



# UNIVERSITAS NUSA MANDIRI

Gedung Rektorat : Nusa Mandiri Tower Jl. Jatiwaringin Raya No. 2, Jakarta Timur 13620  
Telp. (021) 28534471, 28534390 e-mail : rektorat@nusamandiri.ac.id

## KEPUTUSAN REKTOR UNIVERSITAS NUSA MANDIRI NOMOR: 002/2.01/UNM/IX/2024

### TENTANG

#### TUGAS MELAKSANAKAN PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT SEMESTER GANJIL TAHUN AKADEMIK 2024/2025

#### REKTOR UNIVERSITAS NUSA MANDIRI,

- Menimbang : a. bahwa dalam rangka pelaksanaan tridharma antara lain berupa kegiatan penelitian dan pengabdian kepada masyarakat di Universitas Nusa Mandiri agar dapat menjaga kelancaran tugas dan tertib administrasi jalannya penelitian dan kegiatan pengabdian kepada masyarakat dengan baik maka perlu menugaskan dosen Universitas Nusa Mandiri untuk melaksanakan penelitian dan pengabdian kepada masyarakat;
- b. bahwa dosen yang namanya tersebut dalam dalam surat keputusan ini dipandang cakap dan memenuhi syarat untuk melakukan penelitian dan pengabdian kepada masyarakat;
- c. bahwa berdasarkan pertimbangan sebagaimana dimaksudkan dalam huruf a dan b di atas, perlu diterbitkannya surat keputusan Rektor tentang tugas melaksanakan penelitian dan pengabdian kepada masyarakat Semester Ganjil tahun akademik 2024/2025
- Mengingat : 1. Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional;
2. Undang-Undang Nomor 12 Tahun 2012 tentang Pendidikan Tinggi;
3. Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi (Lembaran Negara Republik Indonesia Tahun 2014 Nomor 16, Tambahan Lembaran Negara Republik Indonesia Nomor 5500);
4. Peraturan Pemerintah Republik Indonesia Nomor 4 Tahun 2022 tentang Perubahan atas Peraturan Pemerintah Republik Indonesia Nomor 57 Tahun 2021 tentang Standar Nasional Pendidikan;
5. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Republik Indonesia Nomor 44 Tahun 2015 tentang Standar Nasional Pendidikan Tinggi;
6. Keputusan Menteri Pendidikan Nasional Republik Indonesia Nomor 82/E/O/2021 tentang Pemberian Izin Penggabungan Sekolah Tinggi Manajemen Informatika dan Komputer Nusa Mandiri di Jakarta dan Akademi Pariwisata Tridaya di Jakarta Menjadi Universitas Nusa Mandiri di Jakarta yang diselenggarakan oleh Yayasan Indonesia Nusa Mandiri di Jakarta;
7. Peraturan Yayasan Indonesia Nusa Mandiri Nomor 086/YINM/IX/2023 tanggal 08 September 2023 tentang Statuta Universitas Nusa Mandiri.
8. Rencana Induk Penelitian Universitas Nusa Mandiri Nomor 211/2.01/UNM/VIII/2021 tanggal 6 Agustus 2021;
9. Rencana Strategis Pengabdian Kepada Masyarakat Universitas Nusa Mandiri Nomor 212/2.01/UNM/VIII/2021 tanggal 6 Agustus 2021;



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10. Pedoman Penelitian Universitas Nusa Mandiri Nomor 028/2.01/UNM/II/2022 tanggal 25 Februari 2022;
11. Pedoman Pengabdian kepada Masyarakat Universitas Nusa Mandiri Nomor 027/2.01/UNM/II/2022 tanggal 25 Februari 2022;

Memperhatikan : Hasil rapat pimpinan Universitas Nusa Mandiri pada tanggal 30 Agustus 2024.

## MEMUTUSKAN :

Menetapkan : **KEPUTUSAN REKTOR UNIVERSITAS NUSA MANDIRI TENTANG TUGAS MELAKSANAKAN PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT SEMESTER GANJIL TAHUN AKADEMIK 2024/2025.**

KESATU : Menugaskan masing-masing dosen untuk melaksanakan kegiatan penelitian yang dibiayai oleh dana mandiri atau dana hibah (internal atau eksternal baik dalam negeri maupun luar negeri) yang dilakukan secara perorangan maupun kelompok, yang menghasilkan luaran minimal salah satu bentuk sebagai berikut:

- a. Karya ilmiah/jurnal ilmiah yang dipublikasikan minimal pada jurnal nasional terakreditasi, jurnal internasional atau jurnal internasional bereputasi terindex Thomson Reuters Web of Science (WOS), atau Scopus (Elsevier);
- b. Karya ilmiah/jurnal ilmiah yang dipublikasikan dalam seminar nasional maupun seminar internasional yang dilengkapi dengan buku prosiding seminar;

Dan menghasilkan minimal salah satu bentuk berikut:

- a. Buku ajar atau buku referensi maupun buku populer yang telah diterbitkan dan memiliki ISSN/ISBN;
- b. Hasil karya yang didaftarkan untuk mendapatkan Hak Kekayaan Intelektual (HKI) ke Kementerian Hukum dan Hak Asasi Manusia (Kemenkumham);

KEDUA : Menugaskan masing-masing dosen untuk melaksanakan kegiatan pengabdian kepada masyarakat yang sesuai dengan bidang keilmuan, yang menghasilkan luaran berupa Artikel di media massa (Press Release) cetak atau elektronik tingkat Nasional atau Lokal;

Dan atau menghasilkan minimal salah satu bentuk sebagai berikut;

