6 CLEAN WATER AND SANITATION

Ensure availability and sustainable management of water and sanitation for all

Goal 6: Clean Water & Sanitation

The Roles of Universitas Sumatera Utara to ensure Clean Water and Sanitaion Accessibility For All

Universitas Sumatera Utara
Medan
2022

RESEARCH PROJECTS OF UNIVERSITAS SUMATERA UTARA ON SDGs 6

No	Research Title	Results/Output/Outcome
1	DEVELOPMENT OF MAGNETS FROM RAW MATERIALS OF TRANSITION METALS (CO AND NI) LOCAL RAW MATERIALS FOR HEAVY METAL WASTEWATER CLEANING MATERIALS	Technological developments are increasingly sophisticated, especially innovations in material manufacturing, especially nanomagnetic materials. Various innovations in making magnetic materials continue to be developed such as ferrite-based permanent magnetic materials. In addition, Indonesia has abundant natural materials, especially in the availability of natural sand in rivers and on beaches. In this study, the development of magnets from transition metals (Co and Ni) with natural sand raw materials for heavy metal wastewater absorbing materials will be made. This research aims to utilize waste into new material products that are of high economic value, environmentally friendly and open up new business opportunities for industry, and increase competitiveness in the field of technology in accordance with USU RENSTRA 2020-2029. The addition of cobalt and nickel in natural sand is expected to provide a cubic spinel structure and magnetic parameter properties that have high coercivity so that they can be applied in testing heavy metal waste. Cobalt chloride, nickel chloride and natural iron sand were used as the main precursors for the manufacture of magnets with the formula Co1-xNixFe2O4 x=(0-0.3) %. The combustion temperature was carried out at 900oC with a 2-hour hold. The effect of molar ratio variation on the precursor will be tested. The tests carried out are from the structure using XRD, SEM-EDX, chemical structure and magnetic properties using FTIR and VSM testing. The effectiveness of the magnet will be tested in heavy metal absorption using AAS testing. The theme of this research is in accordance with one of the goals of the sixth global action plan or Sustainable Development Goals (SDGs), namely ensuring the availability and sustainable management of clean water and sanitation for all. The expected research results can make magnetic materials and can be published in 1 Reputable International Journal Q1 Materials Science and Energy Technology and additional outputs in 1 Reputable International Procceding.

No	Research Title	Results/Output/Outcome
2	POLICY POLITICS: (A STUDY ON THE IMPLEMENTATION OF THE MASTER METER PROGRAM IN THE PROVISION OF ACCESS TO CLEAN WATER, SANITATION AND HYGIENE TO IMPROVE THE WELFARE OF THE POOR IN MEDAN CITY)	The current achievement of access to clean water in Indonesia has only reaches 72.55 percent. This figure is still far below the Sustainable Development Goals (SDGs) target of 100 percent. In detail, there are 33.4 million people in Indonesia who lack clean water. In addition, there are 99.7 people in Indonesia who lack access to good sanitation facilities. The problem of lack of clean water and lack of access to good sanitation facilities is also experienced by residents in North Sumatra, including Medan City which is the capital city. The purpose of this study is to describe how the Implementation of the Master Meter Program Policy in Providing Access to Clean Water, Sanitation and Hygiene to improve the Welfare of the Poor in Medan City and to analyze the Supporting and Obstructing Factors. The method used is descriptive research method with qualitative approach. In-depth interviews with various stakeholders in the policy. Analysis is done qualitatively. The results of the research conducted in Medan City show that the Implementation of the Master Meter Program in Providing Access to Clean Water, Sanitation and Hygiene to Improve the Welfare of the Poor has run quite well. The entire series or process of activities starting from initial socialization, poverty reflection, program implementation, program monitoring all run quite well. The success of the Master Meter Program is very necessary so that it can provide access to clean water to community members in need. The obstacle that occurs in the implementation of this policy is that there are still poor people who have not received the benefits of the Master Meter Program. The North Sumatra Provincial Government, PDAM Tirtanadi, and Stakeholders continue to make efforts to be able to develop the Master Meter Program to all areas in Medan City where residents do not have access to clean water.

