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Supplementary material for

# Modeling the Impact of Investment and National Planning Policies on Future Land Use Development: A Case Study for Myanmar

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## Supplementary Information (SI)

### Section S1. Description of the scenario design

Due to a strong desire to attain export-oriented growth by attracting domestic and overseas investments, Myanmar promulgated the Myanmar Investment Promotion Plan (MIPP) in 2018 [1]. Investment is an important supply-side factor of production, and its flows create capital stocks. These capital stocks will be used directly to support the production of products. The intensive investment can improve the production capabilities and technology, which are contribute to boost production growth in the long run. Meantime, the long-term land use structure prospects are closely linked with any of the development strategies described in the 20-year National Comprehensive Development Plan [2] and Myanmar Sustainable Development Plan [3], such as infrastructure development, industrial restructuring, technologies innovation, and consolidated governance. The mentioned development factors could be reflected in the enhancement of Total Factor Productivity (TFP). Therefore, this study simulated the long-term land use structures under the scenarios of intensive investment and enhancement of TFP.

According to Taguchi and Lar [4], Myanmar's economy shows the potential to follow the economic paths of Thailand and Vietnam. The reasons are: (1) the three economies have similarities in population size as well as cultural and ethnic backgrounds, (2) the penetration of international production network among three economies may make their economic growth paths common among the economies, and (3) the three economies are all located in the Mekong region. Thailand is one of the forerunners in the Mekong region in achieving export-oriented economic structure by attracting investment. The investment ratio relative to GDP ranged from 25–50% during the periods with intensive investment from 1980 to 1997. According to the MIPP, Myanmar's investment target is 57 Billion US$ by the end of 2030. The investment ratio relative to GDP in Myanmar ranged from 20.14% to 37.17% during 2010-2021 [5]. In this context, this study set the investment ratio relative to GDP with values of 25%, 33%, and 40% under the baseline development scenario (BD_scenario), harmonious development scenario (HD_scenario), and fast development scenario (FD_scenario), respectively. The growth rate of TFP value (6%), adopted by Taguchi and Lar [4], was applied to the HD_scenario and FD_scenario, which was set by considering the TFP growth of the main Asian countries [6]. As reported by APO [7], the TFP growth of Myanmar decreased slightly in recent years. In this case, this study assumed that the TFP in Myanmar would remain unchanged. Therefore, the growth rate of TFP under the BD_scenario was set as 0.

Population growth and climate change are the other two important factors in land use simulation. Myanmar's population growth has been projected from 2014 to 2050 under three scenarios, namely low, medium, and high variants [8]. These scenarios were applied to represent the population change under the BD_scenario, HD_scenario, and FD_scenario, respectively. The new climate change projections for Myanmar under the RCP4.5 and RCP8.5 scenarios, the medium-low and highest emission scenarios adopted by the International Panel on Climate Change (IPCC) for its fifth Assessment Report (AR5), have been documented [9]. It is reported that the minimum and maximum temperatures in Myanmar would increase by 0.8–2.0˚C and 0.8–1.9˚C by the end of 2060 under the RCP4.5 scenario, respectively. Increases of 0.9–2.4˚C and 0.8–2.3˚C for the minimum and maximum temperatures would been found under the RCP8.5 scenario. Moreover, precipitation has been projected to rise by 5–15% under the RCP4.5 scenario and 11–20% under the RCP8.5 scenario. In this study, the least and medium values of the increased minimum temperature under the RCP4.5 scenario were used to represent the increase of temperature under the BD_scenario and HD_scenario, and the medium value under the RCP8.5 scenario was applied to reflect the increase of temperature under the FD_scenario. Similarly, the least and medium values of the increased rainfall under the RCP4.5 scenario and the medium value under the RCP8.5 scenario were used to represent the rise value of rainfall under the BD_scenario, HD_scenario, and FD_scenario, respectively.