- a. Publikasi di jurnal ilmiah cetak atau elektronik pada jurnal internasional atau jurnal nasional terakreditasi atau jurnal nasional tidak terakreditasi;
- b. Artikel ilmiah dimuat di prosiding cetak atau elektronik tingkat Internasional atau Nasional atau Lokal;
- c. Dokumentasi pelaksanaan berupa video kegiatan;
- d. Keynote speaker atau invited dalam temu ilmiah tingkat Internasional atau Nasional atau Lokal;
- e. Pembicara tamu (visiting lecturer) tingkat Internasional;
- f. Kekayaan Intelektual (KI) berupa Paten atau Paten Sederhana atau Perlindungan Varietas Tanaman atau Hak Cipta atau Merk Dagang atau Rahasia Dagang atau Desain Produk Industri atau Indikasi Geografis;



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- g. Buku ber ISBN;
- h. Book chapter;
- i. Mitra Non Produktif mengalami peningkatan berupa Pengetahuannya atau Keterampilannya atau Kesehatannya atau Pendapatannya atau Pelayanannya;
- j. Mitra Produktif Ekonomi/Perguruan Tinggi mengalami peningkatan berupa Pengetahuannya atau Keterampilannya atau Kualitas produknya atau Jumlah produknya atau Jenis produknya atau Kapasitas produksi atau Jumlah aset atau Jumlah omsetnya atau Jumlah tenaga kerjanya atau Kemampuan manajemennya atau Keuntungannya atau Income generating PT;
- k. Mitra Produktif Ekonomi/Perguruan Tinggi berhasil melakukan ekspor atau berhasil melakukan pemasaran antar pulau atau produk tersertifikasi atau produk terstandarisasi atau unit usaha berbadan hukum atau jumlah wirausaha baru mandiri;

- KETIGA : Bersedia mentaati dan mematuhi peraturan, prosedur dan ketentuan yang berlaku di lingkungan Universitas Nusa Mandiri;
- KEEMPAT : Keputusan ini berlaku selama semester Ganjil tahun akademik 2024/2025.
- KELIMA : Keputusan ini berlaku sejak ditetapkan dan apabila ditemukan kekeliruan dikemudian hari, akan dilakukan perbaikan sebagaimana mestinya.

Ditetapkan di : Jakarta  
Pada tanggal : 02 September 2024  
Rektor,



Prof. Dr. Ir. Dwiza Riana, S.Si, MM, M.Kom, IPU, ASEAN Eng.

Tembusan:

- 1. Ketua Yayasan Indonesia Nusa Mandiri
- 2. Ka. Divisi SDM
- 3. Wakil Rektor Bidang Akademik
- 4. Ka. BAAK, BAKU & BTI
- 5. Dekan
- 6. Ka. Prodi
- 7. LPPM
- 8. Ybs
- 7. Arsip



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## LAMPIRAN KEPUTUSAN REKTOR UNIVERSITAS NUSA MANDIRI

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Tanggal: 02 September 2024

### TUGAS MELAKSANAKAN PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT SEMESTER GANJIL TAHUN AKADEMIK 2024/2025

| NO | NIP       | Nama Dosen                                |
|----|-----------|---|
| 1  | 201909183 | Abdul Rahman Kadafi, MM,M.Kom             |
| 2  | 202009193 | Achmad Bayhaqy,M.Kom                      |
| 3  | 201708227 | Achmad RifaiM.Kom                         |
| 4  | 201909143 | Ade Priyatna, S.KOM, MM                   |
| 5  | 202109174 | Agus Syukur, M.Pd                         |
| 6  | 202107137 | Ahmad Hafidzul Kahfi,M.Kom                |
| 7  | 201203103 | Akmaludin, S.Kom, MMSI                    |
| 8  | 201609444 | Albert Riyandi, M.Kom                     |
| 9  | 202103233 | Ami Rahmawati,M.Kom                       |
| 10 | 201509231 | Amrin, S, Si,M.Kom                        |
| 11 | 202011220 | Andi Sanjaya, S.Kom,M.Kom                 |
| 12 | 201209558 | Andi Saryoko,M.Kom                        |
| 13 | 202103229 | Andri Agung Riyadi,M.Kom                  |
| 14 | 201509259 | Andry Maulana, M.Kom                      |
| 15 | 201507207 | Anggi Oktaviani,M.Kom                     |
| 16 | 201603482 | Ani Oktarini Sari,M.Kom                   |
| 17 | 201709211 | Ani Yoraeni, S.Pd,M.Kom                   |
| 18 | 201609464 | Anna Mukhayaroh,M.Kom                     |
| 19 | 201009395 | Anton,M.Kom.                              |
| 20 | 201507213 | Antonius Yadi Kuntoro, S.Kom, MM          |
| 21 | 200809945 | Arfhan Prasetyo,M.Kom.                    |
| 22 | 201203388 | Arif Hidayat, SS, M.HUM                   |
| 23 | 201503111 | Arief Rama Syarif, S.T,M.Kom              |
| 24 | 201909152 | Arif Ismail Husin, ST,M.Kom               |
| 25 | 200510052 | Astria Mulyani, S.Si,M.Kom                |
| 26 | 202109255 | Ati Chandrasari, SE, MM                   |
| 27 | 201309479 | Bakhtiar Rifai,M.Kom                      |
| 28 | 201609436 | Biktra Rudianto,M.Kom                     |
| 29 | 202109227 | Bryan Givan, S.E, MM                      |
| 30 | 202207075 | Dr. Budhy Hery Pancasilawan               |
| 31 | 201002939 | Cahyani Budi Hartanti,M.Kom.              |
| 32 | 201508229 | Cepi Cahyadi, S.Kom, MM                   |
| 33 | 202111305 | Daniati Uki Eka Saputri,M.Kom             |
| 34 | 201709264 | Daning Nur Sulistyowati,M.Kom             |
| 35 | 202309071 | Dedy Syahyuni, S.E, S.IP, M.M.            |
| 36 | 202409198 | Desy Setyorini, S.S, MM                   |
| 37 | 202103249 | Diah Ayu Ambarsari,M.Kom                  |
| 38 | 201612645 | Dr. Agus Subekti, MT                      |
| 39 | 202103267 | Dr. Eng. Muhammad Haris                   |
| 40 | 201611630 | Dr. Hilman Ferdinandus Pardede, ST, M.Eng |