No	Research Title	Results/Output/Outcome
3	MORPHOMETRIC STUDY AND WATER QUALITY PROFILE OF COASTAL LAKES AT ANAK LAUT LAKE, ACEH SIGKIL, ACEH PROVINCE	This study aims to describe the physical conditions and dynamics of coastal lake waters which include water level conditions, bathymetry, and lake morphometry. Tidal and water level data were obtained from real time measurements of the Geospatial Information Agency from January - December 2022. Depth measurements using a Garmin 585 echosonder. Spatial data processing using ArGis. The results of the analysis show that the tidal type in Anak Laut Lake is a mixture of double daily tides, which means that in one day there are two tides and two low tides with different periods and heights. the mean sea level is 1.27m. The type of tide in Singkil waters is mixed tide prevailing semidiurnal, which means that in one day there are two tides and two low tides with different periods and heights. The results of tidal measurements at the study site obtained the highest water level elevation (HAT) value is 1.92 in May 2022. The lowest water elevation (LAT) was 0.62 m in February. The measured MSL was 1.27 m. This difference in water level results in differences in the hydro-morphometry of the lake. In general, Anak Laut Lake is very dynamic and fluctuating, following the dynamics of the tidal cycle in the Indian Ocean.
4	TRAINING ON CLEAN WATER MEDIA EEL BREEDING AND ENLARGEMENT AS AN EFFORT TO INCREASE THE ENTREPRENEURIAL CAPACITY OF THE PAYAGELI VILLAGE COMMUNITY	The process of cultivating eels that does not require a lot of equipment and maintenance as well as large areas of land is a special attraction in terms of its development potential. The people of Paya Geli Village have long cultivated eels as a side commodity due to the ease of the cultivation process. Until now, the Paya Geli Village Community has only used a conventional system where eels are left alone in mud tanks and fed with leftover food. The use of this conventional system not only has an impact on small productivity but will also encourage a bad and dirty paradigm to the eel consumer community. The conventional system also has an impact on erratic harvest scheduling so that the harvest cannot immediately match market demand. The solution to these problems is the use of eel cultivation methods with clean water media and partial harvesting which will not only increase productivity but also make it easier to control and harvest according to market specifications. Therefore, community service activities to increase the capacity of eel cultivation in the Paya Geli Village community through training in eel cultivation with clean water media

No	Research Title	Results/Output/Outcome
		and partial harvesting are important. This service activity has been carried out at the stage of handing over and designing eel ponds as well as training on the design and assembly of tarpaulin ponds and training on cultivation and enlargement of eels personally to service partners. This community service activity will also be refined with a market entry strategy as a supplyer/supplier of eels. It is hoped that this service activity will not only increase the productivity of eel cultivation but also become a new source of economic drivers for the people of Paya Geli Village and expand employment opportunities through entrepreneurial eel cultivation activities.

Kode Talenta/Kode Fakultas : 06/08
Menyasar SDGs No : 6

LAPORAN AKHIR
PENELITIAN TALENTA USU
SKEMA KOLABORASI NASIONAL WCU (*World Class University*)

Pengembangan Magnet dari Logam Transisi (Co dan Ni) Berbahan Baku Lokal untuk Material Pembersih Air Limbah Logam Berat

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Tahun Anggaran 2022
sesuai dengan Kontrak Penelitian
Nomor: 11119.1/UN5.1.R/PPM/2022, tanggal 08 Agustus 2022

FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS SUMATERA UTARA

MARET 2023

Halaman Pengesahan Laporan Akhir
PENELITIAN KOLABORASI NASIONAL PENERIMA DANA HIBAH WCU

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SUMMARY

DEVELOPMENT OF MAGNETS FROM RAW MATERIALS OF TRANSITION METALS (CO AND NI) LOCAL RAW MATERIALS FOR HEAVY METAL WASTEWATER CLEANING MATERIALS

Technological developments are increasingly sophisticated, especially innovations in material manufacturing, especially nanomagnetic materials. Various innovations in making magnetic materials continue to be developed such as ferrite-based permanent magnetic materials. In addition, Indonesia has abundant natural materials, especially in the availability of natural sand in rivers and on beaches. In this study, the development of magnets from transition metals (Co and Ni) with natural sand raw materials for heavy metal wastewater absorbing materials will be made. This research aims to utilize waste into new material products that are of high economic value, environmentally friendly and open up new business opportunities for industry, and increase competitiveness in the field of technology in accordance with USU RENSTRA 2020-2029. The addition of cobalt and nickel in natural sand is expected to provide a cubic spinel structure and magnetic parameter properties that have high coercivity so that they can be applied in testing heavy metal waste. Cobalt chloride, nickel chloride and natural iron sand were used as the main precursors for the manufacture of magnets with the formula Co1-xNixFe2O4 x=(0-0.3) %. The combustion temperature was carried out at 900oC with a 2-hour hold. The effect of molar ratio variation on the precursor will be tested. The tests carried out are from the structure using XRD, SEM-EDX, chemical structure and magnetic properties using FTIR and VSM testing. The effectiveness of the magnet will be tested in heavy metal absorption using AAS testing. The theme of this research is in accordance with one of the goals of the sixth global action plan or Sustainable Development Goals (SDGs), namely ensuring the availability and sustainable management of clean water and sanitation for all. The expected research results can make magnetic materials and can be published in 1 Reputable International Journal Q1 Materials Science and Energy Technology and additional outputs in 1 Reputable International Procceding.

