



Presented at the FIG Working Week 2023,  
28 May - 1 June 2023 in Orlando, Florida, USA

# FIG WORKING WEEK 2023

28 May - 1 June 2023 Orlando Florida USA

Protecting  
Our World,  
Conquering  
New Frontiers

## Analysis of the Impact of Rebana Priority Areas on Phenomenon of Landuse Changes in Indramayu Regency, Indonesia

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## Outline

- Introduction
  - Literature Review
  - Overview of The Region
  - Analysis and Discussion
  - Conclusion and Recommendation



## Introduction

Indramayu Regency is a Indonesia National Food Barn with production in 2020 of 1,363,312 tons of dry milled grain (DMG), equivalent to 782,132 tons of rice or 25% of total Indonesia national production (BPS, 2020).

There has been a change in the function of agricultural land in Indramayu Regency which has resulted in a decrease in food production and threatens national food security. The conversion of agricultural land occurs naturally due to population growth and due to policies to accelerate the development of the Rebana Priority Area.

There is no comprehensive study and accurate data regarding trends in land use change and the effectiveness of controlling instruments so that land use in Indramayu Regency is optimal.



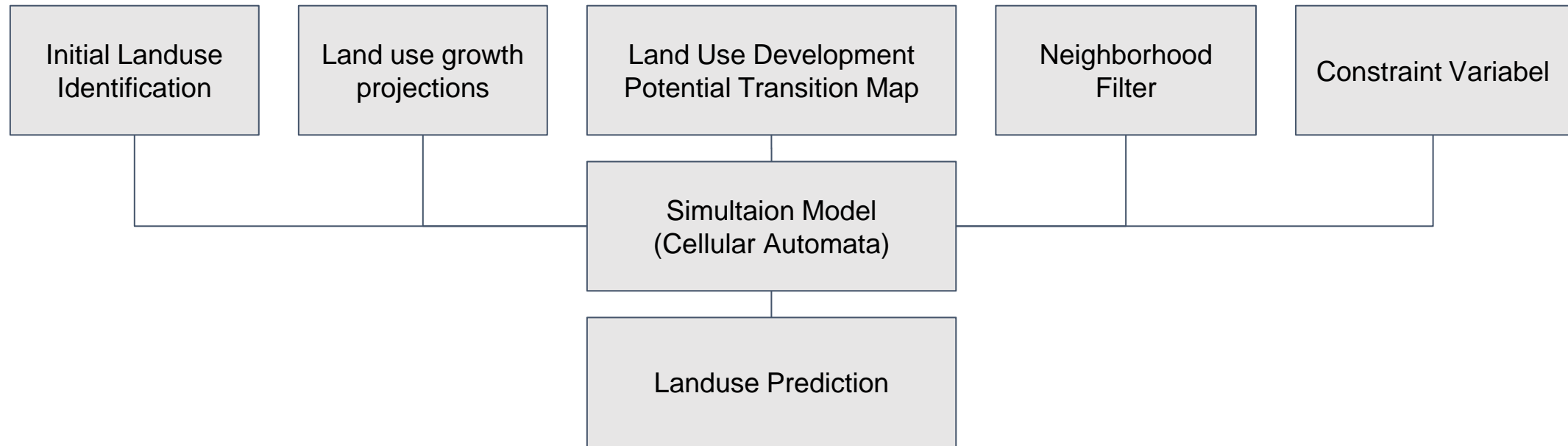
## Research Goals

The prediction of land use change in Indramayu Regency uses the CA method and its relation to the Rebana priority area development plan.

## Research Objectives

1. Identification of trends in land cover change in Indramayu Regency in 2011-2021
2. The prediction of land cover for Indramayu Regency in 2031 was produced according to the existing trend scenario (as usual) and according to the Industrial Allotment Area scenario of "Rebana Priority Area" built in 2021 and 2031.
3. Resulted in an analysis of the suitability of predictions of land cover in 2031 for the spatial planning of the RTRW of Indramayu Regency for 2011-2031 (Revised for 2021-2041), Protected Paddy Fields and KPI of Rebana Priority Areas.

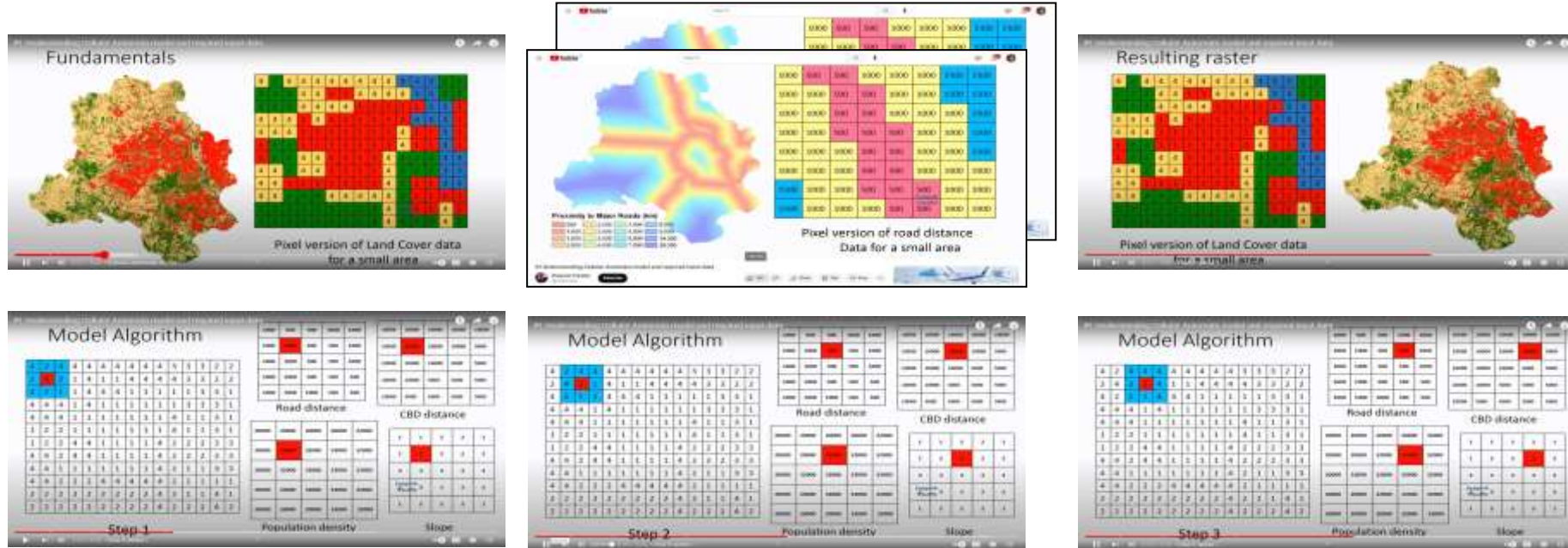
## Literature Review : Land Cover Model Changes



Land cover change modeling is one of the innovative techniques for inventorying, monitoring and managing land resources. The simulation stages and the main components in the land cover change simulation include identification of baseline land cover, projected land use growth, and transition rules.



## Literature Review : Cellular Automata



**Visualization of Pixel Operations in the Cellular Automata Method**

Land cover change modeling is one of the innovative techniques for inventorying, monitoring and managing land resources. The simulation stages and the main components in the land cover change simulation include identification of baseline land cover, projected land use growth, and transition rules.

## Literature Review : Cellular Automata

There are 5 basic elements of cellular automata, namely (Liu & He, 2009):

1. Cell (cell) is the smallest unit in the cellular space. These cells can be in the form of a square which is the basis for analysis in modeling.
2. Condition (state), is an attribute of a system. At any given time, each cell can only have one condition out of a number of conditions (eg representing the type of land use).
3. Neighborhood, is a number of closest neighbor cells that interact with each other to determine the value of a new cell.
4. Transition rules are transitional patterns that determine how a type of land use changes based on current conditions and the conditions of neighboring cells.
5. Time (time-step), is the time variable used during the calculation process and is expressed as the iteration period.

In cellular automata modeling, a land cover cell will change into another land cover cell based on certain transition rules. Distance and area factors are one of the important geospatial elements that affect the dynamics of changes in a phenomenon. The value of the range of a driving factor will determine the direction of change of a particular type of land use, where a driving factor can have a different effect on different types of land use.

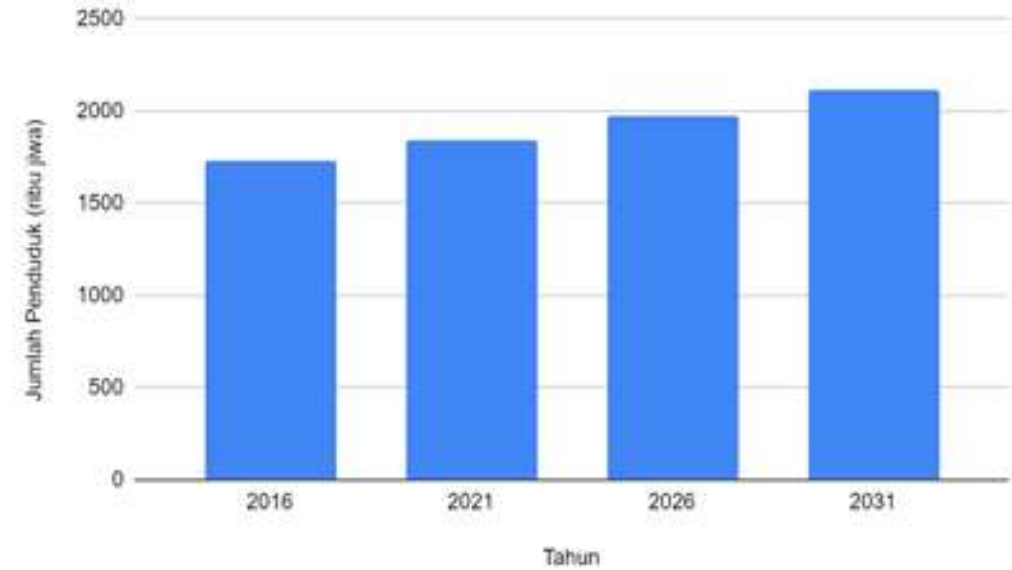




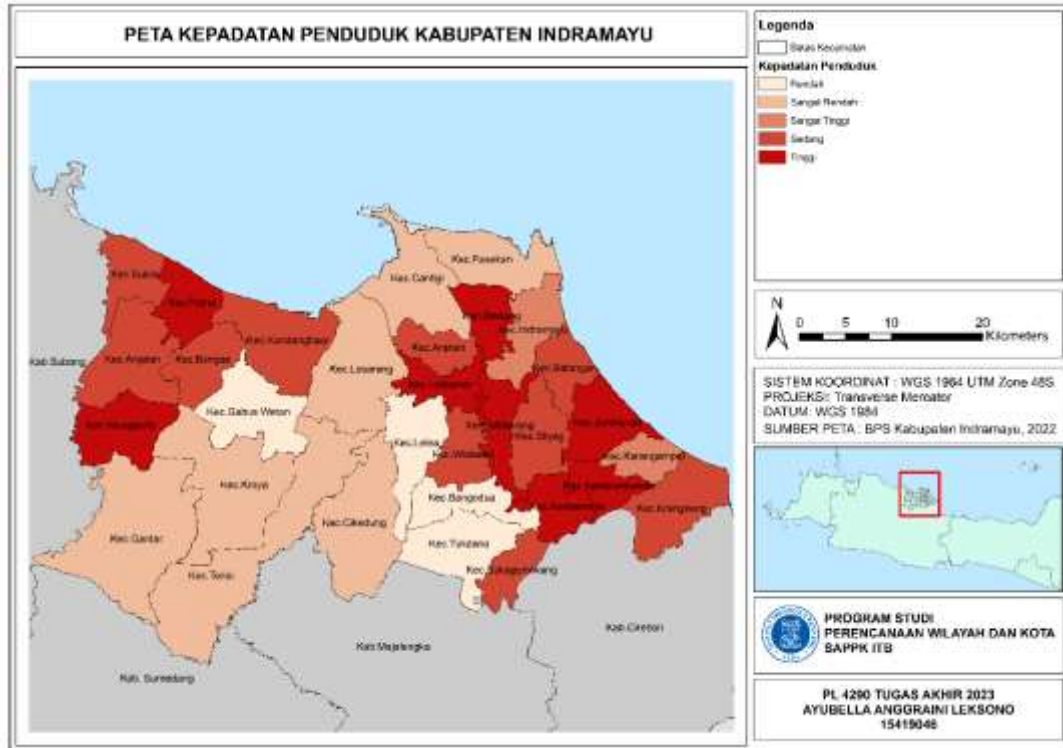


Overall, the population of Indramayu Regency constitutes 35.60% of the population of the Rebana Area. The Rebana Golden Triangle area has 10% of the total population of West Java Province. Indramayu District is a district and the highest population in Indramayu Regency

Proyeksi Jumlah Penduduk 2016-2031



The population of Indramayu Regency has increased from 2011 to 2022. The population projection from 2016 to 2031, there is an increase of 436,782 people over 20 years. This population will increase significantly if the Rebana area plan is completed.