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| NO | NIP       | Nama Dosen                     |
|----|-----------|--------------------------------|
| 41 | 201909149 | Dr. Irwansyah Saputra,M.Kom    |
| 42 | 202410227 | Dr. Jasmir,M.Kom               |
| 43 | 202410225 | Dr. Kurniabudi,M.Kom           |
| 44 | 201903069 | Dr. Lindung Parningotan Manik  |
| 45 | 202109201 | Dr. Mila Desi Anasnti          |
| 46 | 200108003 | Dr. Nita Merlina,M.Kom         |
| 47 | 200809950 | Dr. Windu Gata,M.Kom           |
| 48 | 200812975 | Dr. Yan Rianto                 |
| 49 | 202109200 | Dr. Zico Pratama Putra         |
| 50 | 201909198 | Duwi Cahya Putri Buani,M.Kom   |
| 51 | 201909151 | Edhi Prayitno, M.SI,M.Kom      |
| 52 | 201809117 | Eka Rini Yulia,M.Kom           |
| 53 | 202109256 | Eko Oby Purwanto, SE, M.Si     |
| 54 | 201703048 | Eko Setia Budi,M.Kom           |
| 55 | 202104300 | Elly Firasari,M.Kom            |
| 56 | 201909185 | Endang Pujiastuti,M.Kom        |
| 57 | 200710488 | Eni Heni Hermaliani, M.M,M.Kom |
| 58 | 201909254 | Esron Rikardo Nainggolan,M.Kom |
| 59 | 202201006 | Evita Fitri,M.Kom              |
| 60 | 202103283 | F. Lia Dwi Cahyanti,M.Kom      |
| 61 | 202203047 | Fajar Sarasati,M.Kom           |
| 62 | 202409208 | Faruq Aziz,M.Kom               |
| 63 | 202109225 | Fatimah Azzahro, M.Ag          |
| 64 | 201909201 | Fattya Ariani,M.Kom            |
| 65 | 202107145 | Ferda Ernawan PhD              |
| 66 | 201909233 | Findi Ayu Sariasih, ST, M.MSI  |
| 67 | 202107132 | Fitra Septia Nugraha,M.Kom     |
| 68 | 201001863 | Fitri Latifah,M.Kom            |
| 69 | 202409196 | Fitri Rahmiyatun, S.E, MM      |
| 70 | 202309073 | Fitria Uswatun Azizah, M.Pd    |
| 71 | 200803777 | Frieyadie,M.Kom                |
| 72 | 201002945 | Frisma Handayanna,M.Kom, M.TI  |
| 73 | 201909195 | Ganda Wijaya,M.Kom             |
| 74 | 202103227 | Gani Wiharso, SE, MM           |
| 75 | 201504153 | Hafis Nurdin,M.Kom             |
| 76 | 201903088 | Hani Harafani,M.Kom            |
| 77 | 202103225 | Hary Mulyadi, SE, MM           |
| 78 | 202109175 | Hendra Oktafia Saputra, M.S.I  |
| 79 | 202103248 | Hendri Mahmud Nawawi,M.Kom     |
| 80 | 201309463 | Herman Kuswanto,M.Kom          |
| 81 | 202103250 | Hikmatulloh,M.Kom              |
| 82 | 200803774 | Ida Hendarsih, MM              |
| 83 | 201109235 | Ida Zuniarti, S.E, MM          |
| 84 | 201909141 | Ika Kurniawati, M.Kom          |
| 85 | 201108544 | Imam Budiawan,M.Kom            |
| 86 | 201803013 | Indah Purnamasari, ST,M.Kom    |
| 87 | 201709201 | Instanti Elyana, MM,M.Kom      |
| 88 | 201909150 | Ipin Sugiyarto,M.Kom           |