Keywords: Magnetic ferrite, Co1-xNixFe2O4, Heavy Metal Waste

BAB 4
HASIL DAN PEMBAHASAN

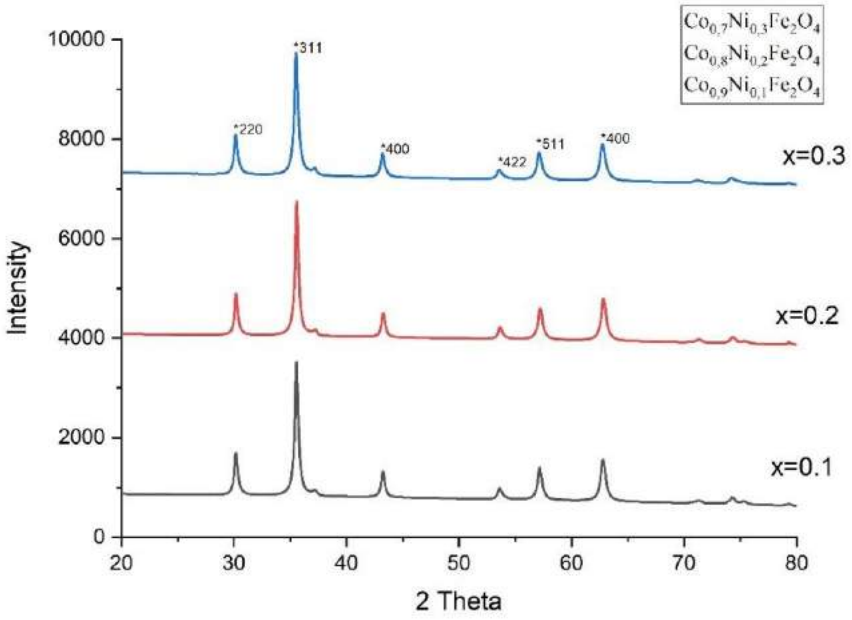
Telah selesai pembuatan sintesis nanopartikel magnetik $Co_{1-x}Ni_xFe_2O_4$ dengan variasi x = 0,1; 0,2; 0,3 dengan metode co-presipitasi. Pada proses pembuatan nanopartikel $Co_{1-x}Ni_xFe_2O_4$, serbuk yang dihasilkan berwarna hitam kecoklatan. Serbuk yang dihasikal dari sintesis kemudian di karakterisasi dengan, *X-ray Diffraction* (XRD) menunjukkan analisa struktur dan ukuran kristal, *Scaning Electron Microscopy* (SEM) menunjukkan ukuran nanopartikel dan komposisi penyusun unsur, *Vibrating Sample Magnetometer* (VSM) menunjukkan analisa sifat magnet, dan *Atomic Adsorption Spectrofotometric* (AAS) menunjukkan analisa penyerapan limbah logam berat.

(1) (2)

Gambar 4.1: (1) Endapan magnet $Co_{1-x}Ni_xFe_2O_4$ mendapat respon terhadap medan magnet luar, dan (2) gambar endapan yang telah dikeringan akan menjadi serbuk

4.1 Analisis *X-Ray Diffraction* (XRD)

X-Ray Diffraction menghasilkan identifikasi struktur kristalin dari sampel nanopartikel magnetik $Co_{1-x}Ni_xFe_2O_4$. Panjang gelombang (λ) sinar X yang digunakan adalah 1,54056 Å. Selanjutnya data yang didapat diolah menggunakan *software Origin 2018.* Sehingga diperoleh grafik seperti yang ditampilkan pada gambar 4.2 berikut:

