

# Analysis Land Use Changes In Mila Dam Using Software Arcswat

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**Submission date:** 25-Mar-2023 09:54AM (UTC-0500)

**Submission ID:** 2046225254

**File name:** G1001023237.pdf (614.7K)

**Word count:** 3048

**Character count:** 14392

## Analysis Land Use Changes In Mila Dam Using Software Arcswat

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### ABSTRACT:

Mila Dam is a multifunctional dam to support the continuation of the 1,689 hectare Rababaka Komplek Irrigation Area (DI) in Woja District which supports the irrigation rababaka complex. The Rababaka Complex irrigation system is the first interconnection irrigation system in Sumbawa Island. Land use changes that occur in the Mila Dam catchment (DTA) obtained from the comparison of 2013 satellite imagery with 2018. In 2013 the available open land area was 15% or 273.4 Ha, while in 2018 the land area existing open land is 51% or 927.6 Ha. With the change in the area of open land in the Mila Dam catchment, of course this will affect the amount of land erosion that occurs and the amount of sedimentation entering the Mila Dam. The highest level of erosion hazard (TBE) in 2013 in the Mila Dam watershed is the level of Light with an area of 1230.95 ha or 77.99% of the total area, followed by medium TBE class with 250.12 ha or 15.85% of the watershed area. The highest level of Erosion Danger in 2018 in the Mila Dam watershed is the Medium level with an area of 724.74 ha or 45.92% of the total area, followed by the Lightweight TBE class with 546.33 ha or 34.61% of the watershed area.

From the simulation results that have been modified in the sub-watershed with very severe and severe TBE, it can be seen that there was a change in Heavy Erosion Danger (TBE), which initially was 16.28% to 1.19% and the sediment transport yield decreased from 3048.85 tons / ha / year to 2517.58 ton / ha / year. From the simulation results that have been modified on sub-watershed with TBE Very Heavy, Heavy and Medium. It can be seen that there was a change in Heavy Erosion Hazard Level (TBE), which was originally at 16.28% to 0.65% and the results of sediment transport which declined from 3048.85 tons / ha / year to 1692.98 tons / ha / year. The following is a map of the Mila Dam Erosion Danger Level with the modified 2018 land Use conditions.

**Keyword:** Mila Dam, Erosion, Land Use.

DATE OF SUBMISSION: 15-01-2020

DATE OF ACCEPTANCE: 31-01-2020

### I. INTRODUCTION

West Nusa Tenggara Province is one of the national rice barns which has a greater priority on agricultural development. NTB is one of the provinces of National stock rice barns. The construction of the Mila Dam is an attempt by the Central Government to realize equitable infrastructure development to support water security and national food security. Mila Dam is located in Woja Subdistrict, Dompu Regency, West Nusa Tenggara Province, becoming a unified system with Tanju Dam. The existence of the Mila Dam with a 6.73 million<sup>3</sup> reservoir volume was built to support the function of the Rababaka Complex Irrigation Area. Through the diversion weir and the Interbasin channel, the two dams will hold the excess

### II. STUDY AREA

Mila Dam is located on the Sori Mila River, Matua Village and Rababaka Village, Woja District, Dompu District, West Nusa Tenggara Province.



Figure 1. Mila Dam location in Dompu Regency

### III. METHOD

#### A. Topography Conditions

The object of the topography is about the position of a section and generally refers to horizontal coordinates such as latitude and longitude, and vertically that is the height. Viewed from the topographic aspect of Dompu Regency, it has 56,784 hectare(23.43%) of land with an altitude between 0-100 meters above sea level. 123,020 hectare (52.92%) is at an altitude between 100-500 meters above sea level, and 38,558 hectare(16.59%) is at an altitude of 500-1,000 meters above sea level, and there are 14,098 hectare(6.06% ) the land is above 1,000 meters above sea level. When viewed from the slope there are 43,470 hectare at a slope between 0-2%, 81,795 Ha at a slope between 2-15% which is the most extensive area, 75,785 hectare at a

slope of 15-40%, and there are 31,410 hectareat slope above 50%.



Figure2. Topographic Map of Dompu Regency

**B. Geological Conditions**

In general, the topography of Dompu Regency is dominated by steep slopes of 15-40% and sloping slopes of 2-15%.