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| NO  | NIP       | Nama Dosen   |
|-----|-----------|--|
| 89  | 200610062 | Irfan Mahendra,M.Kom                                     |
| 90  | 201609548 | Iskhak Kholil,M.Kom                                      |
| 91  | 201809122 | Isnurrini Hidayat Susilowati, M.M.                       |
| 92  | 201909144 | Iwan, S.E, MM  |
| 93  | 202103268 | Jajang Jaya Purnama,M.Kom                                |
| 94  | 202009174 | Johan Hendri Prasetyo, M.M                               |
| 95  | 201809182 | Jordy Lasmana Putra,M.Kom                                |
| 96  | 201903081 | Juarni Siregar, S.PD,M.Kom                               |
| 97  | 201909236 | Juniarti Eka Sapitri, S.S, MM                            |
| 98  | 201511387 | Juniato Sidauruk, S.S, M.Hum                             |
| 99  | 202109248 | Khoirun Nisa,M.Kom                                       |
| 100 | 201309360 | Kurniawan Prambudi Utomo, SE, MM                         |
| 101 | 202003056 | Kursehi Falgenti,M.Kom                                   |
| 102 | 201709206 | Laela Kurniawati,M.Kom                                   |
| 103 | 201209658 | Lestari Yusuf,M.Kom                                      |
| 104 | 200901973 | Lia Mazia, S.Kom, M.M.S.I                                |
| 105 | 201603496 | Lilyani Asri Utami,M.Kom                                 |
| 106 | 200510046 | Linda Marlinda, M.M,M.Kom                                |
| 107 | 202103228 | Luky Fabrianto,M.Kom                                     |
| 108 | 201909211 | Lusa Indah Prahartiwi,M.Kom                              |
| 109 | 202206068 | M. Hilman Fakriza,M.Kom                                  |
| 110 | 202103280 | M. Qomarudin,M.Kom                                       |
| 111 | 202111304 | M. Rangga Ramadhan,M.Kom                                 |
| 112 | 201809114 | Maruloh,M.Kom  |
| 113 | 201909238 | Maryanah Safitri,M.Kom                                   |
| 114 | 202103232 | Mudrikatul Arafah, M.Pd                                  |
| 115 | 201703098 | Mugi Raharjo,M.Kom                                       |
| 116 | 202103230 | Muhamad Hasan,M.Kom                                      |
| 117 | 202009194 | Muhammad Abdullah, MM                                    |
| 118 | 202401120 | Muhammad Bagus Andra, S.Kom, M.Eng, Ph.D                 |
| 119 | 201809152 | Muhammad Fahmi,M.Kom                                     |
| 120 | 202010223 | Muhammad Rezki,M.Kom                                     |
| 121 | 202405154 | Muji Ernawati,M.Kom                                      |
| 122 | 202009176 | Nanang Ruhyana,M.Kom                                     |
| 123 | 202107133 | Nissa Almira Mayangky,M.Kom                              |
| 124 | 202203045 | Nurajijah,M.Kom  |
| 125 | 201109283 | Nurmalasari,M.Kom  |
| 126 | 202104302 | Nurul Khasanah,M.Kom                                     |
| 127 | 201609424 | Normah, M.Kom  |
| 128 | 201203355 | Prof. Dr. Ir Dwiza Riana, S.Si, MM,M.Kom, IPU, ASEAN.Eng |
| 129 | 202209120 | Prof. Dr. Jufriadif Na'am, S.Kom.,M.Kom.                 |
| 130 | 201502045 | Rachman Komarudin,M.Kom                                  |
| 131 | 202410226 | Rahmadya Trias Handayanto, S.T.,M.Kom., Ph.D.            |
| 132 | 201203106 | Rani Irma Handayani,M.Kom                                |
| 133 | 202109254 | Ratna Puspita, SE, MM                                    |
| 134 | 201609452 | Ratnawaty Marginingsih, SE, MM                           |
| 135 | 201909213 | Retno Sari,M.Kom   |



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| NO  | NIP       | Nama Dosen                          |
|-----|-----------|-------------------------------------|
| 136 | 202107138 | Ridan Nurfalalah,M.Kom              |
| 137 | 202103282 | Riki Supriyadi,M.Kom                |
| 138 | 202204064 | Risca Lusiana Pratiwi,M.Kom         |
| 139 | 201903030 | Riva Abdillah Aziz,M.Kom            |
| 140 | 202103255 | Riyan Latifahul H.,M.Kom            |
| 141 | 201909135 | Rizki Aulianita,M.Kom               |
| 142 | 202109208 | Rizky Ade Safitri,M.Kom             |
| 143 | 201209544 | Rosento, S.Sos, MM                  |
| 144 | 201106528 | Ruhul Amin,M.Kom.                   |
| 145 | 201309427 | Sabil, SE, MM                       |
| 146 | 201803042 | Setiaji,M.Kom                       |
| 147 | 202011219 | Shinta Oktaviana, S.Kom ,M.Kom      |
| 148 | 201210751 | Sidik, M.Kom                        |
| 149 | 201709266 | Sita Anggraeni,M.Kom                |
| 150 | 201909218 | Siti Ernawati, M.Kom                |
| 151 | 202107135 | Siti Fauziah,M.Kom                  |
| 152 | 202107136 | Siti Masturoh,M.Kom                 |
| 153 | 202201005 | Siti Nurhasanah Nugraha,M.Kom       |
| 154 | 202010205 | Siti Nurlela,M.Kom                  |
| 155 | 202309075 | Siti Rahmadani Lestari, M.Si        |
| 156 | 202010204 | Sri Hadiani,M.Kom                   |
| 157 | 202109173 | Sri Rahayu,M.Kom                    |
| 158 | 201709192 | Sri Rusiyati, MM                    |
| 159 | 202009162 | Sugiyah, M.PD                       |
| 160 | 201709193 | Suhardoyo, SE, MM                   |
| 161 | 201609429 | Sukmawati Anggraeni Putri, M.Kom    |
| 162 | 200510048 | Sulistianto Sw, MM,M.Kom            |
| 163 | 201803046 | Sumarna,M.Kom                       |
| 164 | 201909217 | Supriyadi,M.Kom                     |
| 165 | 201609435 | Susafa'Ati,M.Kom                    |
| 166 | 202209087 | Dr. Suyoto                          |
| 167 | 202209121 | Syahrir, S.SOS, MM                  |
| 168 | 201507211 | Syaifur Rahmatullah A R,M.Kom       |
| 169 | 202103281 | Syarah Seimahuira,M.Kom             |
| 170 | 201509289 | Syarif Hidayatulloh,M.Kom           |
| 171 | 202111303 | Taopik Hidayat,M.Kom                |
| 172 | 201409249 | Taransa Agasya Tutupoly, S.T,M.Kom  |
| 173 | 201009396 | Tati Mardiana,M.Kom.                |
| 174 | 201107264 | Titin Kristiana,M.Kom               |
| 175 | 201803038 | Tri Santoso,M.Kom                   |
| 176 | 201002926 | Tuslaela,M.Kom.                     |
| 177 | 202003087 | Tuti Haryanti, M.Kom                |
| 178 | 201609476 | Tyas Setiyorini,M.Kom               |
| 179 | 201511390 | Ummu Radiyah, S.Kom, M.Eng          |
| 180 | 202209131 | Valentine Theresia Simamora, SE, MM |
| 181 | 202309070 | Vina Islami, S.Pi, MM               |
| 182 | 200603057 | Vito Triantori,M.Kom                |
| 183 | 202103226 | Wahid Akbar Basudani, SE, MM        |



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# Enhancing Rice Disease Detection with K-Means Segmentation and Comparison of EfficientNetB0, ResNet50, and Xception