## Supplementary Figure

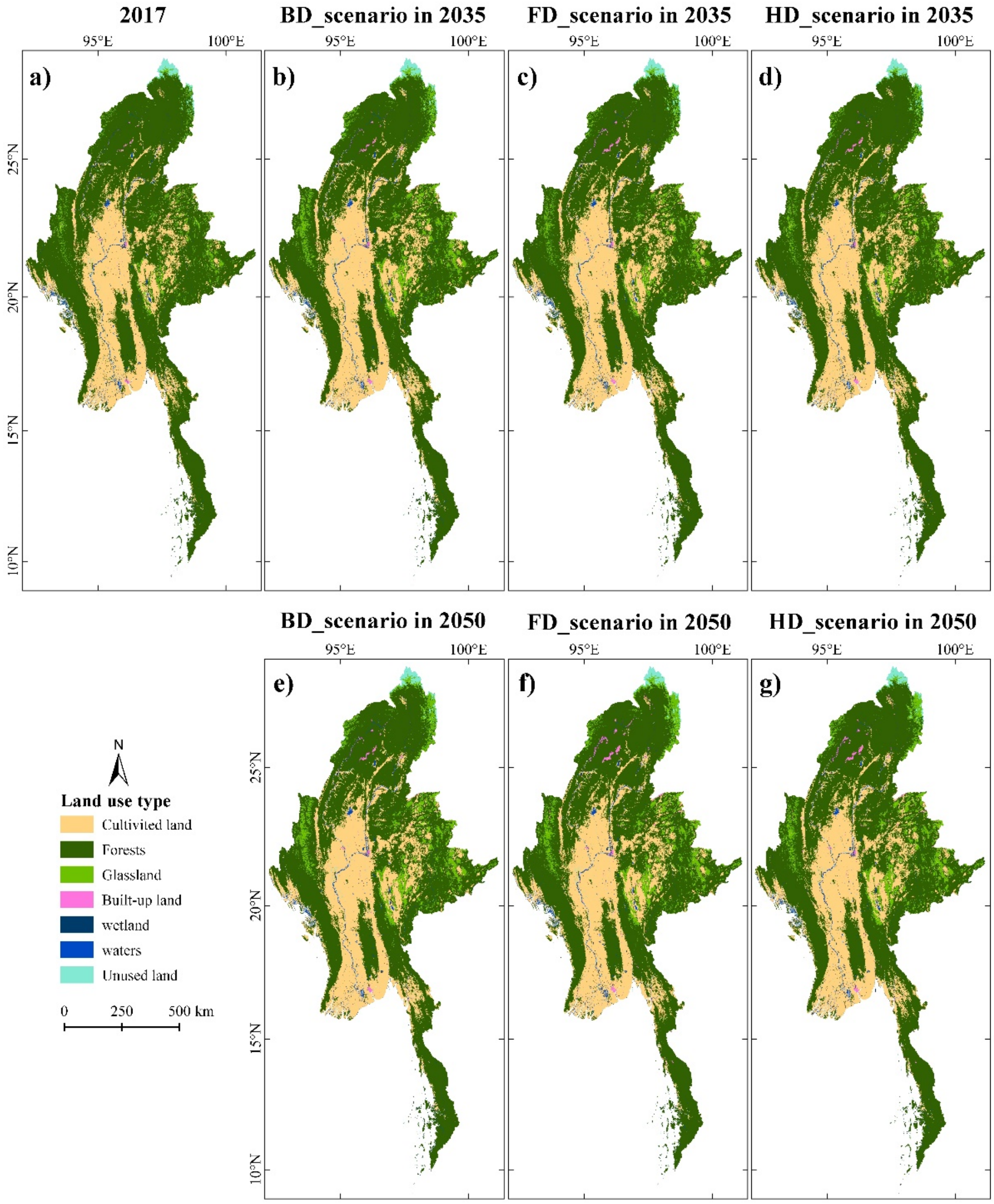


**Figure S1.** Simulated spatial patterns of land use under different scenarios in 2035 and 2050.

## Supplementary Table

**Table S1.** Confusion matrices and user/prouder accuracies of the simulated land use patterns in 2013, 2015, and 2017.

| Year | Land use type | Culti-vated land (km$^2$) | Forests (km$^2$) | Grass-land (km$^2$) | Built-up land (km$^2$) | wetland (km$^2$) | waters (km$^2$) | Unused land (km$^2$) | Total (km 2) | Prouder accuracy (%) | User accuracy (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | Cultivated land | 192,494.75 | 12,265.88 | 163.75 | 81.94 | 315.5 | 873.56 | 603.31 | 206,798.69 | 93.08 | 93.14 |
| | Forests | 11,478.25 | 501,706.06 | 7,201.63 | 90.31 | 31.25 | 927.25 | 96 | 521,530.75 | 96.2 | 96.23 |
| | Grassland | 545.31 | 6,972.44 | 12,941.56 | 1.75 | 0 | 0.81 | 120.44 | 20,582.31 | 62.88 | 62.85 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Built-up land | 133.88 | 35.56 | 0.31 | 1,744.94 | 0.94 | 7.94 | 2.19 | 1,925.75 | 90.61 | 90.79 |
| | wetland | 219.63 | 30.56 | 0.13 | 0.63 | 1,428.63 | 134.81 | 3.88 | 1,818.25 | 78.57 | 77.83 |
| | waters | 1,473 | 172 | 0 | 1.25 | 57.44 | 9,365.4 | 69.13 | 11,138.25 | 84.08 | 81.85 |
| | Unused land | 330.56 | 157 | 283.75 | 1.06 | 1.81 | 132.81 | 5,625.38 | 6,532.38 | 86.12 | 86.27 |
| | Total | 206,675.38 | 521,339.5 | 20,591.13 | 1,921.88 | 1,835.56 | 11,443 | 6,520.31 | 770,326.38 | | |
| 2015 | Cultivated land | 192,461.56 | 12,393.06 | 168.94 | 81.81 | 341.19 | 901.75 | 649.81 | 206,998.13 | 92.98 | 93.04 |