**RI Law No. 41 of 2009 concerning Protection of Sustainable Food Agricultural Land**

**District Regulation Indramayu No. 16 of 2013 concerning Sustainable Food Agricultural Land. 125,529 hectares of rice fields**

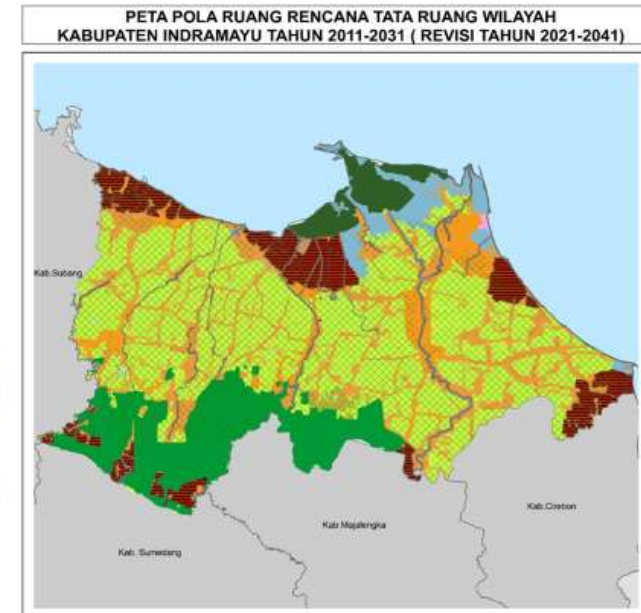
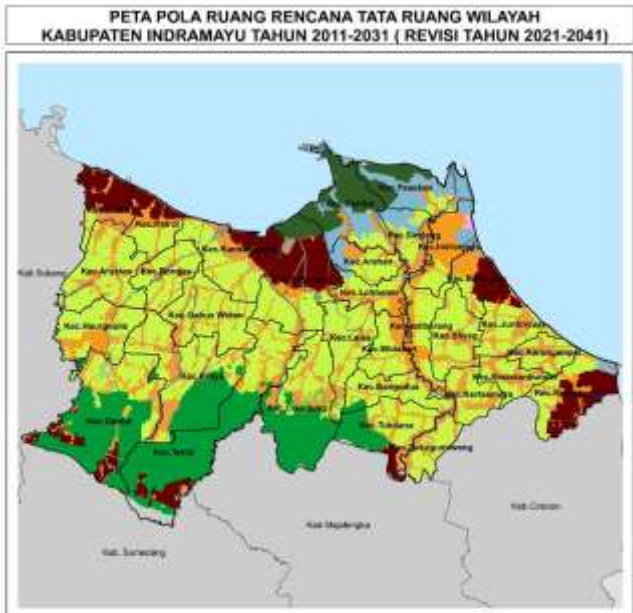
**Republic of Indonesia Presidential Regulation No. 87 of 2021 concerning the Acceleration of the Development of the Tambourine Area and the Southern West Java Region.**

**National Food Barn 226,626 hectares, 25% of national production**

**Rebana Priority Area**  
Best Investment Destination in the ASEAN region. Investment plan of IDR 390 trillion.

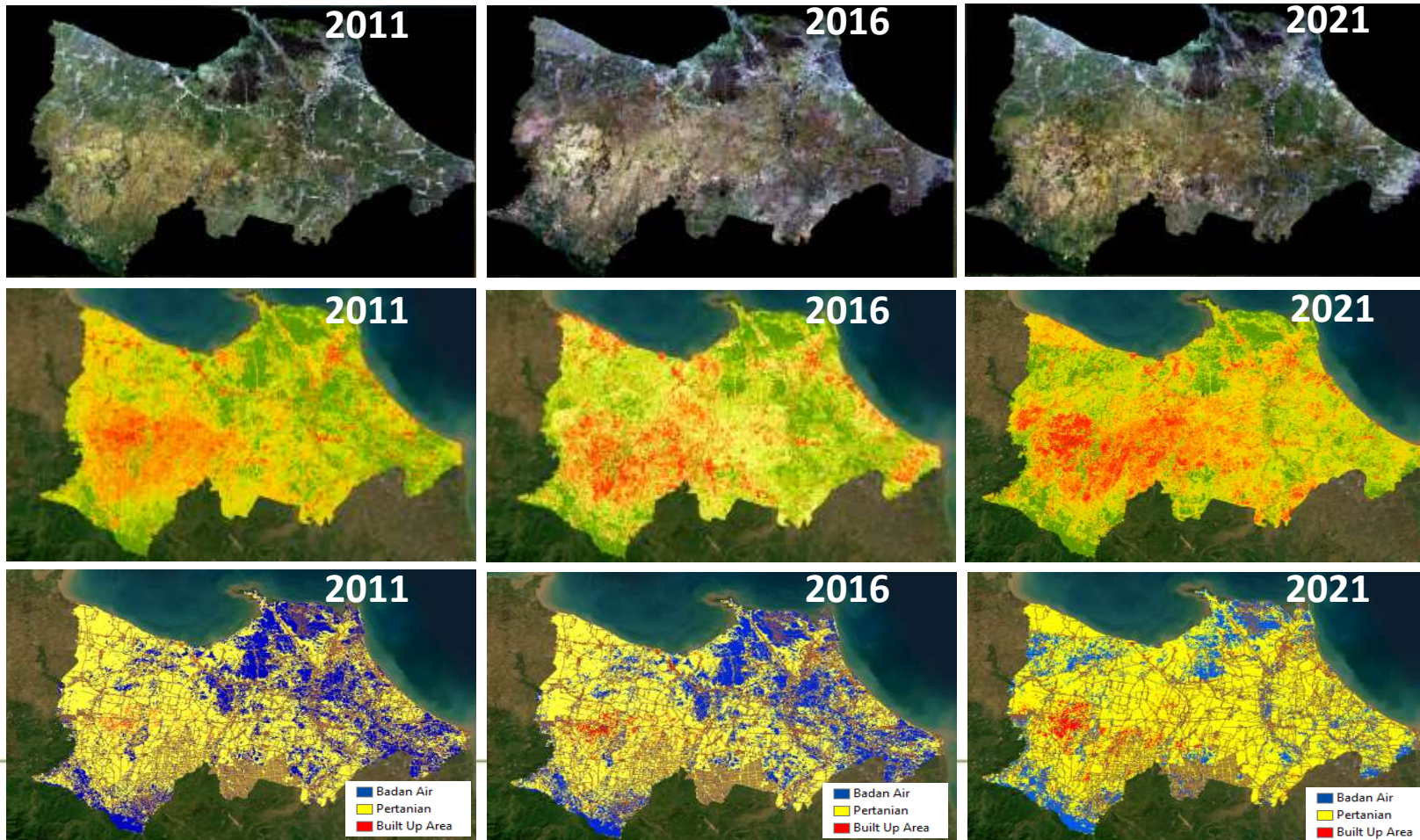
**Very High Landuse Changes**  
Settlements increased 14.8/year  
Paddy fields decreased by 13.9

**Overlapping LP2B & KPI**





## Analysis and Discussion : Trend of Landuse Change in 2011-2016



Citra Landsat 7 band 3,2,1 & Landsat 8  
Landsat 8 band 4,3,2

### Image Enhancement

NDVI (vegetasi)  
NDBI (built up area),  
NDWI (water body)

### Image Classification

Metode Hibrid  
Unsupervised Isodata  
Supervised ANN

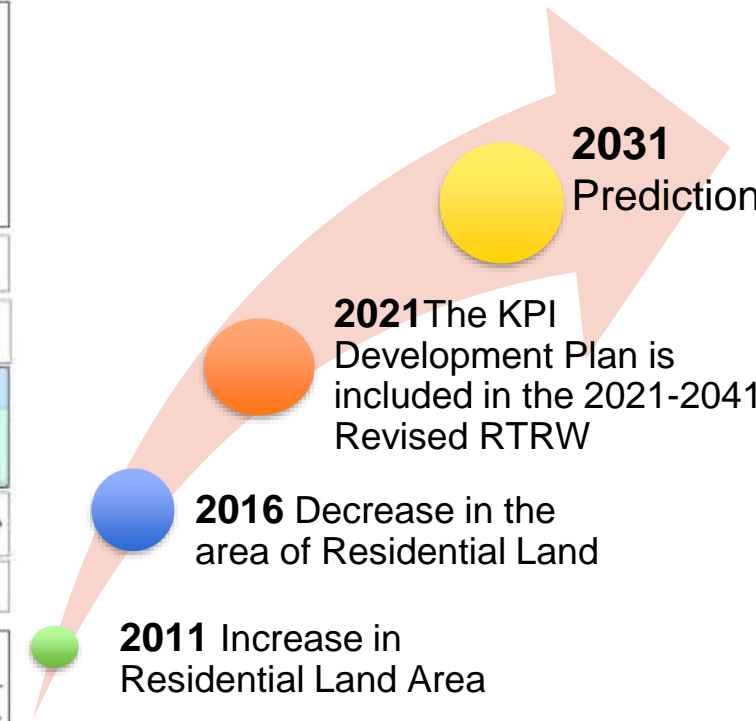
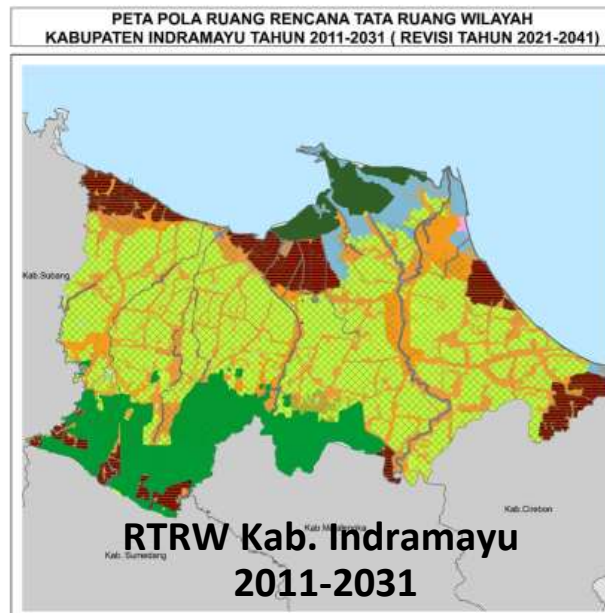
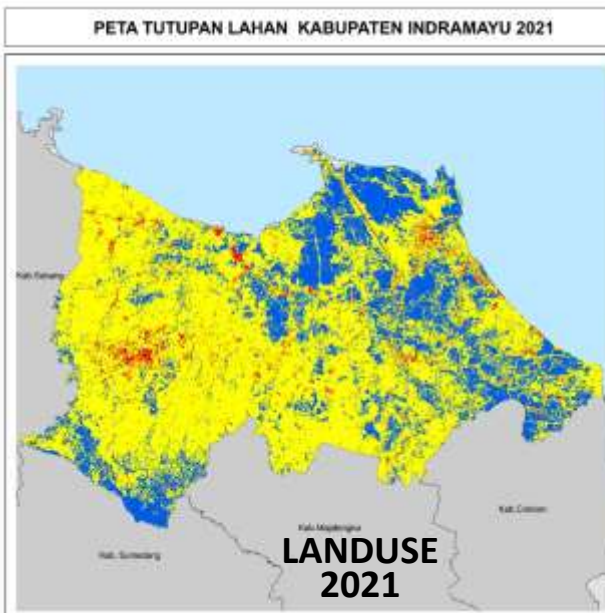
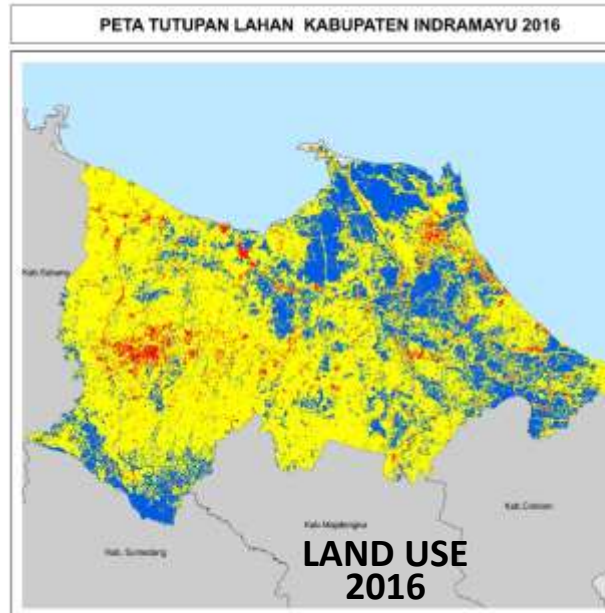
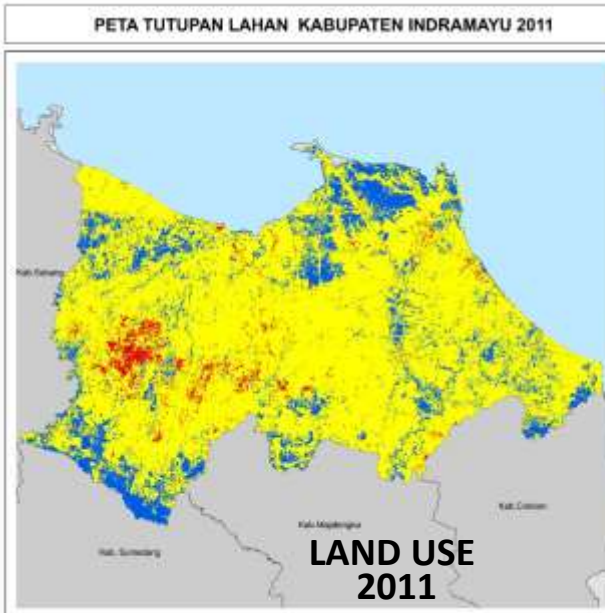
### Reclassification