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**Abstract**—Rice cultivation in Indonesia faces persistent threats from various diseases, posing significant challenges to food security and agricultural sustainability. This study addresses the crucial issue of disease identification in rice plants through advanced image classification techniques. Leveraging the EfficientNetB0 method and K-Means segmentation, we propose an optimized approach to classify five common rice diseases: Blast, Brown Spot, Hawar, Kresek, and Narrow Brown Spot. We collected a dataset comprising 1,275 images of diseased rice leaves acquired from rice fields across three provinces in Indonesia. Following manual classification and preprocessing, we applied K-Means segmentation to distinguish disease-affected areas. Subsequently, the EfficientNetB0 architecture was employed for disease classification. Our methodology achieved an accuracy rate of 89.06% on a test dataset of 128 images, with precision, recall, and F1- scores of 0.85, 0.81, and 0.83 for Blast; 0.86, 0.75, and 0.80 for Brown Spot; 0.96, 0.96, and 0.96 for Hawar; 0.86, 1.00, and 0.93 for Kresek; and 0.92, 0.86, and 0.89 for Narrow Brown Spot, respectively. Comparison with existing architectures revealed the superiority of EfficientNetB0 in terms of accuracy and loss. Additionally, evaluation metrics validate the robustness of our classification model. Our study contributes to the development of diagnostic systems for rice diseases, offering a valuable tool for farmers to identify and manage crop diseases effectively.

**Keywords**— *Image classification, K-Mean segmentation, Agricultural sustainability, Convolutional Neural Network (CNN), EfficientNetB0 architecture, Precision agriculture, Crop disease management*

## I. INTRODUCTION

Rice plays an important role in Indonesia as a staple food and is the main food source for most of the population. As a vital agricultural crop, rice not only contributes significantly to the country's economy, but also plays an important role in meeting the food needs of the Indonesian people [1]. Rice cultivation is prevalent across a diverse range of landscapes, from fertile rice fields to mountainous regions, illustrating its ability to thrive in various ecological conditions. Given its significant role in the Indonesian diet, the prosperity and productivity of rice crops have a direct

and substantial influence on the nation's food security and overall welfare [2]. Consequently, the cultivation of rice, technological advancements, and agricultural policies are closely monitored and developed to ensure a stable and sustainable supply of this essential grain, highlighting the crucial relationship between rice production and the daily lives of Indonesians [3].

Nonetheless, the projected rice harvest in Indonesia is often impeded by a multitude of plant diseases, such as blast, brown spot, narrow brown spot, crackle, and bacterial leaf blight [4]. Collectively, these diseases pose a major challenge to the agricultural sector, leading to reduced crop quality and quantity. Blast disease, caused by the fungus *Pyricularia oryzae*, manifests in small brown lesions on the leaves, thereby affecting overall crop health and productivity [5]. Brown spot, a prevalent ailment, is distinguished by the presence of dark brown, circular spots that may merge, resulting in significant harm to the leaves [6]. Narrow brown spot, caused by the fungus *Cercospora janseana*, further adds to the challenge by causing long, narrow lesions on leaves [7]. In addition, bacterial leaf blight or crackle caused by *Xanthomonas oryzae*, and blight characterized by dark streaks on the leaves caused by *Xanthomonas oryzae* pv. *oryzae*, add to the threat to rice plants [8].

The consequences of these diseases extend beyond mere visual symptoms, significantly compromising the health and productivity of rice plants as a whole. Effective management strategies, including the development and adoption of disease-resistant varieties, integrated pest management practices, and farmer education programs, are crucial for mitigating these challenges and ensuring the resilience of the rice farming industry in Indonesia [9].

The adoption of environmentally friendly agricultural technology is one of the alternatives that is increasingly being practiced by farmers. Sustainable agriculture aims to increase and maintain high productivity by considering organic fertilizer use, minimizing dependence on anorganic fertilizers, improving soil biota, ecological-based pest management, and plant diversification. The application of environmentally friendly rice farming, in addition to being

able to obtain high-yielding rice, is also healthier and more sustainable [10].

Plant disease classification can be instrumental in mitigating the threat of crop failure due to diseases affecting plants. The following categories of rice leaves were studied: Brown Spot, Hawar, Leaf Brown, and Healthy Leaves. The research involved Literature Study, Data Collection, Data Preprocessing, and Data Analysis. The research findings were derived from training, testing, and validation data [11]. The process of classifying the rice leaf disease involves the use of histograms, which are plots depicting the healthy leaf image components. This process is repeated for testing the leaves, and the results are compared and saved. Moreover, the system conducts feature extraction to examine the morphological changes in the rice plant leaves affected by the disease based on their texture [12].

Other research to answer the challenge of rice disease prediction focuses on automatic detection methods for image segmentation and automatic detection methods to identify certain diseases [13]. The K-Means method based on centroid feeding is used to segment parts of the disease, combined with the SVM method for classification of several classes [14]. Other research explores the CaffeNet deep learning method to classify 13 types of rice pests and diseases. However, in comparison with other deep learning methods on the same dataset, the classification results are still lacking [15]. Based on the problem described, the author proposes the use of the Convolutional Neural Network (CNN) method for classifying rice diseases using the EfficientNetB0 architecture in this research report [16]. Previously, the author conducted segmentation to separate foreground objects or front leaves from background leaves on rice leaves. This is to improve the accuracy of classification. CNN is chosen as an effort to follow technological advancements, and it is hoped that classification of rice diseases using this method can help farmers in early detection of rice diseases as a pest control effort to prevent crop failures.