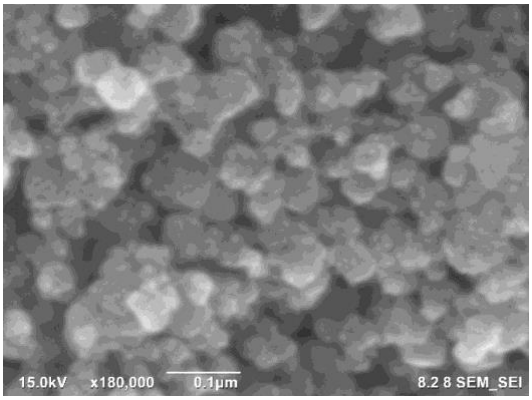


Gambar 4.2 Spektrum XRD dari nanopartikel magnetik $Co_{1-x}Ni_xFe_2O_4$

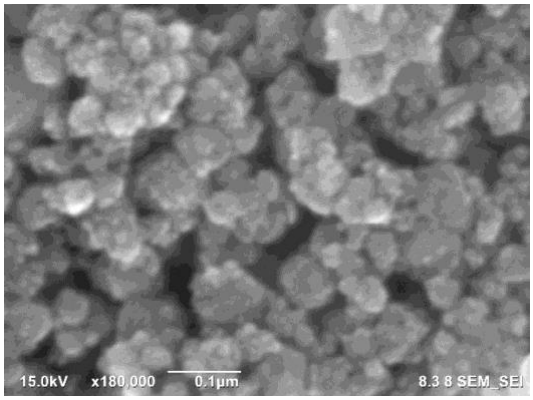
Pada grafik bisa dilihat bahwa pada gambar 4.2 menampilkan puncak-puncak difraksi dari sampel $Co_{1-x}Ni_xFe_2O_4$ telah dilengkapi indeks miller (*hkl*) pada sampel. Puncak-puncak difraksi yang muncul pada sampel termasuk dari indeks miller khas struktur spinel. Hasil karakteristik XRD menampilkan jika nanopartikel $Co_{1-x}Ni_xFe_2O_4$ mempunyai puncak utama pada daerah 2θ sekitar 35,50° merupakan puncak bidang (311). Berdasarkan pola XRD pada ketiga sampel nanopartikel $Co_{1-x}Ni_xFe_2O_4$ variasi x= 0,1; 0,2; dan 0,3, memperlihatkan bahwa *Cobalt Nickel Ferrite* ($Co_{1-x}Ni_xFe_2O_4$) yang memiliki struktur kristal kubik. Berdasarkan *Joint Committee on Powder Diffraction Standars* (JCPDS) puncak-puncak lain yang teridentifikasi dalam sampel material $Co_{1-x}Ni_xFe_2O_4$ secara berurut adalah bidang (200), (400), (511), dan (440). Hal ini membuktikan bahwa sampel $Co_{1-x}Ni_xFe_2O_4$ mengkristal cukup baik.

4.2 Analisis *Scanning Electron Microscopy – FE* (FE-SEM)

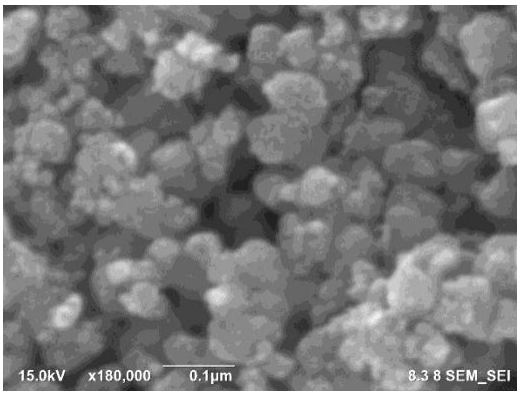
Pengujian SEM dilakukan untuk melihat ukuran nanopartikel pada serbuk $Co_{1-x}Ni_xFe_2O_4$. Analisa SEM juga dibuat untuk mengetahui komposisi unsur penyusun sampel nanopartikel $Co_{1-x}Ni_xFe_2O_4$. Hasil analisa SEM dengan variasi x=0,1 ; x=0,2 ; x=0,3 memperlihatkan bahwa ukuran partikel masing-masing sebesar 38,94 nm, 42,80 nm, dan 24,16 nm. Hasil dari gambar dapat diperlihatkan oleh gambar di bawah ini, yang menunjukkan bahwa sampel memiliki ukuran partikel yang berbeda-beda dan mengalami alglomerasi yang dipengaruhi oleh pH dan endapan dari nanopartikel $Co_{1-x}Ni_xFe_2O_4$.



(a)



(b)

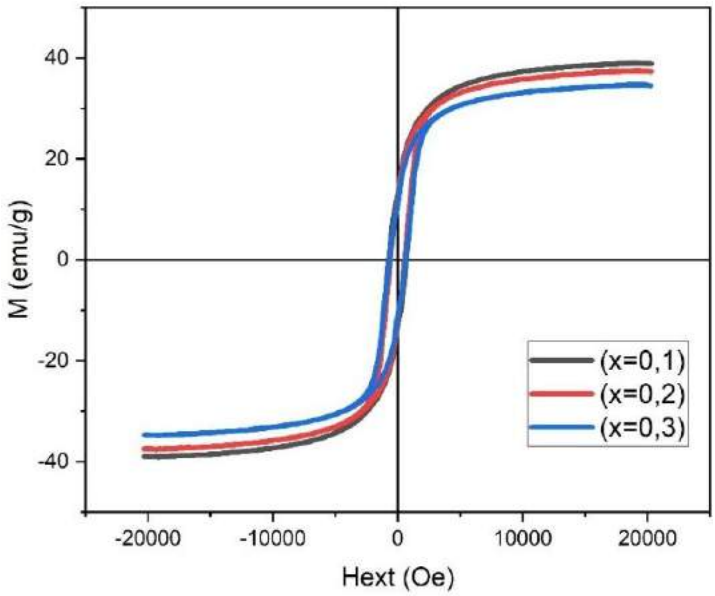


(c)