HISTOGRAM OPERATION

Landuse Map  
Format Raster

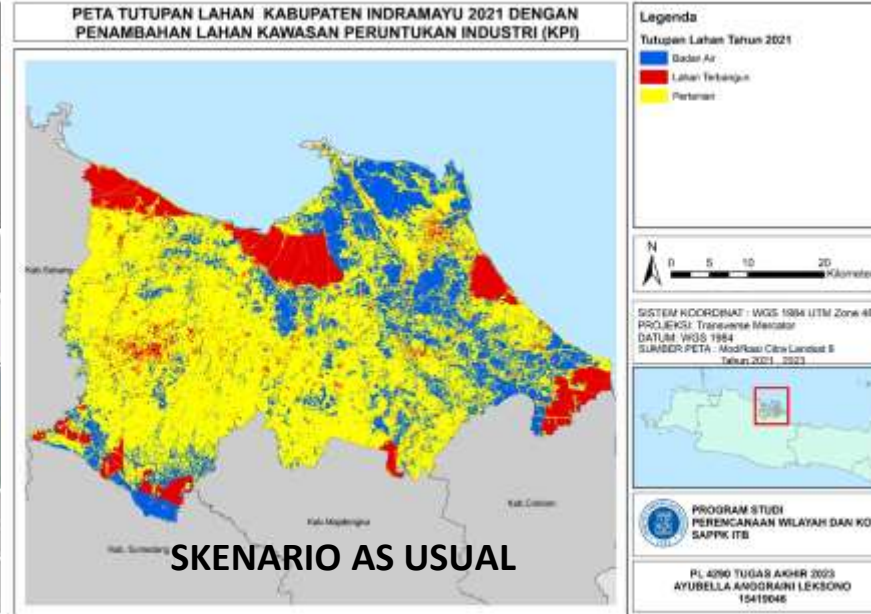
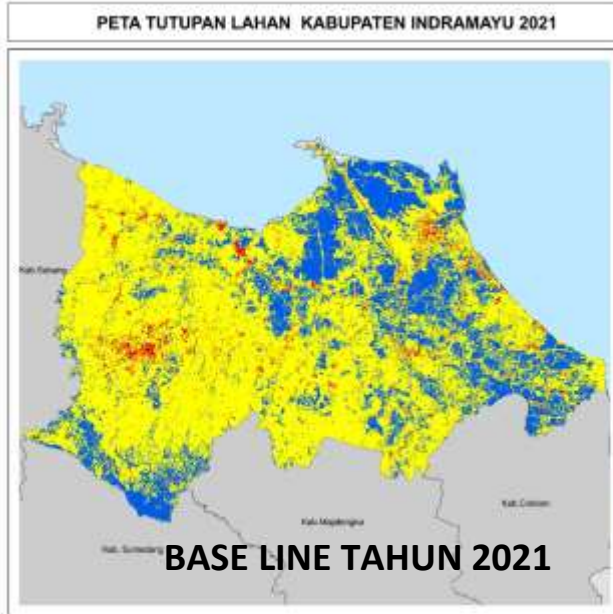


# TREND OF LAND COVER CHANGES IN 2011-2016-2021





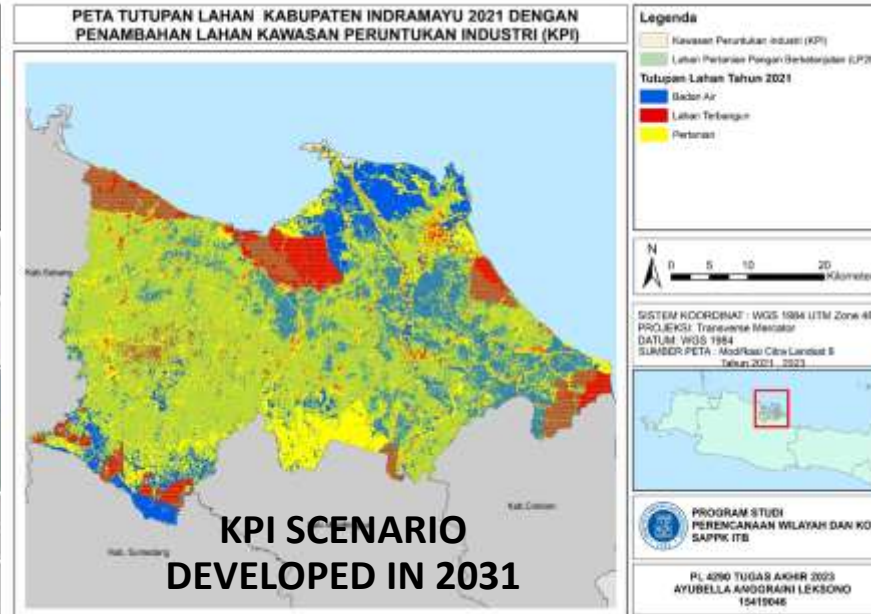
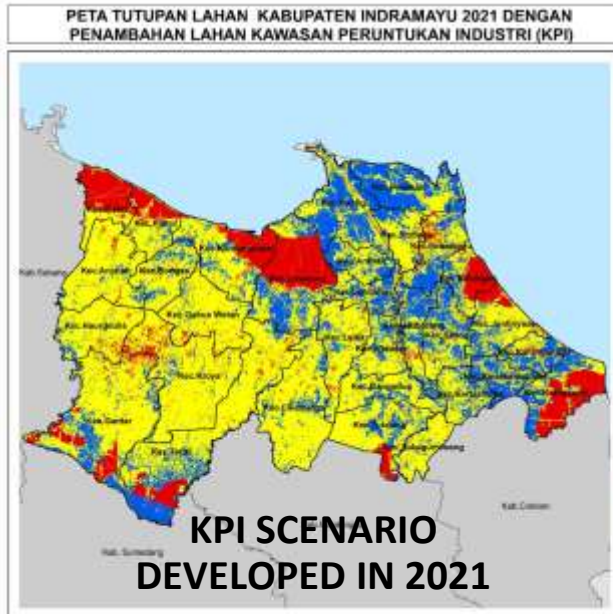
# Analysis and Discussion : The Prediction of Land Cover for Indramayu in 2021



**3 Scenarios for Land Cover Prediction in 2031 were prepared**



**SKENARIO AS USUAL  
KPI SCENARIO DEVELOPED IN 2021**

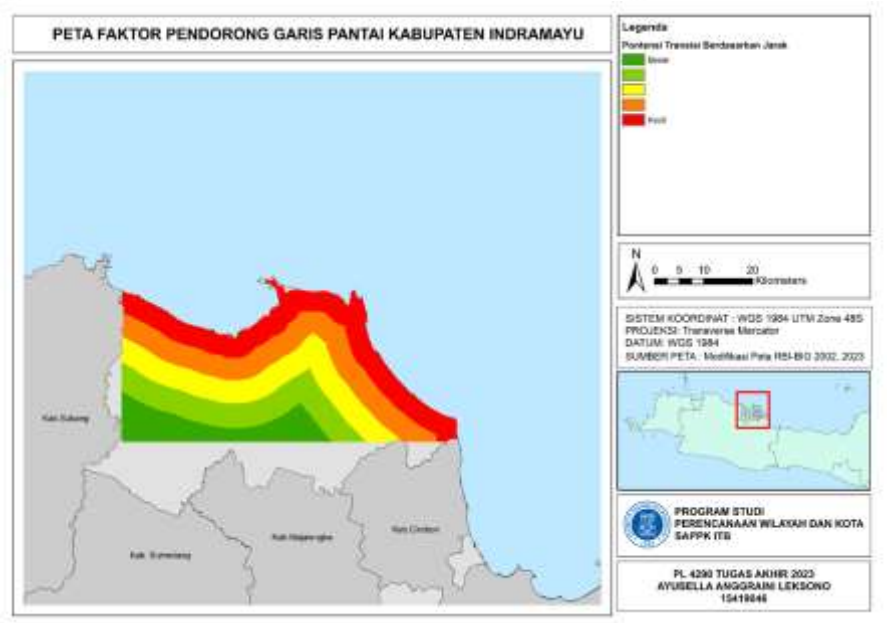
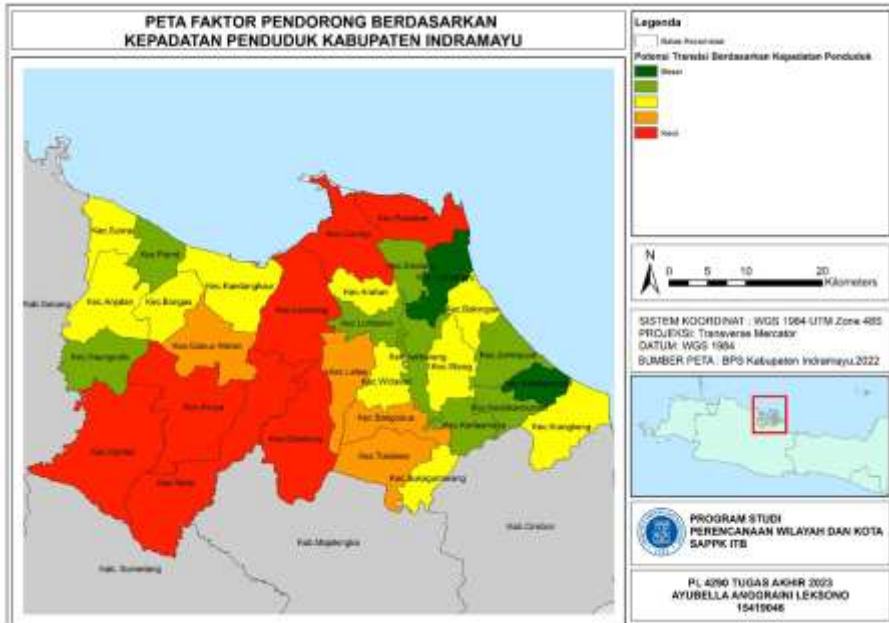
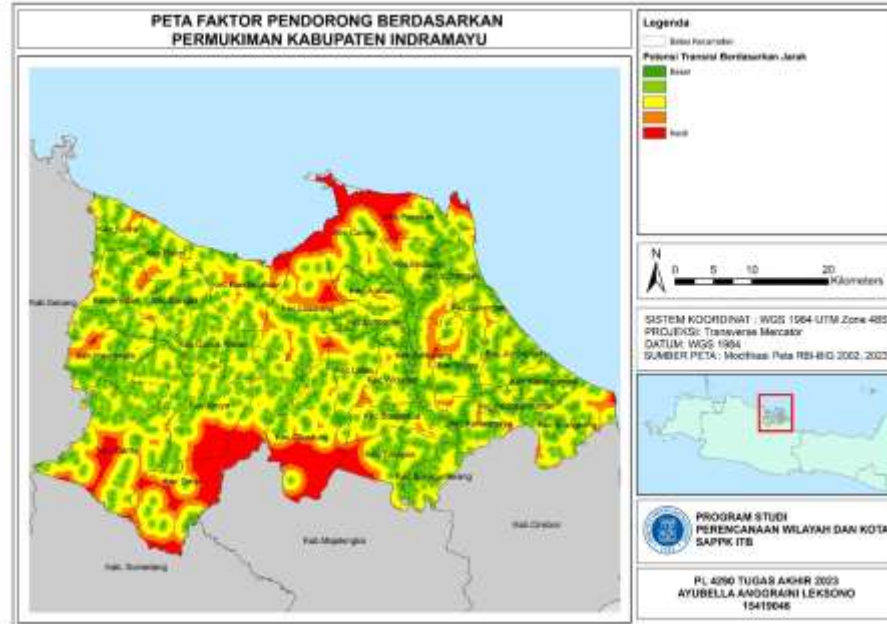
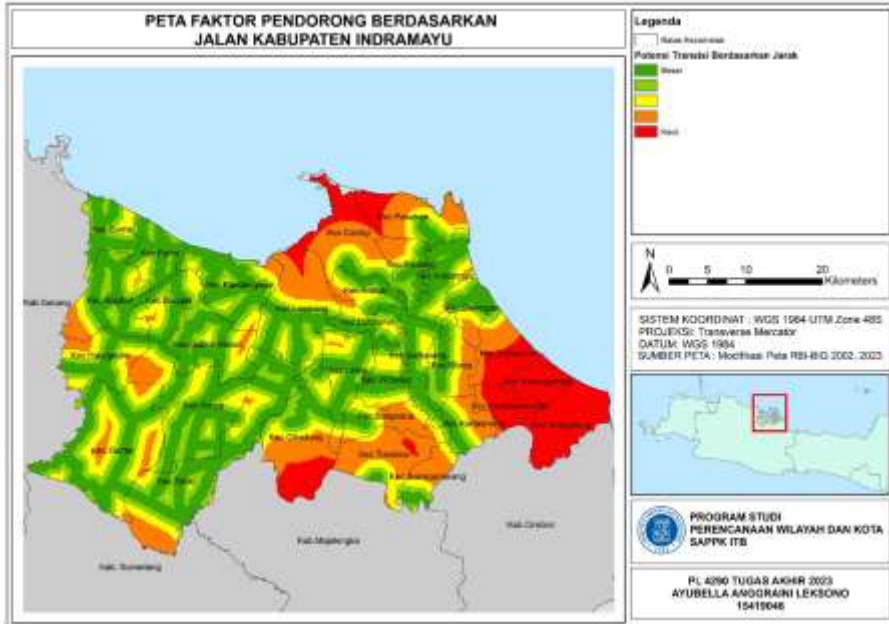


