

**Table S1.** Accuracy assessment results of U-Net predictions to establish the optimal image combination.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Dataset 1 - Multispectral bands*** | | | | |  | ***Dataset 2 - SAR bands*** | | | | |
| **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |  | **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |
| **Precision** | 0.77 | 0.71 | 0.88 | 0.91 |  | **Precision** | 0.66 | 0.65 | 0.87 | 0.94 |
| **Recall** | 0.67 | 0.62 | 0.89 | 0.96 |  | **Recall** | 0.67 | 0.54 | 0.88 | 0.95 |
| **F1 Score** | 0.72 | 0.66 | 0.88 | 0.93 |  | **F1 Score** | 0.66 | 0.59 | 0.88 | 0.94 |
| **Mean IoU** | 0.52 | 0.49 | 0.67 | 0.87 |  | **Mean IoU** | 0.46 | 0.41 | 0.66 | 0.89 |
| ***Dataset 3 - Optical indices*** | | | | |  | ***Dataset 4 - Multispectral + SAR bands*** | | | | |
| **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |  | **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |
| **Precision** | 0.72 | 0.64 | 0.88 | 0.89 |  | **Precision** | 0.75 | 0.73 | 0.90 | 0.93 |
| **Recall** | 0.69 | 0.47 | 0.86 | 0.95 |  | **Recall** | 0.72 | 0.70 | 0.89 | 0.96 |
| **F1 Score** | 0.70 | 0.54 | 0.87 | 0.92 |  | **F1 Score** | 0.73 | 0.71 | 0.89 | 0.95 |
| **Mean IoU** | 0.50 | 0.37 | 0.64 | 0.85 |  | **Mean IoU** | 0.54 | 0.56 | 0.70 | 0.89 |
| ***Dataset 5 - SAR + Optical indices*** | | | | |  | ***Dataset 6 - Multispectral + Optical indices*** | | | | |
| **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |  | **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |
| **Precision** | 0.74 | 0.68 | 0.88 | 0.94 |  | **Precision** | 0.74 | 0.70 | 0.90 | 0.92 |
| **Recall** | 0.71 | 0.65 | 0.89 | 0.95 |  | **Recall** | 0.71 | 0.65 | 0.88 | 0.95 |
| **F1 Score** | 0.72 | 0.66 | 0.88 | 0.95 |  | **F1 Score** | 0.72 | 0.67 | 0.89 | 0.94 |
| **Mean IoU** | 0.53 | 0.49 | 0.69 | 0.89 |  | **Mean IoU** | 0.53 | 0.51 | 0.69 | 0.88 |
| ***Dataset 7 - Multispectral + SAR + Optical indices*** | | | | |  |  | | | | |
| **Metrics** | **Built-up area** | **Vegetated** | **Non-rice fields** | **Rice fields** |  |  |  |  |  |  |
| **Precision** | 0.75 | 0.72 | 0.90 | 0.94 |  |  |  |  |  |  |
| **Recall** | 0.72 | 0.70 | 0.89 | 0.96 |  |  |  |  |  |  |
| **F1 Score** | 0.73 | 0.71 | 0.89 | 0.95 |  |  |  |  |  |  |
| **Mean IoU** | 0.54 | 0.55 | 0.71 | 0.89 |  |  |  |  |  |  |

**Table S2.** Error matrix and classification accuracy results of the Random Forest classification and optimal U-Net prediction (where U\_Accuracy = Users' Accuracy and P\_Accuracy = Users' Accuracy).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **U-Net - Dataset 4 - Multispectral + SAR bands** | | | | |
| **Class Name** | **Non-Rice** | **Rice fields** | **Total** | **U\_Accuracy** |
| Non-Rice | 696 | 9 | **705** | 0.99 |
| Rice fields | 54 | 241 | **295** | 0.82 |
| **Total** | **750** | **250** | **1000** |  |
| P\_Accuracy | 0.93 | 0.96 |  |  |
| F1-Score | 0.96 | 0.88 |  |  |
| **Overall Kappa** | 0.84 |  |  |  |
| **Overall Accuracy** | 0.94 |  |  |  |
| **Mean F1-Score** | 0.92 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **RF (250) - Dataset 4 - Multispectral + SAR bands** | | | | |
| **Class Name** | **Non-Rice** | **Rice fields** | **Total** | **U\_Accuracy** |
| Non-Rice | 691 | 29 | **720** | 0.96 |
| Rice fields | 59 | 221 | **280** | 0.79 |
| **Total** | **750** | **250** | **1000** |  |
| P\_Accuracy | 0.92 | 0.88 |  |  |
| F1-Score | 0.94 | 0.83 |  |  |
| **Overall Kappa** | 0.77 |  |  |  |
| **Overall Accuracy** | 0.91 |  |  |  |
| **Mean F1-Score** | 0.89 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **RF (500) - Dataset 4 - Multispectral + SAR bands** | | | | |
| **Class Name** | **Non-Rice** | **Rice fields** | **Total** | **U\_Accuracy** |
| Non-Rice | 692 | 29 | **721** | 0.96 |
| Rice fields | 58 | 221 | **279** | 0.79 |
| **Total** | **750** | **250** | **1000** |  |
| P\_Accuracy | 0.92 | 0.88 |  |  |
| F1-Score | 0.94 | 0.84 |  |  |
| **Overall Kappa** | 0.78 |  |  |  |
| **Overall Accuracy** | 0.91 |  |  |  |
| **Mean F1-Score** | 0.89 |  |  |  |

**Figure S.1**. U-Net CNN segmentation paddy rice map produced from a combination of Sentinel 2 multispectral and Sentinel-1 dual polarization bands (Dataset 4).

A map of a country

Description automatically generated with medium confidence

**Figure S.2**. Random Forest (500 trees) paddy rice map produced from a combination of Sentinel 2 multispectral and Sentinel-1 dual polarization bands (Dataset 4).



**Figure S.3**. Comparison of U-Net segmentation and Random Forest predictions using Dataset 4.

Chart, treemap chart

Description automatically generated

**Figure S.4**. Comparison of U-Net segmentation and Random Forest predictions using Dataset 4 (contd.)