| | Forests | 11,687.13 | 499,420.69 | 7,901.19 | 94.0 | 31.38 | 899.19 | 96.69 | 520,130.31 | 96.02 | 96.06 |
| | Grassland | 571.88 | 7,683.06 | 13,387.75 | 1.44 | 0.06 | 0.56 | 120.94 | 21,765.69 | 61.51 | 61.49 |
| | Built-up land | 136.31 | 35.94 | 0.31 | 1,744.44 | 0.56 | 8.69 | 2.19 | 1,928.44 | 90.46 | 90.65 |
| | wetland | 211.13 | 31.06 | 0.06 | 0.44 | 1,423.06 | 141.13 | 4.25 | 1,811.13 | 78.57 | 76.71 |
| | waters | 1,477.37 | 173.56 | 0 | 1.19 | 57.13 | 9,345.2 | 67.81 | 11,122.25 | 84.02 | 81.72 |
| | Unused land | 323.94 | 171.38 | 314.44 | 0.94 | 1.81 | 138.94 | 5,619 | 6,570.44 | 85.52 | 85.65 |
| | Total | 206,869.31 | 519,908.75 | 21,772.69 | 1,924.31 | 1,855.19 | 11,435 | 6,560.69 | 770,326.38 | | |
| 2017 | Cultivated land | 187,685.19 | 15,868.63 | 312.63 | 217.44 | 482.75 | 1,657 | 631.5 | 206,855.13 | 90.73 | 90.87 |
| | Forests | 15,043.69 | 494,359.06 | 8,433.31 | 196.13 | 114.56 | 1,560.9 | 152.25 | 519,859.88 | 95.09 | 95.1 |
| | Grassland | 693.5 | 8,266.13 | 12,691.56 | 5.06 | 0.13 | 2.63 | 171.8 | 21,830.81 | 58.14 | 58.13 |
| | Built-up land | 257 | 142.63 | 4 | 1,466.81 | 4.38 | 46.69 | 4.25 | 1,925.75 | 76.17 | 75.72 |
| | wetland | 377.44 | 143.81 | 0.19 | 6.06 | 1,155.69 | 168.81 | 5.19 | 1,857.19 | 62.23 | 62.23 |
| | waters | 2,091.56 | 832.06 | 2.38 | 41.13 | 97.25 | 8,278.7 | 95.44 | 11,438.5 | 72.38 | 69.74 |
| | Unused land | 403.37 | 207 | 387.69 | 4.5 | 2.38 | 156.63 | 5,397.56 | 6,559.13 | 82.29 | 83.58 |
| | Total | 206,551.75 | 519,819.31 | 21,831.75 | 1,937.13 | 1,857.13 | 11,871 | 6,458 | 770,326.38 | | |

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