**KPI SCENARIO DEVELOPED IN 2031**



**LAND COVER PREDICTION IN 2031**  
Analyzed against Spatial Planning of RTRW, LP2B & KPI

# Driving Factor of Landuse Changes



## Distance to road:

The closer to the road, the higher the potential for land cover change. The first driving factor.

## Distance to settlements:

The closer to existing settlements, the higher the potential for land cover change. Settlements are the second driving factor.

## Population density:

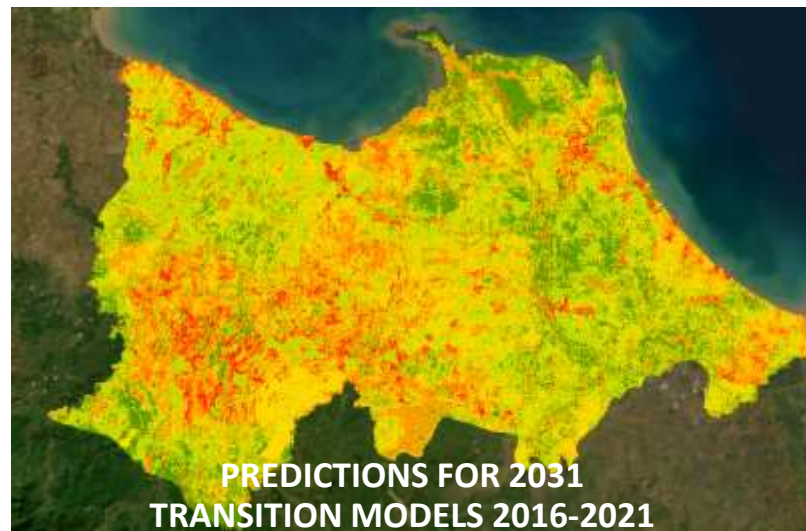
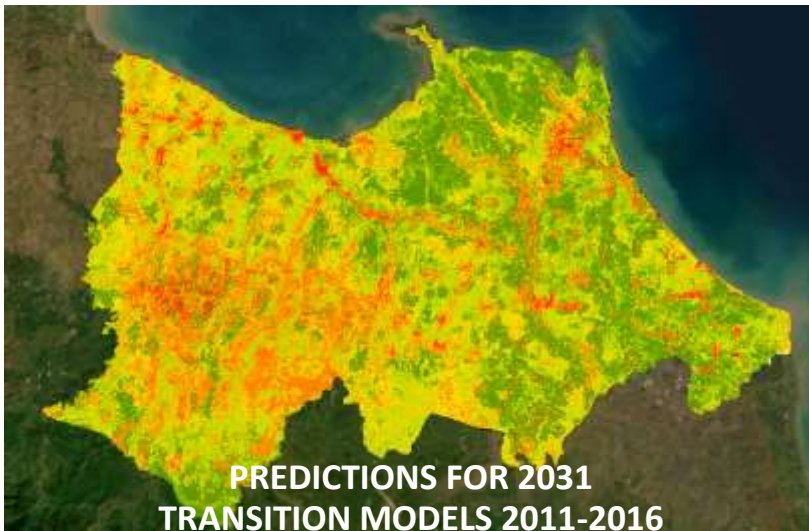
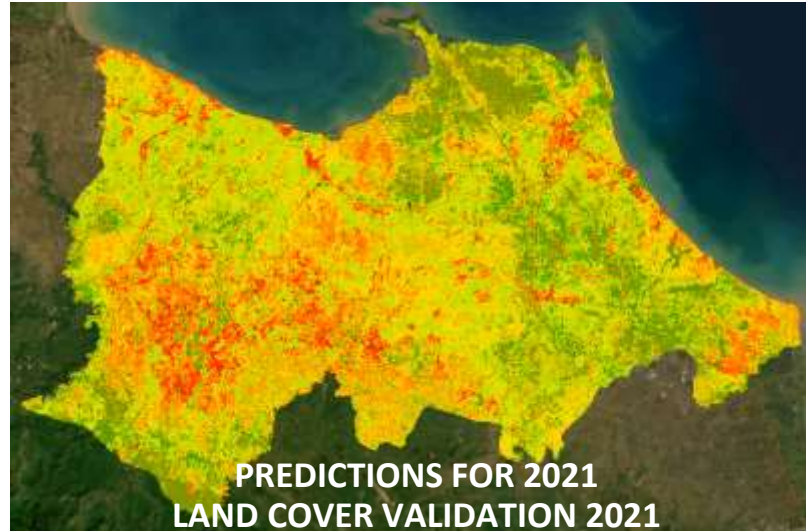
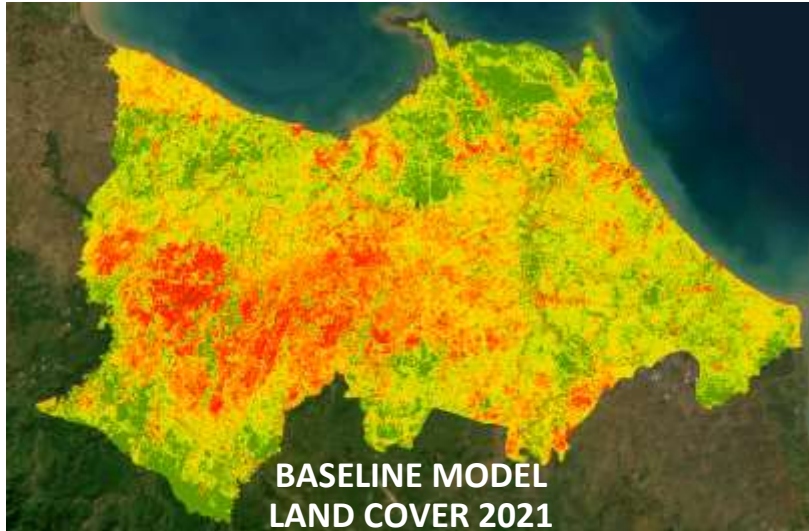
The higher the population density, the higher the potential for land cover change. Population density is the third driving factor.

## Distance to shoreline:

The closer to the coastline the lower the potential for land cover changes. The distance to the shoreline is an inhibiting factor. This is associated with the risk of tidal floods, inundations, and tsunamis.



# LAND COVER MODELING IN 2031 USUAL SCENARIO



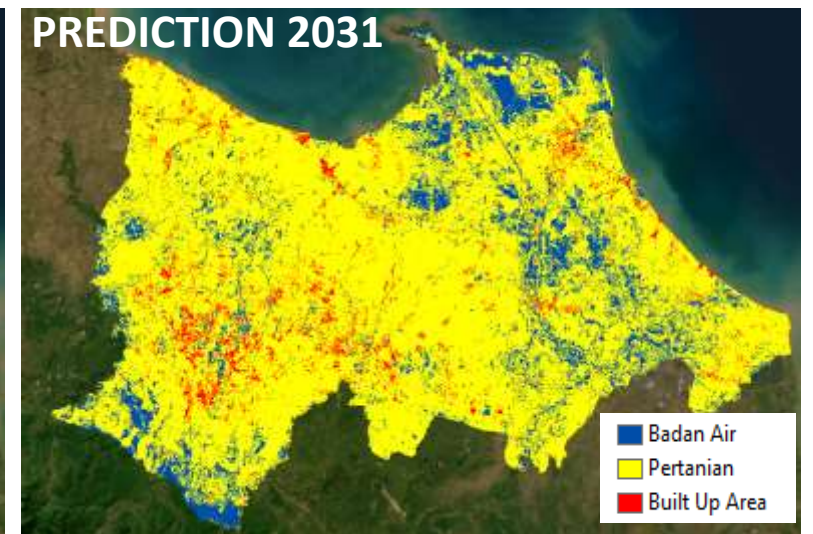
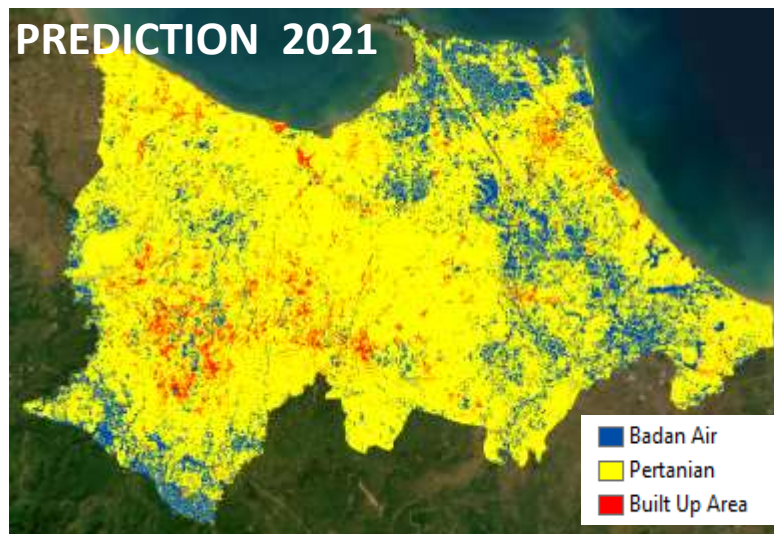
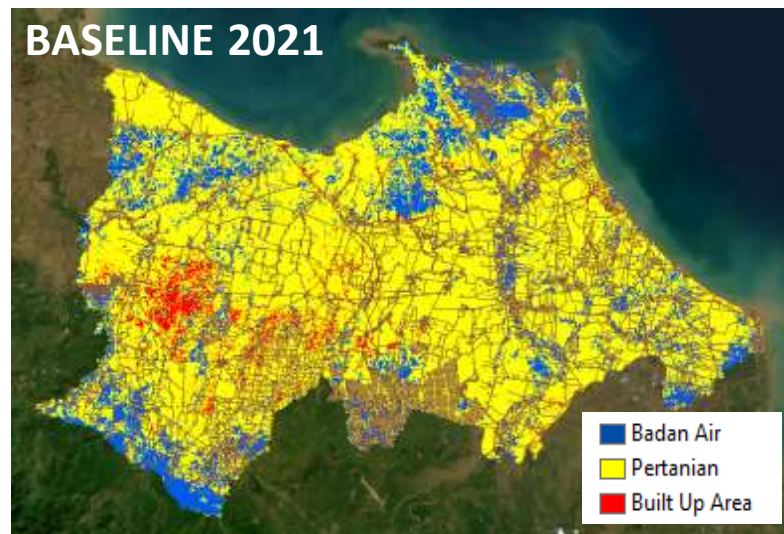
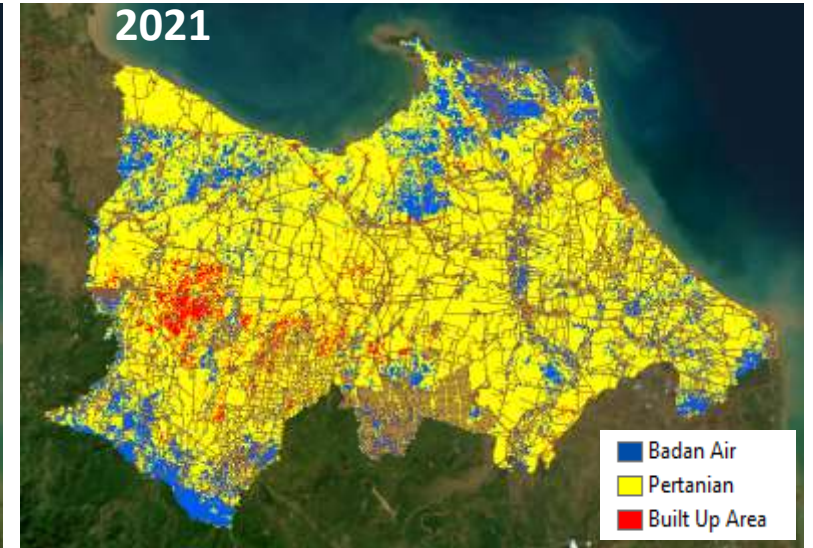
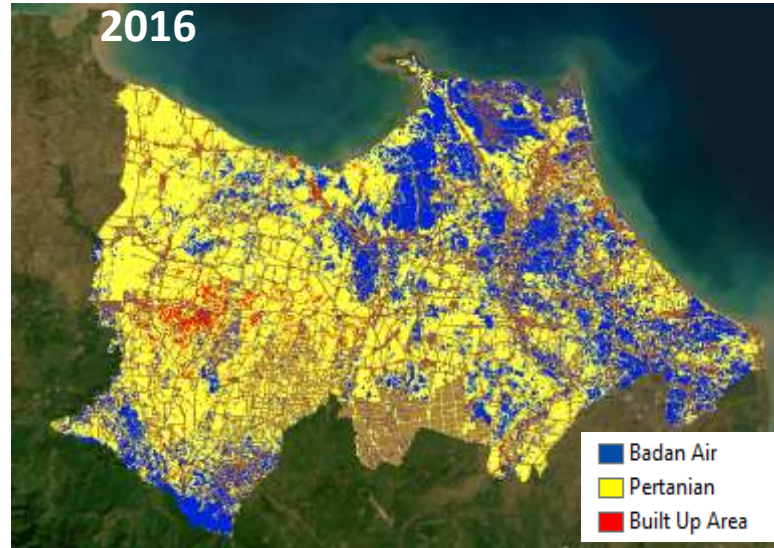
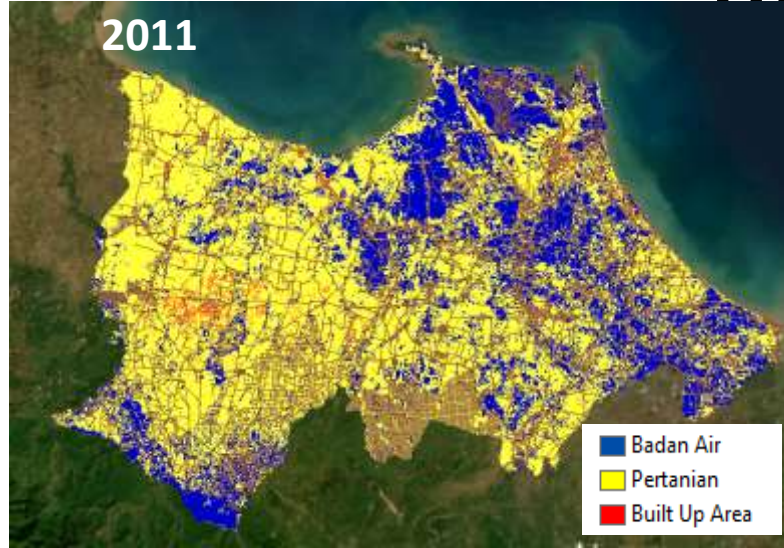
Landsat 8 Satellite Image Raster Data for 2021 as Baseline & Reference for model testing.