Gambar 4.3 (a) Morfologi sampel $Co_{1-x}Ni_xFe_2O_4$ X=0,1 ; (b) Morfologi sampel $Co_{1-x}Ni_xFe_2O_4$ X=0,2 ; (c) Morfologi sampel $Co_{1-x}Ni_xFe_2O_4$ X=0,3

4.3 Analisis *Vibrating Sample Magnetometer* (VSM)

Agar bisa mengetahui sifat kemagnetan pada nanopartikel $Co_{1-x}Ni_xFe_2O_4$ maka dilakukan analisis dengan penggunaan alat VSM. Pada kurva histerisis akan memuat data dari sifat kemagnetan yang diperoleh dari koersivitas (jHc), magnetisasi saturasi (σs), magnetisasi remanen (σr), dan koersivitas eksternal (Hext). Gambar dan tabel menunjukkan hasil pengujian VSM $Co_{1-x}Ni_xFe_2O_4$ dengan variasi X= 0,1; 0,2; dan 0,3. Kurva Histerisis nanopartikel magnetik $Co_{1-x}Ni_xFe_2O_4$ variasi X= 0,1; X= 0,2; dan X= 0,3.



Gambar 4.5 Kurva Histerisis $Co_{1-x}Ni_xFe_2O_4$

Tabel 4.1 Hasil analisa kurva histerisis $Co_{1-x}Ni_xFe_2O_4$

Sampel (x)	Ms (emu/g)	Hc (Oe)	Mr (emu/g)
0.1	39.07	709.89	13.01
0.2	37.60	551.01	11.52
0.3	34.49	621.35	10.83

Hasil sifat magnetik dari hasil pengujin VSM diperlihatkan pada tabel 4.1 yang menunjukkan bahwa terjadi peningkatan dan penurunan nilai koersivitas pada sampel nanopartikel $Co_{1-x}Ni_xFe_2O_4$ hal ini diperkirakan telah terjadinya aglomerasi (penggumpalan) pada serbuk dan penggerusan pada sampel yang kurang maksimal. Sifat kemagnetan suatu bahan bergantung pada kristalinitas, ukuran partikel dan adanya fasa sekunder (pengotor). Semakin tinggi nilai koersivitasnya maka semakin tinggi sifat kemagnetannya. Berdasarkan tabel 4.1 Pada nilai magnetisasi saturasi nilai sampel x=0,3 memiliki nilai saturasi paling kecil diakibatkan adanya fasa hematit. Hematit bersifat antiferomagnetik sehingga nilai saturasinya berkurang. Nilai koersivitas terendah diperoleh oleh sampel x=0.2 dikarenakan sampel ini memiliki ukuran kristalit paling kecil sehingga cenderung memiliki domain magnetik tungga dan paling cenderung bersifat superparamagnetik. Nilai remanensi sampel x=0.1 paling tinggi dikarenakan adanya hematit sehingga momen magnetiknya sulit untuk disearahkan. Dan pada tabel 4.1 mengidentifikasikan bahwa seluruh sampel bersifat *hard magnetic*

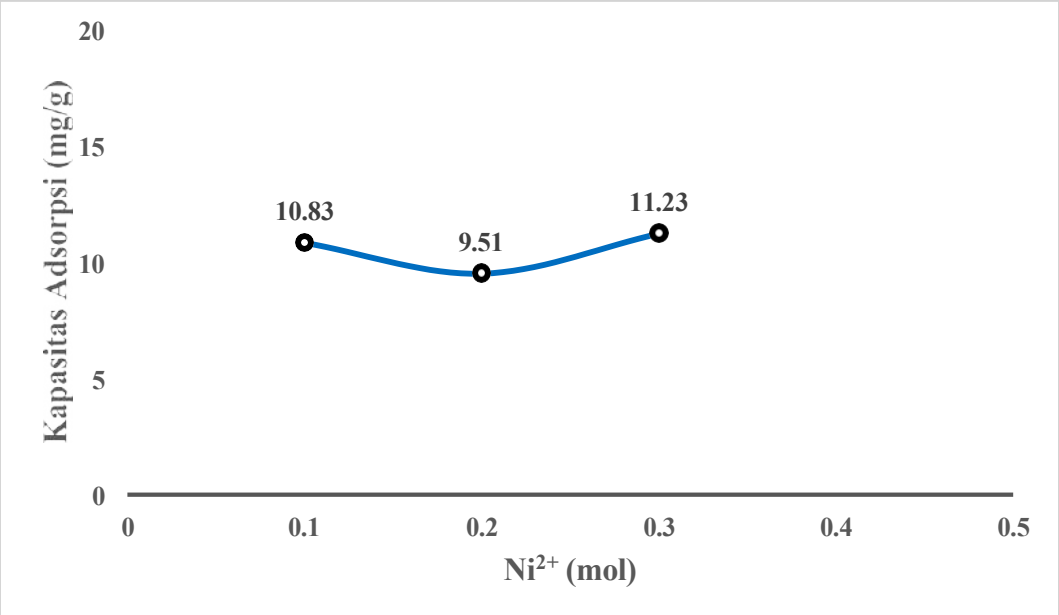
4.4 *Atomic Adsorption Spectrofotometric* (AAS)