**C. Climatology Conditions**

Climatology studies only focus on rainfall. Rainfall is the amount of water that falls on a flat surface during a certain period measured in units of height (mm) above the horizontal surface (if there is no evaporation, runoff and infiltration). The rainfall unit commonly used by BMKG is millimeters (mm). Rainfall of 1 (one) millimeter, meaning that in an area of one square meter in a flat place where water is as high as 1 (one) millimeter or accommodated as much as 1 (one) liter or 1000 milliliters of water.

The highest rainfall in Dompu District based on 2014 statistical data was 343 mm, this occurred in January in Hu'u District. While the lowest rainfall is 6 mm and occurs in July in the Pekat District. The highest average rainfall occurs in Dompu District which is 105 mm. The average rainfall in Dompu Regency is 69.83 mm. Most rainy days occur in December, which is 24 days and occurs in Dompu District.

**D. Hydology Conditions**

Seen from the hydrological aspect, Dompu District has sufficient water supply for the needs of daily living and irrigation for agricultural land, because Dompu Regency is supported by 19 large river flows and several small rivers and several other water sources that are watered throughout the year that can used as a source of livelihood and irrigation for the people of Dompu.

**IV. RESULT AND DISCUSSION**

Land use changes that occur in the Mila Dam catchment (DTA) obtained from the comparison of 2013 satellite imagery with 2018. In 2013 the available open land area was 15% or 273.4 Ha, while in 2018 the land area existing open land is 51% or 927.6 Ha. With the change in the area of open land in the Mila Dam catchment, of course this will affect the amount of land erosion that occurs and the amount of sedimentation entering the Mila Dam.

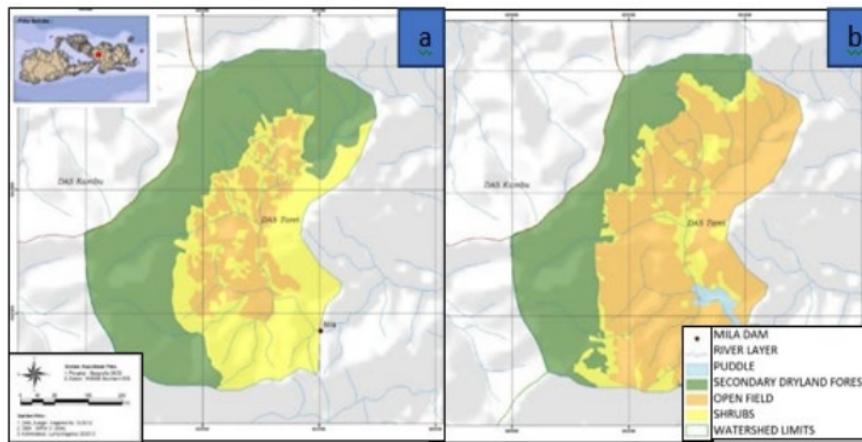


Figure3. (a) Mila Dam Land Use Map of 2013 (Left) and (b) Mila Dam Land Use Map of 2018 (right)

**A. Land Use Data of the Mila Dam Watershed**

In the existing Mila Dam watershed area, it is classified into 4 (four) land use classes which are then adjusted to the input code of Arcswat.

Table1. Code land use In Mila Dam Watershed.

| No. | Area(ha) | LU Swat | Land Use       |
|-----|----------|---------|----------------|
| 1   | 535.92   | FRST    | Dryland Forest |

| No. | Area(ha) | LU Swat | Land Use   |
|-----|----------|---------|------------|
| 2   | 207.84   | GRBN    | Shrubs     |
| 3   | 24.27    | WATR    | Water      |
| 4   | 878.63   | FPEA    | Open Field |

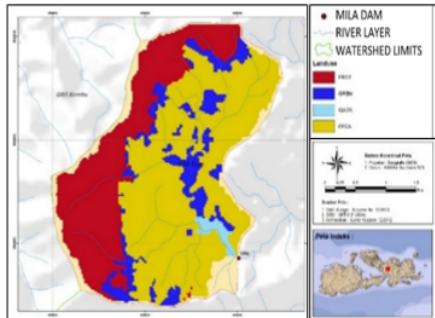


Figure4. Map of the distribution of land use in 2018 in the Mila Dam Basin

### B. SWAT Simulation in Mila Dam Catchment Area

SWAT model simulation on the Mila Dam watershed uses a monthly format by comparing the two land use periods, namely 2013 land use with 2018 land use to determine the amount of sedimentation that occurs in the Mila Dam watershed.