## Modeling Stage:

1. The learning stage of the model uses Landsat imagery data for 2011-2016.
2. The model training phase for predicting land cover in 2021 uses the 2011-2016 transition rule.
3. The model validation stage uses land cover imagery from Landsat 8 image processing in 2021.
4. Model implementation stage. A valid model is used to predict land cover in 2031 with three scenarios.



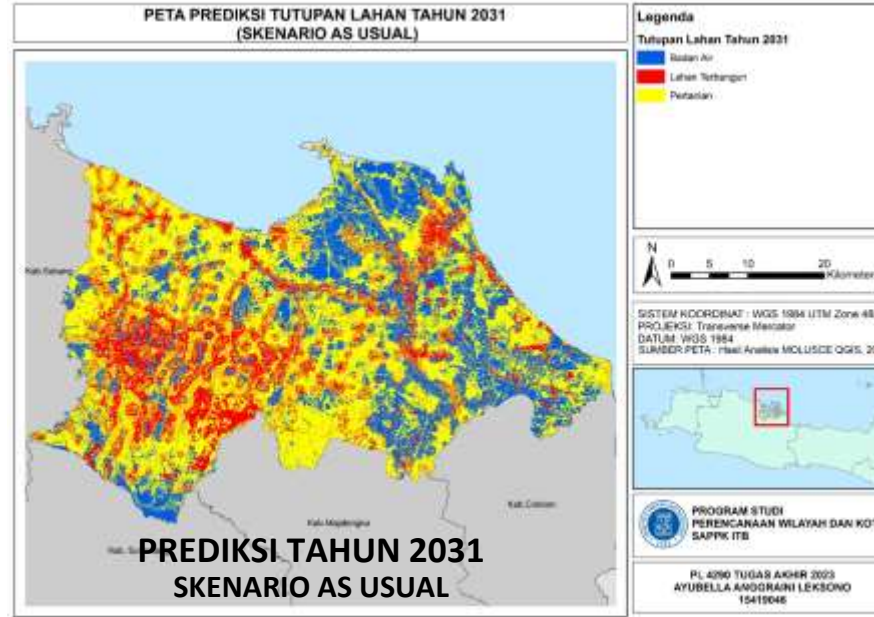
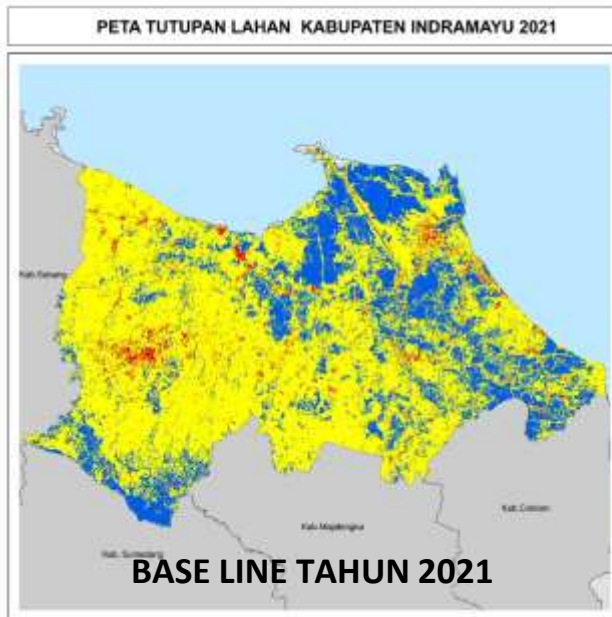
# LAND COVER PREDICTION IN INDRAMAYU DISTRICT BASED ON TRANSITION RULE 2011-2016





# LAND COVER PREDICTION IN 2031

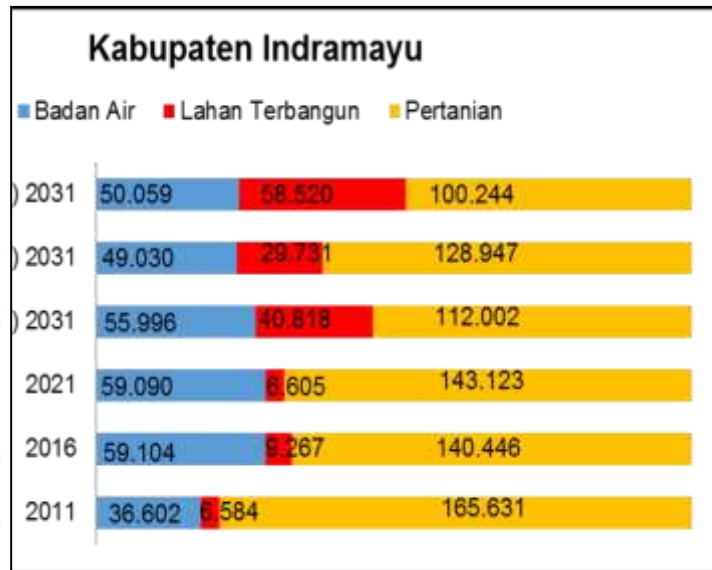
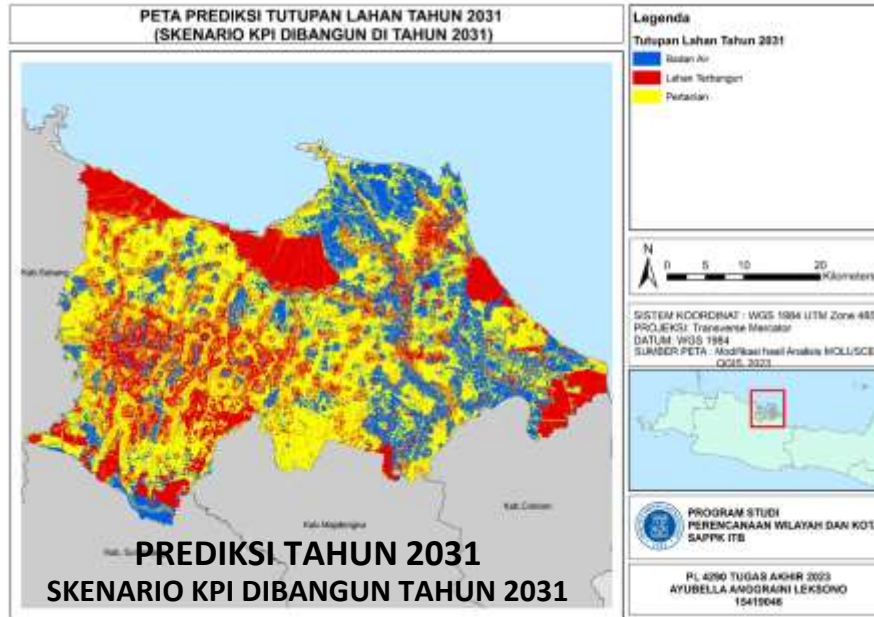
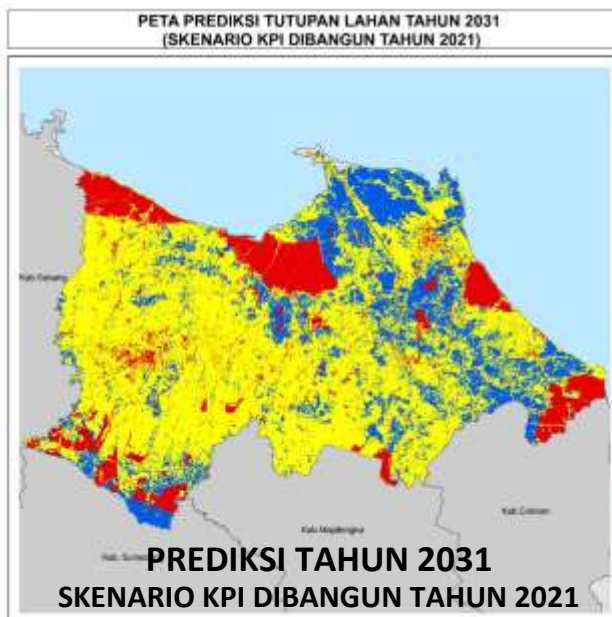
## AS USUAL SCENARIO, KPI TO BE DEVELOPED IN 2021 AND KPI TO BE BUILT IN 2031