## II. METHODOLOGY

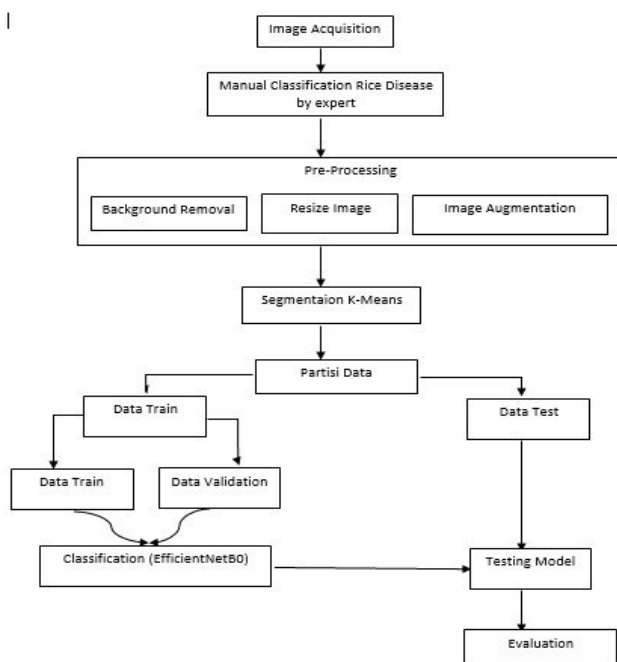


Fig. 1. Methodology

In conducting this research, the author designed a plan that outlined the procedures or steps taken during the course of the study. The stages of the research conducted by the author included the following based on Figure 1. The author proposes the following research method with an explanation: the testing on the rice leaves is performed in a computerized manner. Here are the detailed steps:

### A. Image Acquisition

The image acquisition for this study was conducted in a systematic and controlled manner to ensure the quality and consistency of the data. The following steps outline the procedure: Sample Collection: The images were collected directly from rice fields located in three provinces in Indonesia: Klaten Regency in Central Java, Gunung Kidul Regency in Yogyakarta Special Region (DIY), and Sukabumi Regency in West Java. A total of 1,275 images of diseased rice leaves were captured, representing a comprehensive dataset covering five common rice diseases: Blast, Brown Spot, Hawar, Kressek, and Narrow Brown Spot.

Camera and Settings: The images were captured using a Samsung A10 smartphone camera. This choice was made to ensure practicality and ease of use in the field. The camera was set to capture images at a resolution suitable for detailed analysis. While the exact resolution is not specified in the current version of the paper, ensuring high resolution is crucial for accurate segmentation and classification.

Camera Angle and Positioning: The images were taken at a consistent angle and distance to minimize variability. The camera was positioned perpendicular to the leaf surface to capture the entire leaf area clearly. Each leaf was isolated from the background as much as possible to ensure that the images focused solely on the leaf and its disease symptoms.

Lighting Conditions: Natural lighting conditions were used whenever possible to maintain consistency with real-world scenarios. In cases where natural lighting was insufficient, additional light sources were used to ensure that the images were well-lit, and the disease symptoms were clearly visible.

Preprocessing: After capturing the images, preprocessing steps were applied to enhance the quality and usability of the data. This included background removal, image resizing, and data augmentation techniques such as rotation, flipping, and scaling to increase the diversity of the dataset and improve the robustness of the classification model.







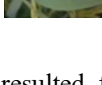
Dataset Division: The dataset of 1,275 images was divided into training, testing, and validation sets. The exact ratio of the division was not mentioned in the paper but should typically follow a standard practice such as 70% for training, 20% for testing, and 10% for validation to ensure a balanced and effective model training and evaluation process. The chosen dataset split percentages are based on standard practices in machine learning to ensure a balanced and effective model training and evaluation process. A 70-20-10 split ratio is commonly used to provide a sufficient amount of data for training while reserving adequate samples for testing and validation [17]. However, in this study, a slightly different ratio was used where the testing

set constitutes 10% of the total dataset. This decision was made due to the relatively small size of the dataset (1,275 images). By allocating 10% of the data for testing (128 images), we ensured that the training set remains large enough to train the model effectively, while the testing set is still sufficient to evaluate the model's performance reliably. The validation set was kept at 10% to fine-tune the model and avoid overfitting.

### B. Manual Classification

The manual classification process pertains to the task of labelling a dataset. In this instance, the author collaborated with nine agricultural experts to complete the task. Each expert was provided with a questionnaire that contained 194 questions, along with an accompanying photo of a rice leaf. The experts were instructed to classify each image based on the type of disease present. To ensure the accuracy of the labels, the labelled images were cross-referenced with the book "Pests and Diseases of Rice Plants" from the Center for Agricultural Technology Study of the Riau Islands. Furthermore, the author personally verified the classification results with some of the experts to guarantee the reliability of the labels.

TABLE I. SAMPLE OF CLASSIFICATION RESULTS BY EXPERT

| Classification Results     | Image Sample  | Information |
|----------------------------|---|-------------|
| Blast                      |    | Disease     |
| Brown Spot                 |  | Disease     |
| Blight                     |  | Disease     |
| Bacterial Leaf Blight      |  | Disease     |
| Narrow Brown Spot          |  | Disease     |
| Necrosis                   |  | Pest        |
| Chanaphalocrosis Medinalis |  | Pest        |

The labelled dataset that resulted from this manual classification process was subsequently utilized for training and testing the CNN model. The labels served as a benchmark for the supervised learning algorithm, allowing it to learn and accurately predict the disease classes.

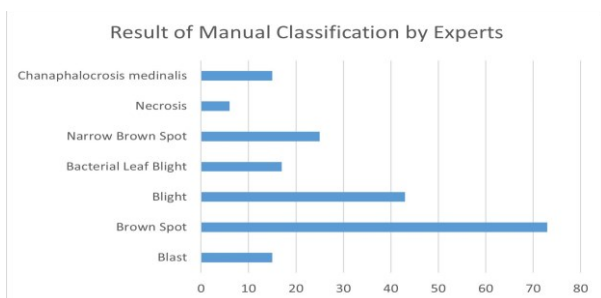


Fig. 2. Results of Manual Classification by Experts

Figure 2 illustrates the distribution of the original images collected and manually classified according to the type of rice disease. This chart shows the number of images for each disease category before any data augmentation was performed. A collection of classification results data which includes images for diseases and pests is listed in Table 1.