Based on the simulation results, it can be concluded that the dominant contributor of sediment in the Mila Dam watershed is sub-watersheds 6, 14, 5, 15, and 25 with 2018 land use.

From the results of the above analysis, it can be seen that changes in land use that occurred during the five years increased the sedimentation rate by 64% from 88,928 tons / year (2013) to 146,011 tons / year (2018).



Figure5.(a) Graph of Correlation between Sediment Transport and Mila Dam Discharge with Land Use in 2013 (left), and (b) Graph of Relationship of Sediment Transportation with Mila Dam Discharge with 2018 Land Use (right)

### C. Erosion Hazard Classification (TBE) Classification

The classification of erosion hazard level is obtained by comparing the results of the total count of eroded land per year in each HRU and the Erosion Hazard Level (TBE) can be calculated by comparing the erosion rate of a land (land unit) to the amount of erosion allowed.

In 2013 the average erosion yield of the Mila Dam watershed produced a figure of 86.1 tons / ha / year, while the erosion yields for each unit of land varied from 6.44 tons / ha / year to 680.29 tons

/ ha / year, whereas in 2018 the average erosion yield of the Mila Dam watershed is 112.92 tons / ha / year, while the erosion yield for each unit of land varies from 6.44 tons / ha / year to 668.24 tons / ha / year. After the amount of erosion for each HRU land unit is generated, the next step is to divide the erosion class of each land unit in accordance with the provisions, namely based on the effective depth of the soil. Results of the Erosion Hazard Level (TBE) of the Mila Dam watershed can be seen in the following table.

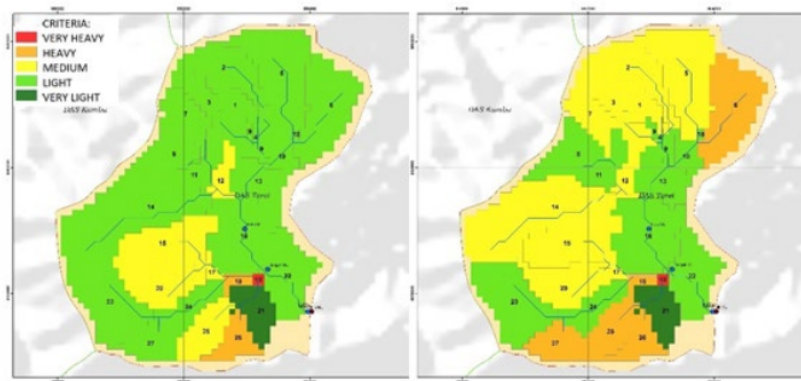
Table2. Recapitulation of Erosion Danger Hazard Levels of the Mila Dam Watershed in 2013

| Criteria   | Erosion (tons / ha / year) | Erosion Result (ton/ha/year) | Erosion Results (tons / ha / year) | Percentage (%) |
|------------|----------------------------|------------------------------|------------------------------------|----------------|
| TBE        |                            |                              |                                    |                |
| Very Heavy | >480                       | 680.29                       | 3.41                               | 0.22%          |
| Heavy      | 180 - 480                  | 371.62                       | 46.95                              | 2.97%          |
| Medium     | 60 - 180                   | 580.10                       | 250.12                             | 15.85%         |

| Criteria   | Erosion (tons / ha / year) | Erosion Result (ton/ha/year) | Erosion Results (tons / ha / year) | Percentage (%) |
|------------|----------------------------|------------------------------|------------------------------------|----------------|
| Light      | 15 - 60                    | 686.37                       | 1230.95                            | 77.99%         |
| Very Light | <15                        | 6.44                         | 46.95                              | 2.97%          |
| Total      |                            | 2324.82                      | 1578.38                            | 100.00%        |

**Table3.**Recapitulation of Erosion Danger In Mila Damwatershed area with Land Use condition2018

| Criteria   | Erosion (tons / ha / year) | Erosion Result (ton/ha/year) | Erosion Results (tons / ha / year) | Percentage (%) |
|------------|----------------------------|------------------------------|------------------------------------|----------------|
| Very Heavy | >480                       | 33516.87                     | 105.85                             | 6.71%          |
| Heavy      | 180 - 480                  | 2075.32                      | 441.33                             | 27.96%         |
| Medium     | 60 - 180                   | 300.01                       | 128.05                             | 8.11%          |
| Light      | 15 - 60                    | 156.10                       | 348.29                             | 22.07%         |
| Very Light | <15                        | 27.57                        | 554.87                             | 35.15%         |
| Total      |                            | 36075.87                     | 1578.38                            | 100.00%        |