Serbuk nanopartikel $Co_{1-x}Ni_xFe_2O_4$ dengan variasi x = 0,1; 0,2, dan 0,3 pada pengujian ini akan di gunakan untuk menyerap limbah logam berat. Logam berat yang digunakan adalah ion timbal (Cr3+) dan (Cu2+). Serbuk logam berat (Cr3+) dan (Cu2+) terlebih dahulu di larutkan dengan Aquades hingga menjadi larutan. Kemudian serbuk nanopartikel $Co_{1-x}Ni_xFe_2O_4$ dicampur dengan larutan logam berat (Cr3+) dan (Cu2+)untuk di shaker selama 30 menit. Hasil pencampuran yang berupa cairan tersebut dianalisisuntuk mengetahui seberapa besar daya serap (adsorpsi) nanopartikel $Co_{1-x}Ni_xFe_2O_4$ terhadap limbah logam berat (Cr3+) dan (Cu2+) di Laboratorium Teknologi Lingkungan Gedunga Geostech 820, Kawasan Puspipek serpong – Tangerang Selatan. Berikut ini laporan hasil uji.

Hasil Analisa AAS pada sampel $Co_{1-x}Ni_xFe_2O_4$

Sampel	Konsentrasi Total Cr (mg/L)	Konsentrasi Ion Cr Total Terserap (mg/L)	Removal Efficiency (%)	Kapasitas Adsorpsi (mg/g)
X= 0,1	22,5	0,84	96,26	10,83
X= 0,2	22,5	3,48	84,53	9,51
X= 0,3	22,5	<0,03	99,86	11,23

Grafik pengaruh mol Ni^{2+} dengan kapasitas adsorpsi pada Co1-xNixFe2O4



Gambar 2 : Grafik pengaruh mol Ni2+ dengan kapasitas adsorpsi pada Co1-xNixFe2O4

Dapat dilihat pada tabel 1 dan gambar 2 bahwa efisiensi dan kapasitas adsorpsi terbesar terjadi pada sampel x = 0,3 yaitu 99,86 % dan 11,23 mg/g. Hal ini karena berkaitan dengan sifat kemagnetan sampel Co1-xNixFe2O4. Pada variasi sampel x = 0,3 memiliki nilai saturasi yang tinggi, nilai remanen paling kecil, namun nilai koersivitas terkecil kedua, hal ini dikarenakan pada sampel x = 0,1 terdapat fasa pengotor yang dapat mengakibatkan nilai koersivitasnya rendah.

BAB 5.
KESIMPULAN

1. Telah berhasil dilakukan sintesis nanopartikel $Co_{0.7}Ni_{0.3}Fe_2O_4$ x= 0,3 melalui metode co-presipitasi.
2. Sifat magnetik material $Co_{0.7}Ni_{0.3}Fe_2O_4$ *hard magnet* hal ini dapat dilihat bahwa hasil yang didapat 621.35 Oe.
3. Morfologi pada serbuk $Co_{0.7}Ni_{0.3}Fe_2O_4$ memperlihatkan bahwa ukuran partikel masing-masing sebesar 38,94 nm, 42,80 nm, dan 24,16 nm.
4. Struktur kristal $Co_{0.7}Ni_{0.3}Fe_2O_4$ menunjukkan struktur kristal kubik, serta fase utama terdeteksi dengan sedikit pengotor atau unsur lain pada pola difraksinya.
5. Daya serap pada sampel x= 0,3 didapat kapasitas adsorpsi besar yaitu 99,86 % dan 11,23 mg/g. Hal ini karena berkaitan dengan sifat kemagnetan sampel $Co_{0.7}Ni_{0.3}Fe_2O_4$. Pada sampel x= 0,3 memiliki nilai saturasi yang tinggi, nilai remanen paling kecil, namun nilai koersivitas kecil.