### C. Preprocessing

In this preprocessing stage, the author removes the back-ground image, resizes the image, and performs data augmentation on the image of paddy plants to increase the dataset.

### D. Segmentation

The clustering process initiated by the author involved categorizing images based on three color segments: green, brown, and black. However, it is crucial to consider that diseased leaves can exhibit a range of colors, such as yellowish and reddish hues. To address this, the segmentation process was extended to include additional color ranges: Green, representing healthy parts of the leaf; Brown, representing severely affected parts; Black, representing the background to isolate the leaf from its surroundings; Yellow, representing early-stage disease or nutrient deficiency; and Red, representing advanced stages of certain diseases. Incorporating these additional color ranges into the K-Means segmentation enabled the model to accurately segment and analyze leaves with yellowish and reddish segments, as demonstrated in Table 1. This enhancement significantly improves the accuracy and reliability of the disease classification process by providing a more detailed and accurate representation of the affected leaf areas.

### E. Split Data

In this stage, the author properly divided the dataset into training, testing, and validation sets to ensure a balanced and effective training and evaluation process. The dataset, consisting of 1,275 images, was divided as follows: Training Set, approximately 892 images, constituting 70% of the dataset, were used for training the model. The purpose of this set is to teach the model to recognize and classify the different types of rice diseases. Testing Set, approximately 255 images, representing 20% of the dataset, were used for testing the model. This set serves to evaluate the model's performance and ensure that it generalizes well to new, unseen data. Validation Set, approximately 128 images, making up 10% of the dataset, were used for validation during the training process. The purpose of this set is to fine-tune the model's hyperparameters and prevent overfitting. This division of the dataset adheres to the standard practices in machine learning, ensuring that the model is trained, validated, and tested on separate subsets of data, thus providing a robust evaluation of its performance.

### F. Classification

At the stage of classifying paddy diseases, the author uses the CNN method to classify paddy diseases based on manual categorization of paddy disease categories. At this stage, the author uses the EfficientNetB0 architecture. At the classification stage, the author performs modeling and



initialization to build the architecture model that will be used to classify paddy diseases.

### G. Evaluation

At this stage, the author performs an evaluation of the model that has been built, and here the author produces test results in terms of loss and accuracy.

### III. PROPOSED METHOD

The method proposed by the author in this research is to utilize one of the CNN architectures, namely EfficientNetB0, based on several experiments conducted by the author using the same dataset. EfficientNetB0 architecture has a high level of accuracy compared to other architectures, which is supported by previous research that shows that EfficientNet is better than ResNet, Xception, Inception, and others. In this research, the author designed a method for classifying paddy diseases as shown in the following diagram.



Fig. 3. Design of Proposed Methods

The image above depicts the method designed by the author. The input architecture is EfficientNetB0, which has a resolution of 224x224x3 (RGB). The EfficientNetB0 architecture comprises one convolutional layer, followed by mobile bottleneck convolutional (MBConv), which consists of 16 layers. Each layer of MBConv contains various different operations. The final layer produces an output in the form of a classification of 5 paddy diseases. In carrying out this research the author used several tools or frameworks listed in Table 2.





TABLE II. TOOLS AND FRAMEWORK VERSION PURPOSE

| Tool/Framework | Version | Purpose                  |
|----------------|---------|--------------------------|
| Python         | 3.8.5   | Programming Language     |
| Open CV        | 4.5.1   | Image Processing         |
| Tensorflow     | 2.4     | Framework                |
| Keras          | 2.4.3   | Deep learning API        |
| scikit-learn   | 0.24    | Machine Learning Library |
| pandas         | 2.2.2   | Machine Learning Library |
| numpy          | 2.0     | Machine Learning Library |
| matplotlib     | 3.9.1   | Machine Learning Library |
| seaborn        | 0.11.1  | Library visualization    |

## IV. RESULT AND DISCUSSION

In this section, the author discusses several classification processes for rice diseases, starting with the division of data into training, testing, and validation sets. Previously, the author conducted image segmentation of rice diseases by dividing them into three segments, as shown in Table 3.

TABLE III. SAMPLE OF SEGMENTATION RESULT

| Image (RGB)   | Segmentation Result (K-Means)   |
|---|---|
|  |  |
|  |  |

Based on Table 3 above, the impact resulting from this segmentation is that spots on rice leaves which indicate disease are increasingly visible, including leaves with narrow spots such as narrow brown spot disease. Although in reality there are some images that cannot be segmented properly because the spots are spread almost throughout the leaf so that the segmentation results are leaky. Then at this stage the author evaluates the model that has been built. The evaluation here produces the results of loss testing and accuracy testing. At this evaluation stage the author carries out an evaluation with the aim of testing the accuracy of the model built. Through this stage, the comparison between the classification results carried out by the model and the actual classification results can be seen. At this stage the author visualizes it in the form of a confusion matrix as in Figure 4. Where the confusion matrix is displayed in the form of a matrix table which describes the performance of the classification model on a series of test data whose true values are known. The author uses an evaluation model based on accuracy values in graphic form as in Figure 4.