**KPI Scenario Built 2021:**  
settlement growth is the lowest. KPIs do not function as a driving factor.

**KPI Scenario Built 2031:**  
settlement growth is the highest. There is an urban sprawl in the 2021-2031 range.

**As Usual scenario:**  
medium settlement growth. More natural and natural.

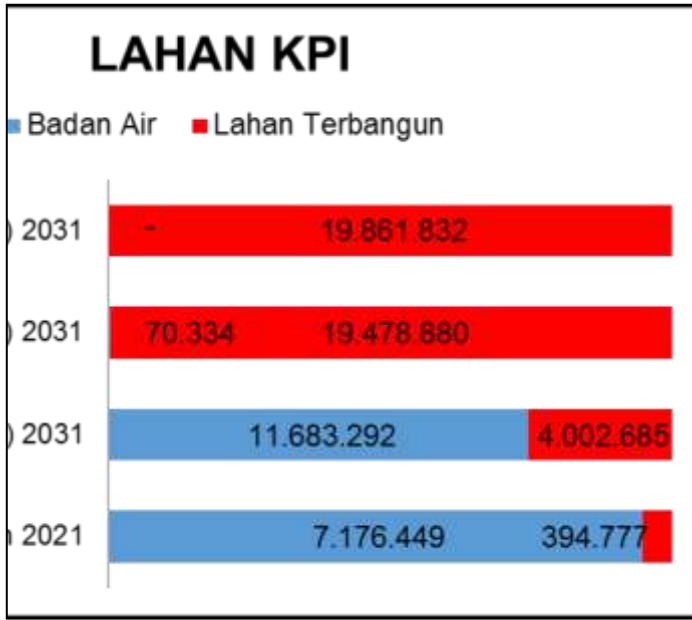
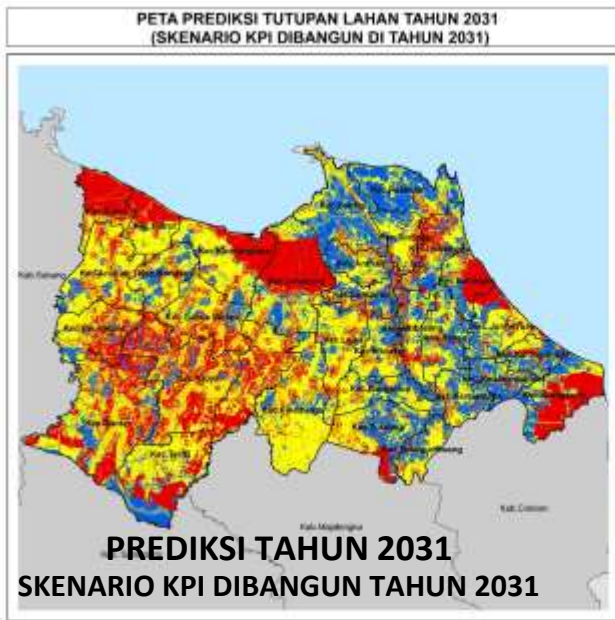
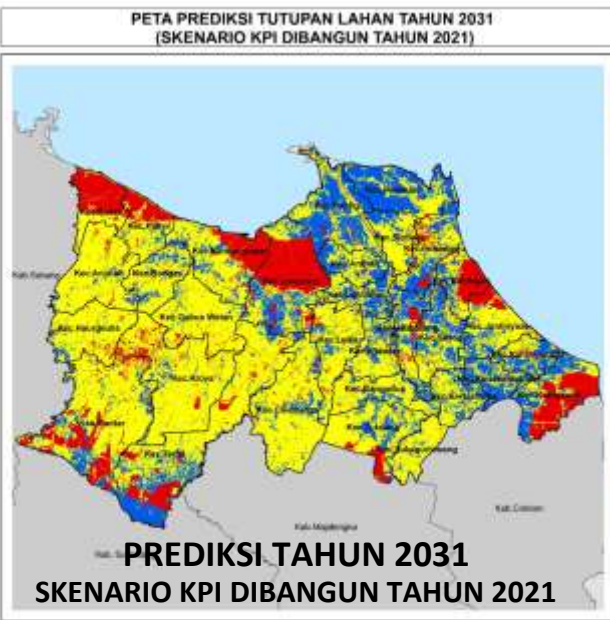
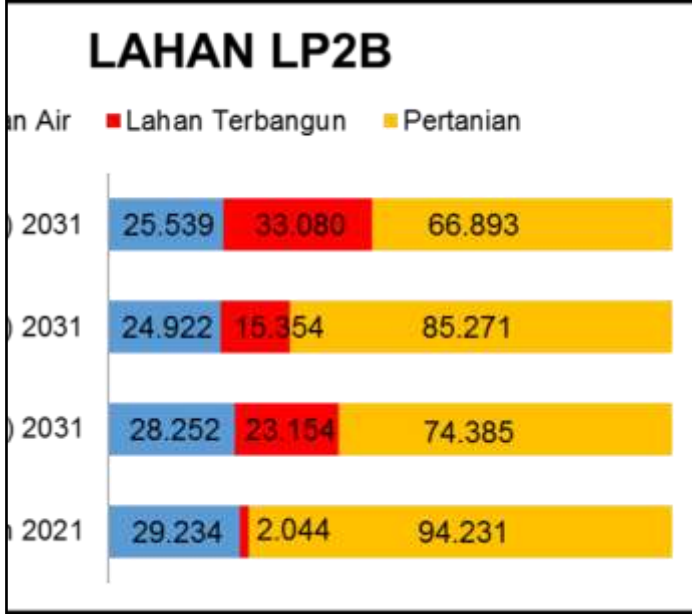
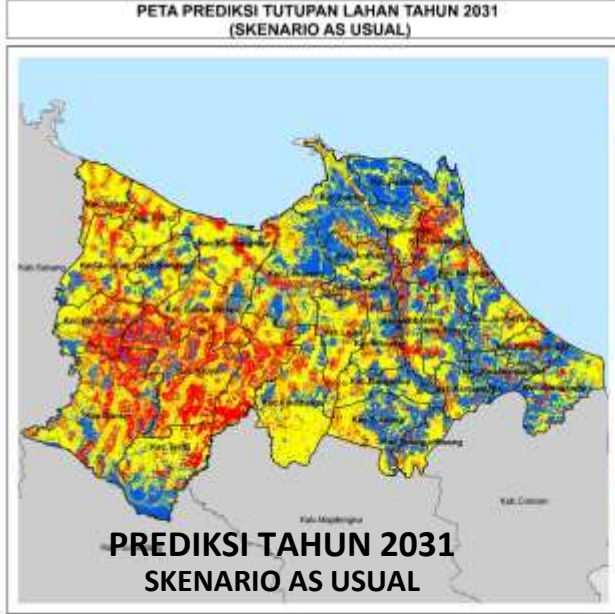
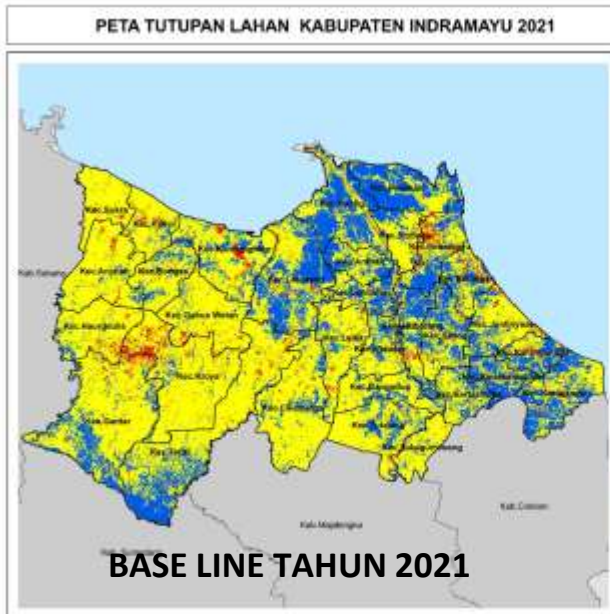


## Analysis and Discussion LAND COVER ANALYSIS IN 2031

- ON SPATIAL SPATIAL RTRW
- LP2B LAND
- LAND KPIS



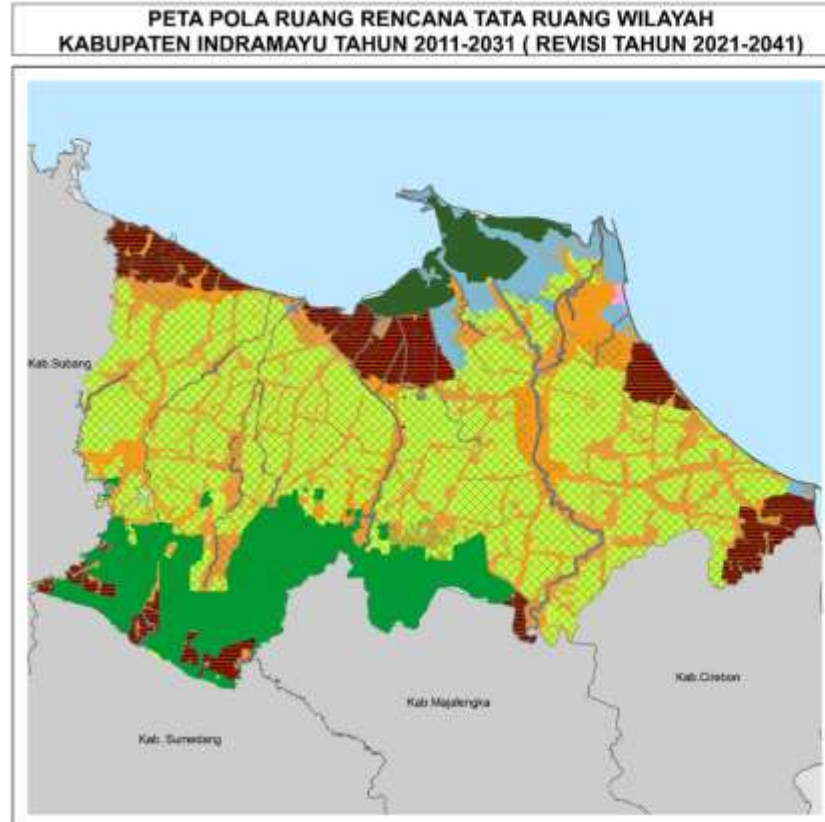
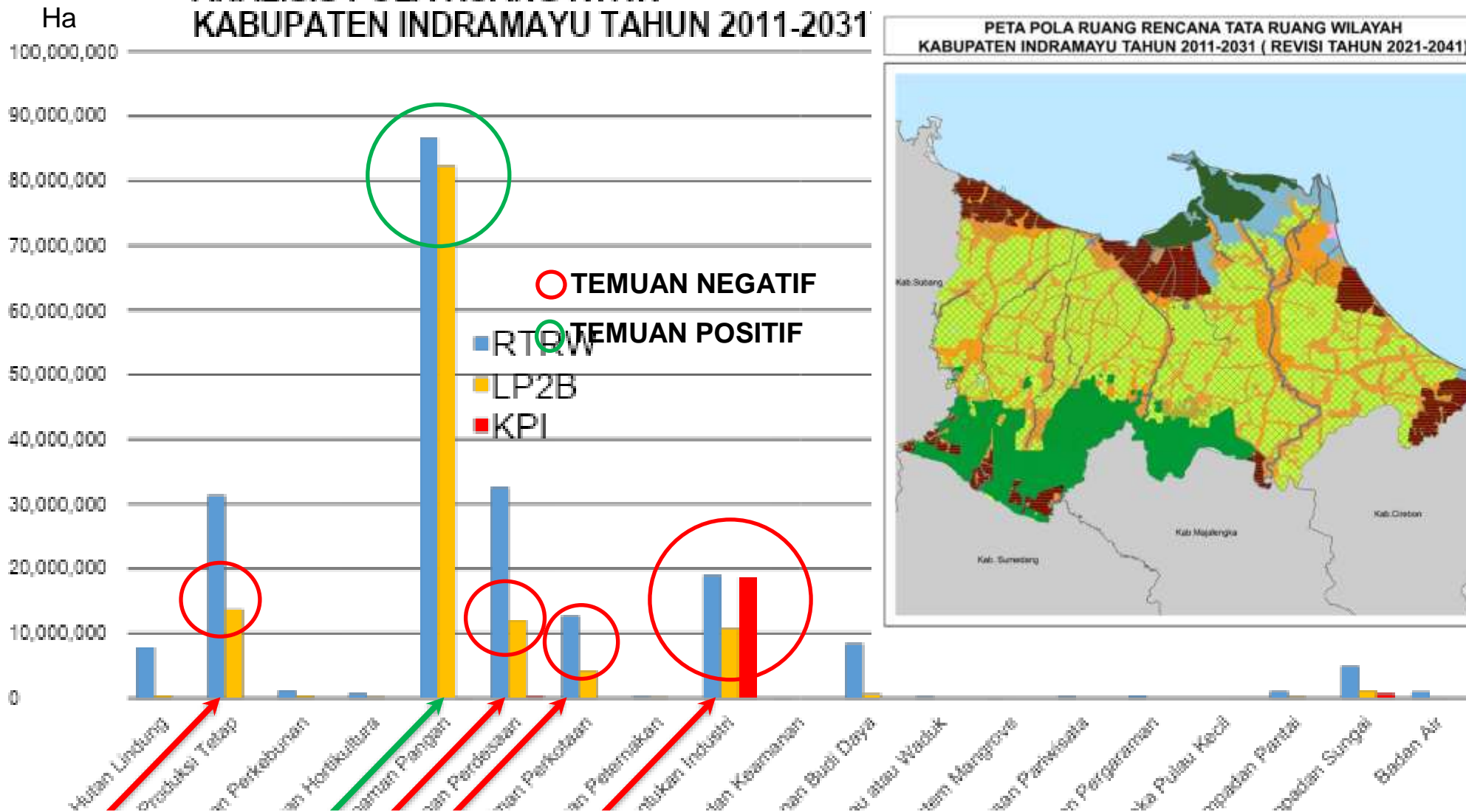
# 2031 LAND COVER ANALYSIS OF RTRW, LP2B & KPI