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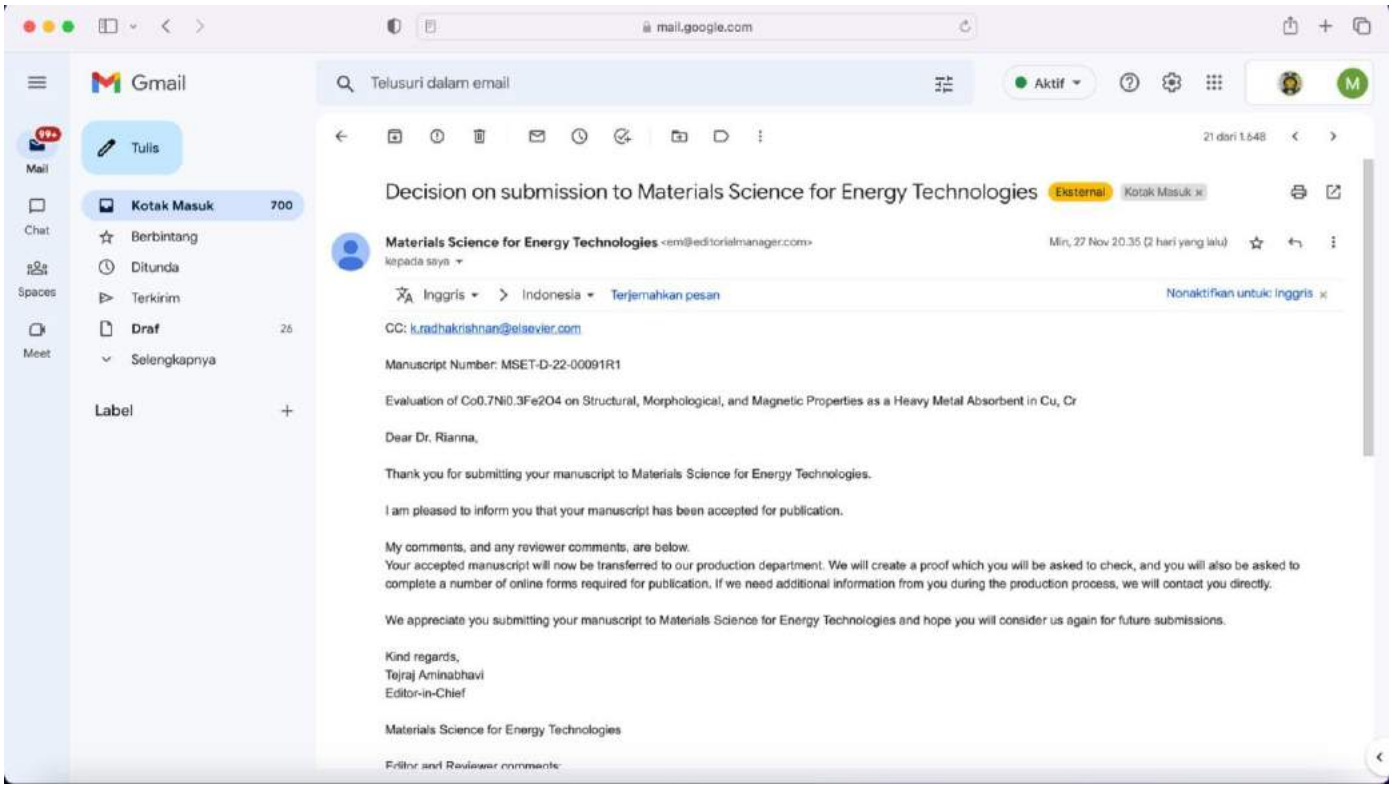

Artikel Ilmiah

Evaluation of $Co_{0.7}Ni_{0.3}Fe_2O_4$ on Structural, Morphological, and Magnetic Properties as a Heavy Metal Absorbent in Cu, Cr

Martha Rianna[1*], Aknes Talanda[1], Yoga Pratama[1], Syahrul Humaidi[1], Eko Arief Setiadi[2], Anggito P. Tetuko[2], Lukman Faris Nurdiyansah[2], Timbangen Sembiring[1], Perdamean Sebayang[2]