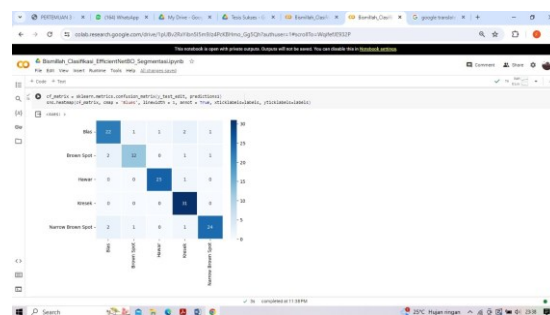


Fig. 4. Confusion Matrix

TABLE IV. CLASSIFICATION REPORT

| Class             | Precision | Recall | F1-Score |
|-------------------|-----------|--------|----------|
| Blas              | 0.85      | 0.81   | 0.83     |
| Brown Spot        | 0.86      | 0.75   | 0.80     |
| Hawar             | 0.96      | 0.96   | 0.96     |
| Kressek           | 0.86      | 1.00   | 0.93     |
| Narrow Brown Spot | 0.92      | 0.86   | 0.89     |

According to Table 4 above, the author reports the model's performance evaluation in the form of precision, recall, and f1-score. Based on the information in the table, the precision value produced indicates that the model's accuracy in distinguishing between data on paddy diseases and the model's predictions shows a high level of accuracy, above 90%. Furthermore, for the recall value, it appears that the model's success in finding information or predicting true positives (TP) compared to the total true positives (TP) is quite good. The model's success in predicting the Brown Spot class is still relatively weak compared to when the model predicts other classes. However, this model has proven to be successful in predicting true data, with an accuracy of up to 96% in the Hawar class. The next performance report is the f1-score value, where based on the table, the f1-score value is quite good, with a score above 90%, indicating that the classification method used has good precision and recall.

In this section, the author discusses several classification processes for rice diseases, starting with the division of data into training, testing, and validation sets.

The performance of the model was primarily evaluated using the testing set to ensure that the results are representative of the model's ability to generalize to new data. Figure 4 illustrates the confusion matrix generated from the test data, showcasing the accuracy of the model in predicting each class of rice disease. The confusion matrix is a comprehensive evaluation tool that offers a detailed overview of a model's performance on test data. The rows in the matrix represent the actual classes, while the columns represent the predicted classes. The cells in the matrix illustrate the number of correct and incorrect predictions made by the model. Additionally, the diagonal cells indicate the number of correct predictions for each class. Based on the accuracy demonstrated in the confusion matrix: The first class, Blas, attains an accuracy of 85%. The second class, Brown Spot, exhibits the lowest accuracy among the classes, which is 86%. The third class, Hawar, achieves an accuracy level of 96%. The fourth class, Kresek, achieves an accuracy level of 86%. The last class, Narrow Brown Spot, obtains an accuracy of 92%. The test data results indicate that the model demonstrates proficient performance across various classes of rice diseases, showcasing its dependability and efficacy.

### Analysis of Potential Overfitting

One of the essential aspects of assessing a machine learning model is to evaluate its potential for overfitting. Overfitting occurs when a model learns the training data too well, capturing noise and details that do not generalize to new, unseen data, resulting in high accuracy on the training set but lower accuracy on the test set. To determine the likelihood of overfitting in our experiment, we compared the accuracy and loss values between the training and testing datasets. The tables below provide a summary of these performance metrics.

TABLE V. COMPARISON OF RESEARCH RESULT

| Model          | Accuracy (Training) | Accuracy (Testing) | Loss (Training) | Loss (Testing) |
|----------------|---------------------|--------------------|-----------------|----------------|
| ResNet50       | 74%                 | 74%                | 62%             | 62%            |
| Xception       | 88%                 | 88%                | 42%             | 42%            |
| EfficientNetB0 | 89%                 | 89%                | 33%             | 33%            |

As evidenced by Table 5, the accuracy and loss values for The results indicate that the model demonstrates minimal over- fitting, as evidenced by the close similarity between the training and testing accuracy and loss metrics for EfficientNetB0. This suggests that the model has the ability to generalize effectively to new data. The data presented in Table 4 indicates that the precision, recall, and F1-score values are consistently high across all classes, which underscores the model's robustness. For instance, the high recall value for the Kresek class demonstrates that the model successfully identifies most of the true positive cases, which is crucial in preventing overfitting.

The outcomes from the test data corroborate that the model performs well across a variety of rice disease classes, showcasing its effectiveness and dependability. The minimal disparity between the training and testing

performance metrics suggests that the EfficientNetB0 model does not suffer from overfitting and maintains its capacity for generalization.

In summary, the assessment of the training and testing results, in conjunction with the evaluation metrics, suggests that the EfficientNetB0 model utilized in this study is sturdy and does not exhibit significant overfitting. This ensures that the model can be effectively employed for practical applications in diagnosing rice diseases.

### V. CONCLUSION

In this research, we effectively tackled the issue of crop failure in rice plants by employing modern diagnostic techniques. By utilizing the EfficientNetB0 architecture in conjunction with the K-Means segmentation method, we analysed and classified 1,275 images of five different types of rice diseases. The achieved accuracy rate of 89.06% from 128 test images demonstrates the effectiveness of our approach in diagnosing rice diseases. The classification results show that "Kresek" was the most prevalent disease, with 31 images identified, followed by "Blas" with 22 images, "Hawar" with 25 images, "Narrow Brown Spot" with 24 images, and "Brown Spot" with 12 images. Furthermore, our findings indicate that the use of the K-Means segmentation method significantly enhanced the classification accuracy in the EfficientNetB0 architecture. This study makes a substantial contribution to the development of diagnostic systems for rice plant diseases, which can assist farmers in identifying and managing diseases more efficiently.

During the course of this research, we encountered several challenges, including data imbalance, variable image quality, and the time-consuming task of manual labelling. To address these, we implemented data augmentation, utilized weighted loss functions, and ensured consistent image capturing conditions. Moving forward, expanding the dataset, developing automated image collection systems, and exploring advanced segmentation methods can further improve model performance. Furthermore, creating mobile applications for real-time disease detection and conducting field trials can enhance practical usability and reliability. Taking these steps will build upon the foundation of our study to develop more effective and scalable solutions for rice disease detection and management.

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