- Tren tutupan lahan Kabupaten Indramayu pada tahun 2011-2021, memperlihatkan adanya kenaikan alih fungsi lahan pertanian menjadi lahan terbangun yang signifikan. Namun demikian tren tutupan lahan tahun 2016-2021 justru terjadi penurunan.
- Prediksi tutupan lahan tahun 2031 skenario as usual, skenario KPI dibangun tahun 2021, dan skenario KPI dibangun tahun 2031 semuanya menunjukkan adanya kenaikan luas lahan permukiman yang signifikan.
- Skenario KPI dibangun tahun 2031, menunjukkan kenaikan lahan permukiman yang paling besar. Hal ini dimungkinkan karena dalam rentang 2021-2031 telah terjadi urban sprawl dan ditambah lagi dengan pembangunan KPI pada tahun 2031.
- Skenario KPI dibangun tahun 2021, menunjukkan kenaikan lahan permukiman yang paling kecil. Hal ini dimungkinkan karena KPI tidak dapat berfungsi sebagai faktor pendorong pertumbuhan permukiman dan justru menjadi faktor penghambat. Hal ini dimungkinkan karena pembangunan suatu Kawasan Industri yang bersifat eksklusif dan tidak diikuti oleh pembangunan sarana prasarana lain, tidak dapat berfungsi sebagai faktor pendorong dan kurang memberi manfaat bagi pertumbuhan masyarakat sekitar.
- Skenario as usual menunjukkan kenaikan menengah diantara skenario KPI dibangun tahun 2021 dan skenario KPI dibangun tahun 2031. Hal ini dimungkinkan karena skenario as usual adalah skenario yang paling realistis karena berlangsung secara alami dan bertahap tanpa ada proses pembangunan yang mendadak.
- Analisis tutupan lahan tahun 2031 terhadap RTRW, LP2B, KPI menunjukkan adanya tumpang tindih yang signifikan antara lahan LP2B dengan KPI (hampir 100% lahan KPI terletak di lahan LP2B). Terdapat pula tutupan lahan kawasan perdesaan dan perkotaan yang terletak di lahan LP2B. Sementara itu, terdapat pula lahan LP2B di kawasan hutan produksi tetap yang dimungkinkan dapat mengancam kelestarian hutan.



# ANALISIS POLA RUANG RTRW KABUPATEN INDRAMAYU TAHUN 2011-2031



**Legenda**

■ Kawasan Perikanan  
■ Kawasan Perikanan Perikanan  
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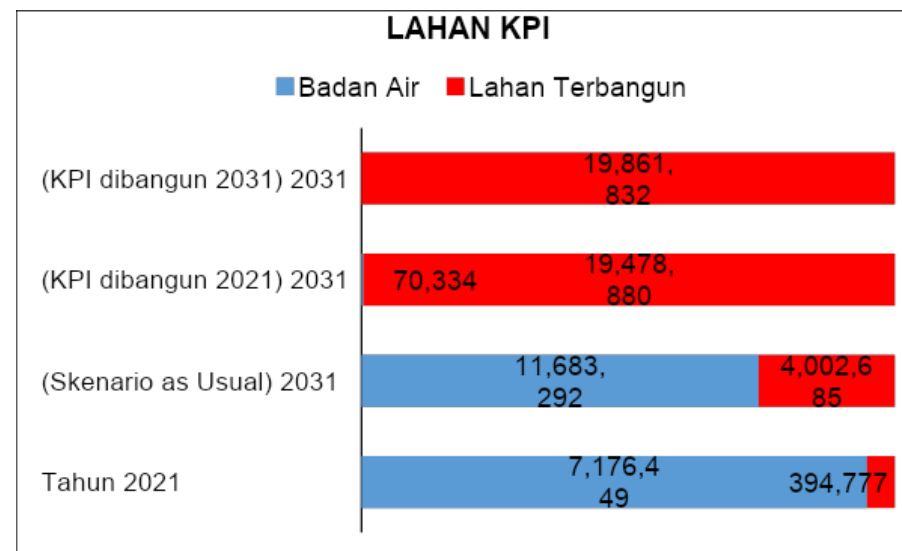
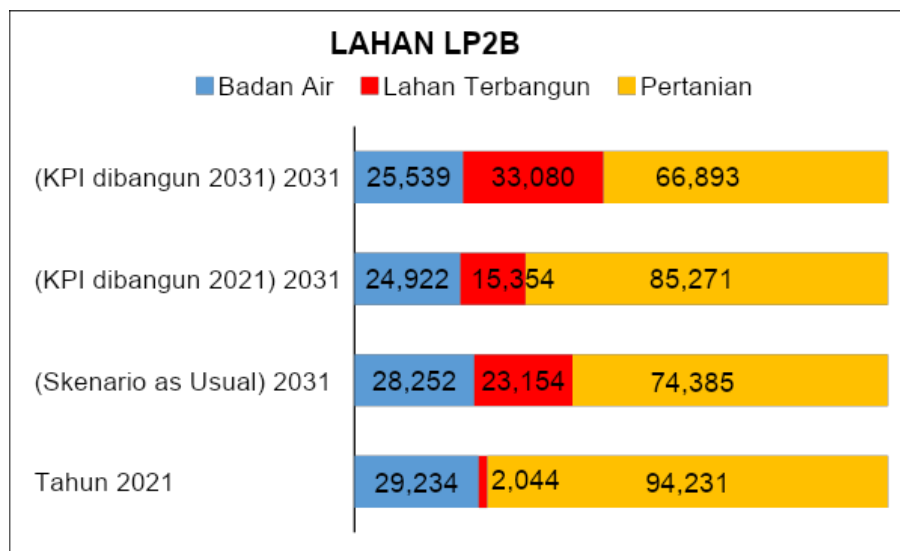
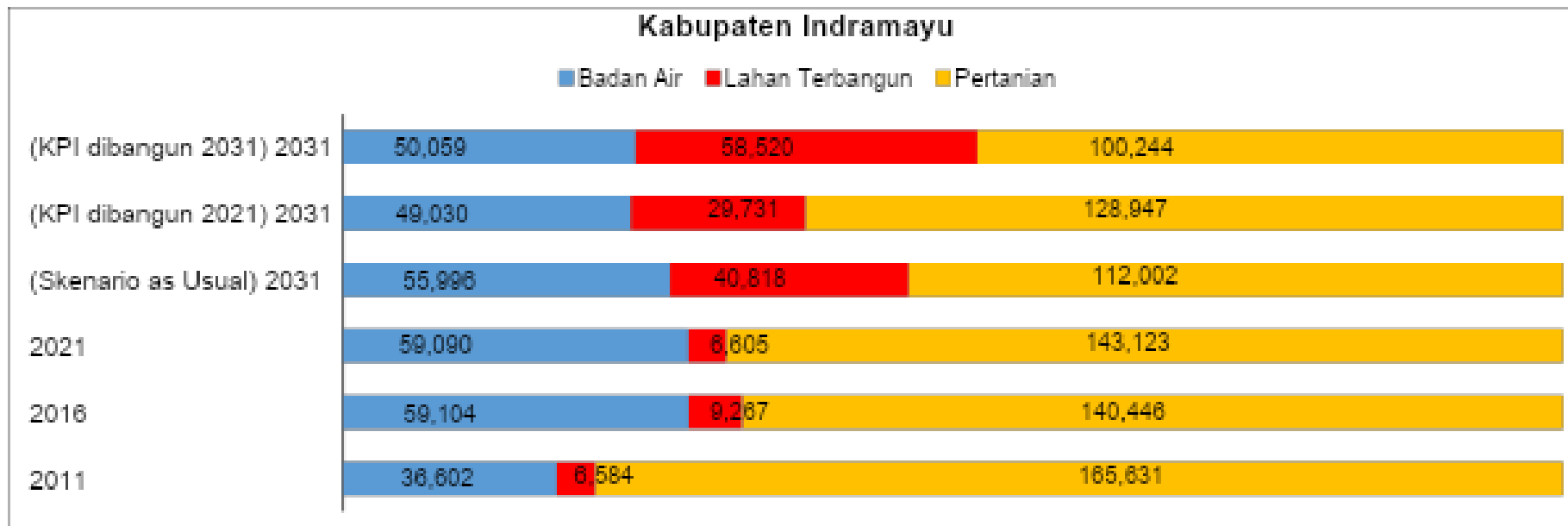
SISTEM KOORDINAT : WGS 1984 UTM Zone 48S  
 PROJEKSI: Transverse Mercator  
 DATUM: WGS 1984  
 SUMBER PETA : Dinas PUPR Kabupaten Indramayu, 2022