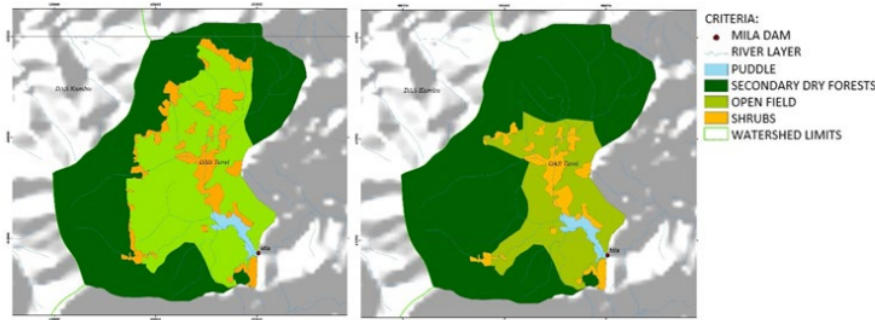


**Figure6.**(a)Mila Dam Erosion Hazard Map with 2013 Land use (left), and (b) Mila Dam Erosion Hazard Map with Land use condition2018 (right hand side).

The table above shows that the Erosion Hazard Level (TBE) in 2013 the highest in the Mila Dam watershed is the Light level with an area of 1230.95 ha or 77.99% of the total area, followed by medium TBE class with a land area of 250.12 ha or 15.85% of the total area watershed area. The highest level of Erosion Danger in 2018 in the Mila Dam watershed is the Medium level with an area of 724.74 ha or 45.92% of the total area, followed by the Lightweight TBE class with 546.33 ha or 34.61% of the watershed area.

#### D. Land Reforestation Simulation

Land reforestation simulations are carried out in sub-watersheds that experience Very Heavy, Severe and Moderate Erosion Hazard (TBE). The simulation is carried out in two scenarios, firstly by modifying land use in the related sub-watershed into forest land use in sub-watersheds that experience very severe and severe TBE. Then the second is by modifying land use in the related sub-watershed into forest land use in sub-watersheds that experience very severe, severe and moderate TBE. From the results of the running test with arcSWAT, it can be seen the changes in sediment transport that occurred after the simulation. The simulation results will be presented in the table below.



**Figure 7.** (a) The 2018 Land Use Map of the Mila Dam Watershed that has been modified in the very watershed sub-watershed with TBE Very Heavy and Heavy (left), and (b) The Land Use Map of 2018 Mila Dam that has been modified in the sub-watershed with Very Heavy, Heavy TBE, and Medium (right)

**Table 4.** Recapitulation of Erosion Danger Hazard Levels of the Mila Dam Watershed in 2018 Modified Land Use in Sub Watersheds with Very Heavy and Heavy TBE

| Criteria   | Erosion (tons / ha / year) | Erosion Result (ton/ha/year) | Erosion Results (tons / ha / year) | Percentage (%) |
|------------|----------------------------|------------------------------|------------------------------------|----------------|
| TBE        |                            |                              |                                    |                |
| Very Heavy | >480                       | 669.20                       | 3.41                               | 0.22%          |
| Heavy      | 180 - 480                  | 367.09                       | 18.78                              | 1.19%          |
| Medium     | 60 - 180                   | 1003.01                      | 735.84                             | 46.62%         |
| Light      | 15 - 60                    | 467.05                       | 773.40                             | 49.00%         |
| Very Light | <15                        | 11.23                        | 46.95                              | 2.97%          |
| Total      |                            | 2517.58                      | 1578.38                            | 100.00%        |

From the results of simulations carried out it can be seen that there was a change in Heavy Erosion Hazard Level (TBE) which was originally