PROGRAM STUDI  
 PERENCANAAN WILAYAH DAN KOTA  
 SAPPK ITB

PL 4296 TUGAS AKHIR 2023  
 AYUBELLA ANGGRAINI LEKSONO  
 15419046

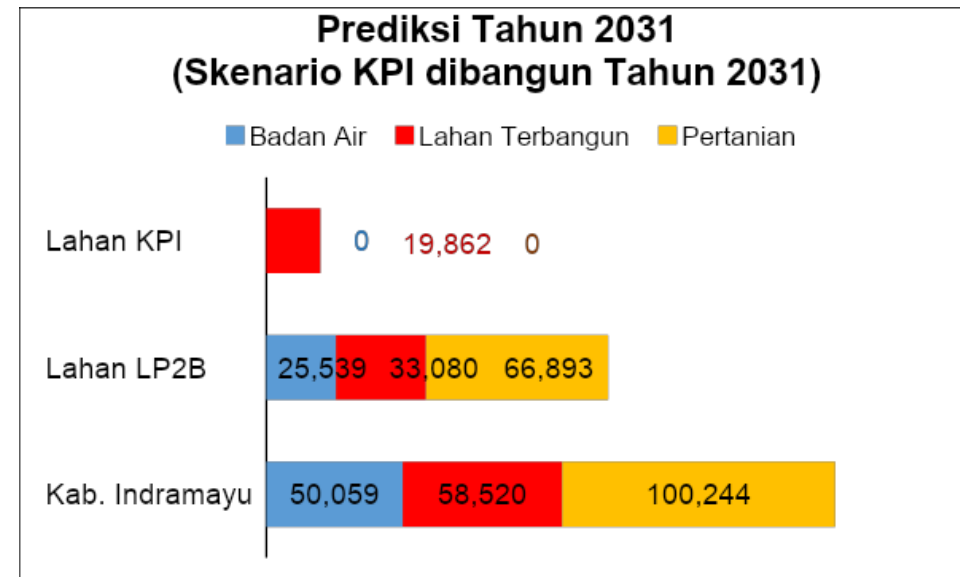
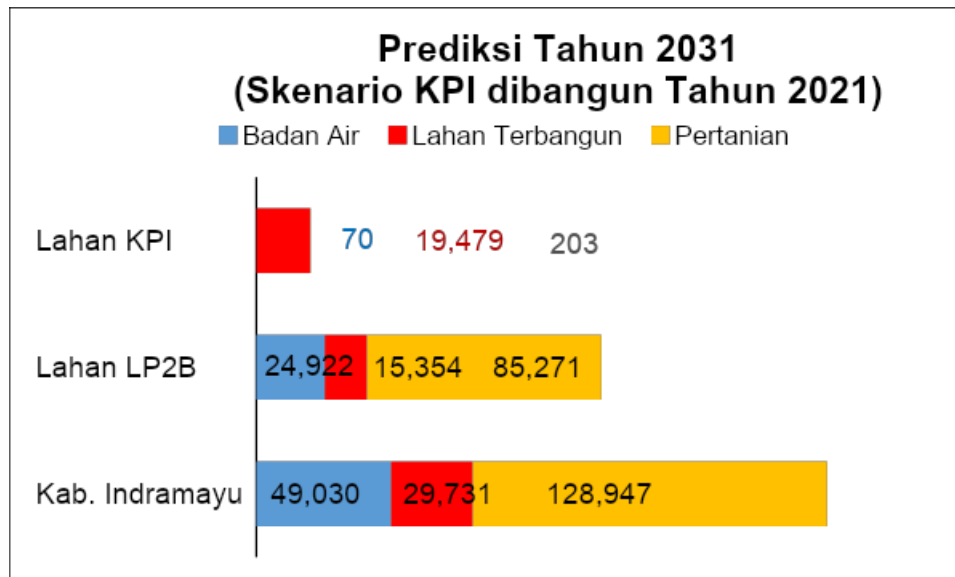
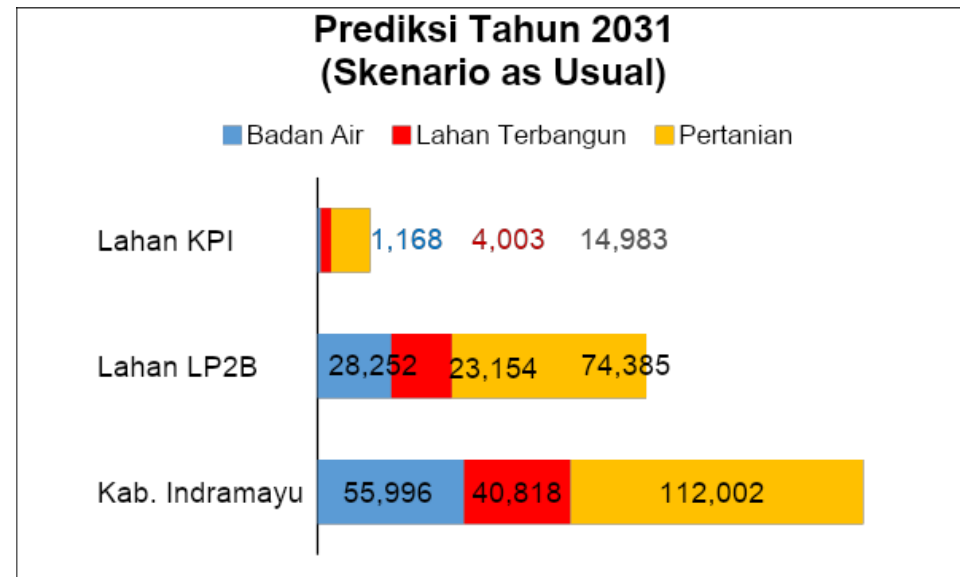
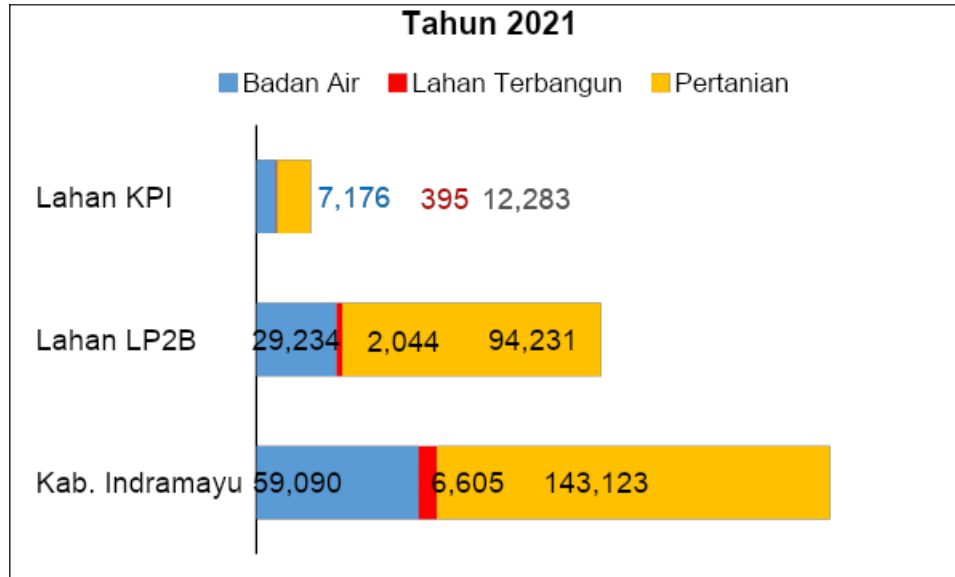
Analysis of land cover in 2031 for RTRW, LP2B, KPI shows that there is significant overlap between LP2B land and KPI (almost 100% of KPI land is located on LP2B land). There is also land cover in rural and urban areas located on LP2B land. Meanwhile, there are also LP2B lands in permanent production forest areas that may threaten forest sustainability.

# ANALISIS TUTUPAN LAHAN TAHUN 2031 TERHADAP RTRW, LP2B & KPI

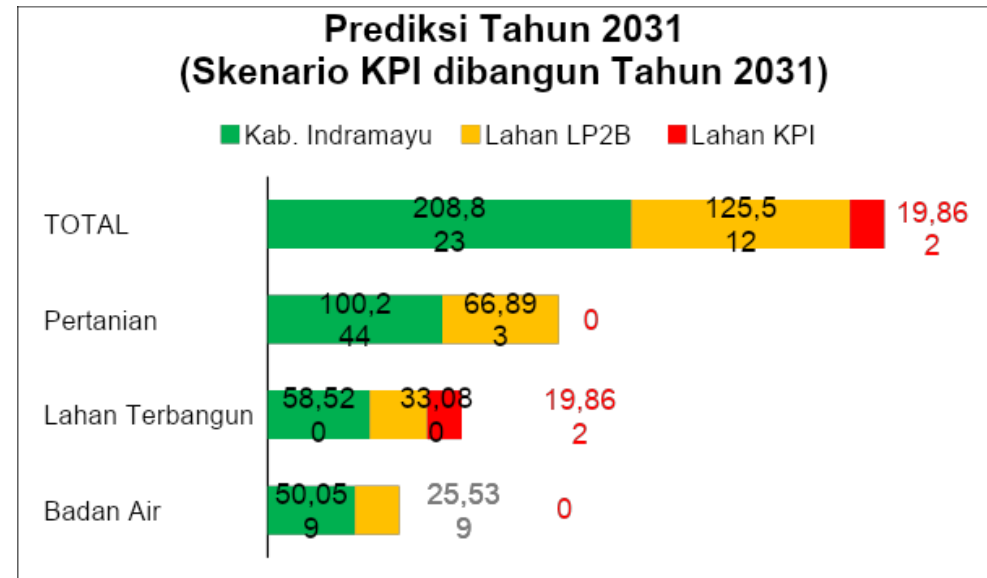
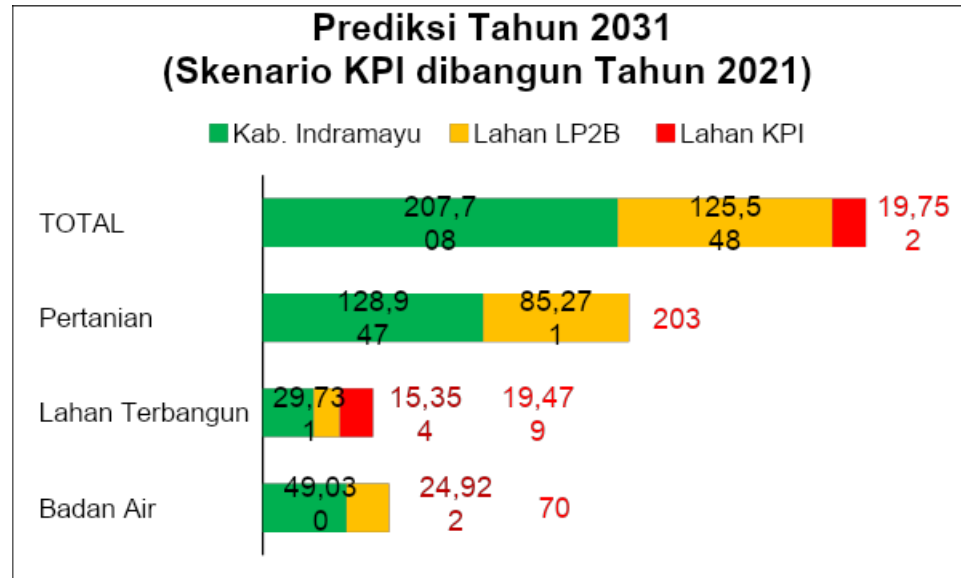
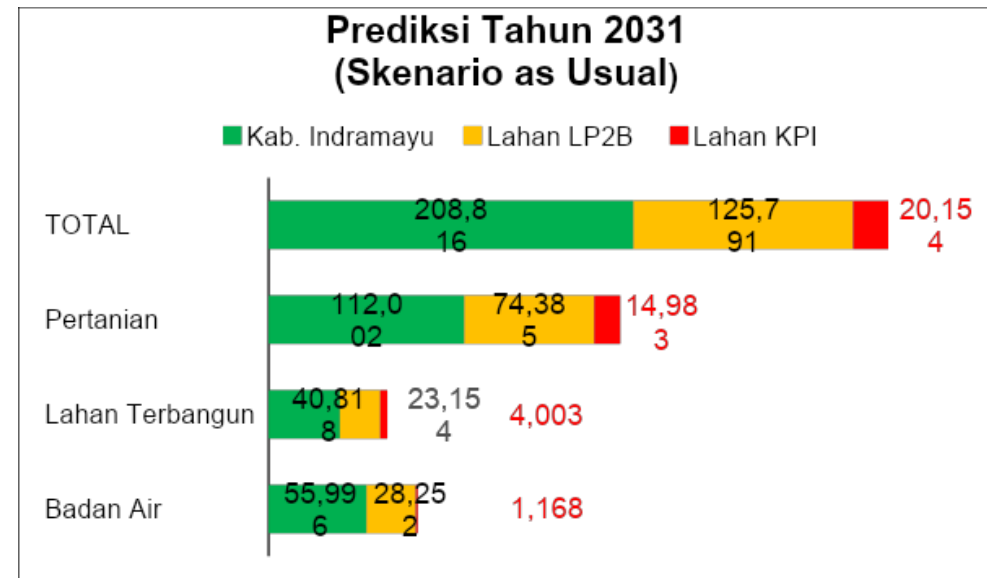
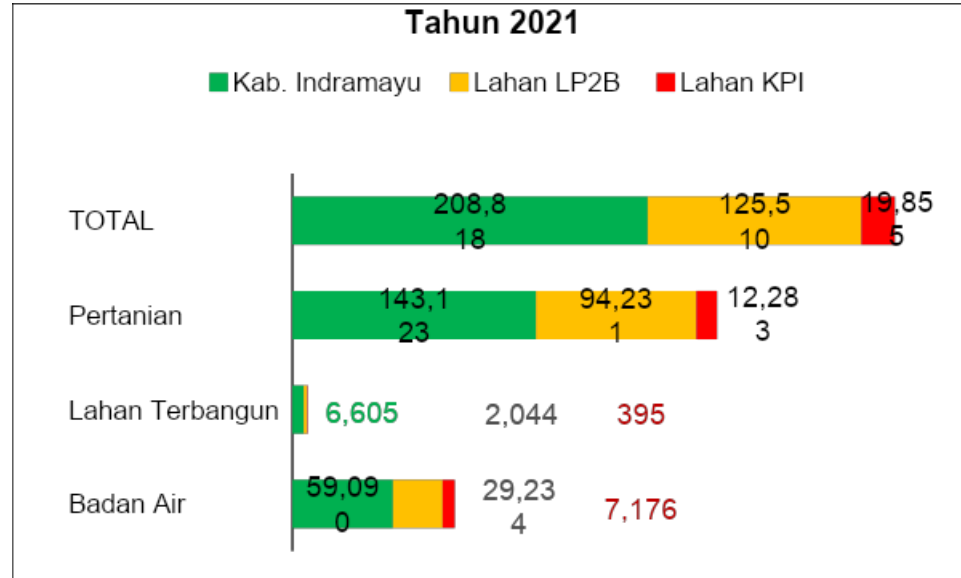




# ANALISIS TUTUPAN LAHAN DI KAWASAN LP2B & KPI



# ANALISIS TUTUPAN LAHAN DI KAWASAN LP2B & KPI





## Conclusion

- Further studies are needed regarding the dynamic modeling of land cover change to model land cover in a spatio-temporal manner that is more accurate.
- Further studies are needed regarding the land cover change model and wider application to different case study areas in order to obtain a land cover change model that is closer to the reality on the ground and can be applied as a tool in preparing land use plans and regional spatial planning.

## Recommendation

- The trend of land cover change developed in this study has proven to be very useful for analyzing and monitoring land cover change in the Indramayu Regency area. Land cover change data is very important as a consideration in planning and monitoring land use in the region.
- The Cellular Automata method using an Artificial Neural Network algorithm has proven to be useful for conducting land cover modeling and generating data characteristic of land cover change trends that are used to make predictions of future land cover change.
- Landsat image data with a pixel resolution of 30x30m, proved very useful for making multitemporal land cover maps with a scale of 1:50,000 (district scale covering an area of 208,000 km<sup>2</sup>). This data is useful for simulating and predicting future land cover based on past land cover data and is indispensable for modeling spatio-temporal changes in land cover for the purposes of planning and monitoring land use and spatial planning

## Recommendation

Indramayu Regency is a National Food Barn with production in 2020 of 1,363,312 tons of dry milled grain (DMG), equivalent to 782,132 tons of rice or 25% of total Indonesia national production (BPS, 2020).



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