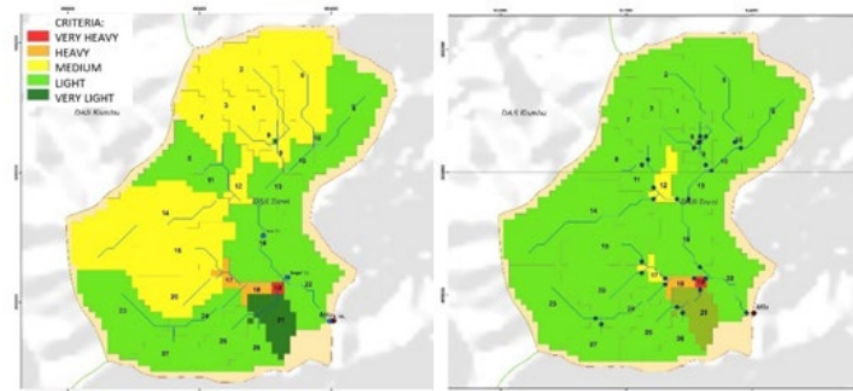
at 16.28% to 1.19% and the results of sediment transport which decreased from 3048.85 tons / ha / year to 2517.58 tons / ha / year.

**Table 5.** Recapitulation of Erosion Danger Hazard Levels of the Mila Dam watershed with Modified Land Use in 2018 in Sub Watersheds with Very Heavy, Heavy and Moderate TBE

| Criteria   | Erosion (tons / ha / year) | Erosion Result (ton/ha/year) | Erosion Results (tons / ha / year) | Percentage (%) |
|------------|----------------------------|------------------------------|------------------------------------|----------------|
| TBE        |                            |                              |                                    |                |
| Very Heavy | >480                       | 678.20                       | 3.41                               | 0.22%          |
| Heavy      | 180 - 480                  | 183.58                       | 10.24                              | 0.65%          |
| Medium     | 60 - 180                   | 185.74                       | 31.58                              | 2.00%          |
| Light      | 15 - 60                    | 635.00                       | 1485.34                            | 94.10%         |
| Very Light | <15                        | 10.47                        | 47.80                              | 3.03%          |
| Total      |                            | 1692.98                      | 1578.38                            | 100.00%        |

From the results of simulations carried out it can be seen that there was a change in Heavy Erosion Hazard Level (TBE) which was originally at 16.28% to 0.65% and the results of sediment

transport which decreased from 3048.85 tons / ha / year to 1692.98 tons / ha / year. The following is a map of the Mila Dam Erosion Danger Level with the modified 2018 land use conditions.



**Figure 8.**(a) Mila Dam Erosion Hazard Map with Modified 2018 Land Use conditions in the sub watershed with very severe and severe TBE (left), and (b) Mila Dam Erosion Hazard Map with 2018 Modified Land Use conditions on sub Watershed with TBE Very Heavy, Heavy and Medium (right).

## V. CONCLUSION

The conclusions from the land use study at Dila Mila Dam in Dompu Regency are:

1. Land use in the Mila Dam watershed area is dominated by 878.63 Ha of open land (53.4%).
2. From the analysis of land use changes that occurred over the past five years, namely the increase in sedimentation rate of 64% from 88,928 tons / year (2013) to 146,011 tons / year (2018).
3. In 2013 the average erosion yield of the Mila Dam watershed produced a figure of 86.1 tons / ha / year, while the erosion yields for each unit of land varied from 6.44 tons / ha / year to 680.29 tons / ha / year, whereas in 2018 the average erosion yield of the Mila Dam watershed is 112.92 tons / ha / year, while the erosion yield for each unit of land varies from 6.44 tons / ha / year to 668.24 tons / ha / year.
4. The highest level of Erosion Hazard (TBE) in 2013 in the Mila Dam watershed is the Light level with an area of 1230.95 ha or 77.99% of the total area, followed by medium TBE class with a land area of 250.12 ha or 15.85% of the watershed area. The highest level of Erosion Danger in 2018 in the Mila Dam watershed is the Medium level with an area of 724.74 ha or 45.92% of the total area, followed by the Lightweight TBE class with 546.33 ha or 34.61% of the watershed area.
5. From the simulation results that have been modified in the sub-watershed with very heavy and heavy TBE, it appears that there was a change in the Heavy Erosion Danger (TBE),

which initially was 16.28% to 1.19% and the sediment transport yield decreased from 3048.85 tons / ha / year to 2517.58 tons / ha / year.

6. From the simulation results that have been modified in sub-watershed areas with very severe, severe and moderate TBE. It can be seen that there was a change in Heavy Erosion Hazard Level (TBE), which was originally at 16.28% to 0.65% and the results of sediment transport which declined from 3048.85 tons / ha / year to 1692.98 tons / ha / year. The following is a map of the Mila Dam Erosion Danger Level with the modified 2018 land use conditions.

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PAGE 2

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