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Abstract

Progressively more complex technological advancements have been made, particularly with the invention of ferrite material manufacture. In this evaluation, the co-precipitation method was used to assess the structure, morphological, and magnetic characteristics of cobalt nickel ferrite for heavy metal adsorbent in Cu, and Cr material. Synthesized cobalt nickel ferrite of $Co_{0.7}Ni_{0.3}Fe_2O_4$ was analyzed structurally and morphologically using x-ray diffraction (XRD) and field emission scanning electron microscopy (FE-SEM), and its room temperature hysteresis loops were measured using a vibrating sample magnetometer (VSM). Atomic absorption spectroscopy was then used to determine the metal content (AAS). XRD study that the six peaks and well-defined reflection planes of (220), (311), (400), (422), (511), and (400) at the 2θ values of 30.12°, 35.57°, 43.29°, 53.71°, and 62.72° and there is no secondary phase in cobalt-nickel ferrite. FE-SEM results confirmed the spherical shape of the ferrite nanoparticle. The average particle size of $Co_{0.7}Ni_{0.3}Fe_2O_4$ is found with a range of 80 to 120 nm. The peaks of Fe, Ni, Co, and O elements as energy dispersive x-ray (EDX) spectra studied the ratio of the chemical composition of metal ions (Co: Ni) and iron to oxygen (Fe:O), The magnetic properties from VSM results evaluated that Ms of 34.46 emu/g, Mr of 14.91 emu/g, Hc of 671.58 Oe, independently. Correspondingly, AAS results from a removal efficiency of 99.86 % with capacity adsorption of 11.23 mg/L of $Co_{0.7}Ni_{0.3}Fe_2O_4$.

Keywords: Cobalt Nickel Ferrite, Natural Iron Sand, Magnetic Properties

1. Introduction

The production of magnetic materials is becoming increasingly innovative. Ferrites are magnetic materials that have both electrical and magnetic characteristics. The primary components of ferrite are metal oxides and iron oxides [1]. Because they have intriguing electrical and magnetic properties, ferrite magnetic materials like cobalt and nickel are crucial for technology. [2], [3]. Recent studies from Debnath et al [4] synthesized cobalt nickel ferrite with the addition of polyvinyl pyrrolidone (PVP) using a heat treatment method. The sample was heat a furnace for 3 h at 700°C. These results show average particle increases with cobalt as doping. Whereas

magnetic properties are reduced as increased cobalt as doping. Ni-CO spinel ferrite synthesis with hydrothermal method has been conducted with doping Ce-Dy rare earth as co-doping [5]. Adding co-doping in Co-Ni has increased magnetic parameters and energy band gap. The influence of co-doping materials caused structural, morphology, magnetic, electrical, and optical properties [6]–[8]. Correspondingly, natural iron sand is one of the main precursors for making ferrite magnetic materials. A previous study, making hexagonal ferrite magnetic materials from natural iron sand has been carried out for microwave absorption materials [9]. Natural iron sand contains iron minerals with a high enough concentration, it can be seen that iron sand and ferrite nanoparticle material are attached to a permanent magnetic material [3] and heavy metal waste [10].

In this research, ferrite magnetic material $Co_{0.7}Ni_{0.3}Fe_2O_4$ will be made with a calcination temperature of 700ºC for 1 h using the co-precipitation method which is synthesized from natural iron sand. The characterizations carried out are structural properties using XRD and FESEM-EDS. To determine magnetic properties using VSM, then to determine the number of heavy metals absorbed using AAS, respectively.

2. Materials and Methods

In this study, the synthesis of $Co_{0.7}Ni_{0.3}Fe_2O_4$ used the coprecipitation method. $CoCl_2$, $NiCl_2$, and natural iron sand are the main precursors. Firstly, 2 g of iron sand was dissolved in 30 ml of HCl (37%) and the mixture is stirred until homogeneous for 20 min under room temperature, then filtered using filter paper. Then, the solution was mixed with 2.8 g of $CoCl_2$ and 1.9 g of $NiCl_2$ which have been dissolved with 30 ml of distilled water. After the mixed solution is dropped into 16 g of NaOH solution. This synthesis process is carried out at a temperature of 100◦C and the solution is stirred with a magnetic stirrer at a speed of 500 rpm for 120 minutes. After 120 minutes the solution was precipitated and washed, then the sample was dried in the oven for 15 h at a temperature of 100◦C until the powder was evaluated. The powder was calcined at a temperature of 700◦C for 1 h with a heating rate of 10 ◦C/min. The sample was characterized by X-ray Diffraction (XRD) and Field Emission Scanning Electron Microscopes (FE-SEM), the room temperature hysteresis loops were measured by Vibrating Sample Magnetometer (VSM) then to determine metal content with heavy metal used Atomic Absorption Spectrophotometer (AAS).

3. Results and Discussion

The X-Ray diffraction (XRD) of $Co_{0.7}Ni_{0.3}Fe_2O_4$ has been obtained in Figure 1. The diffraction peaks match with JCPDS card 22-1086. Figure 1 shows six peaks and well-defined reflection planes of (220), (311), (400), (422), (511), and (400) at the 2θ values of 30.12º, 35.57º, 43.29º, 53.71º, and 62.72º.

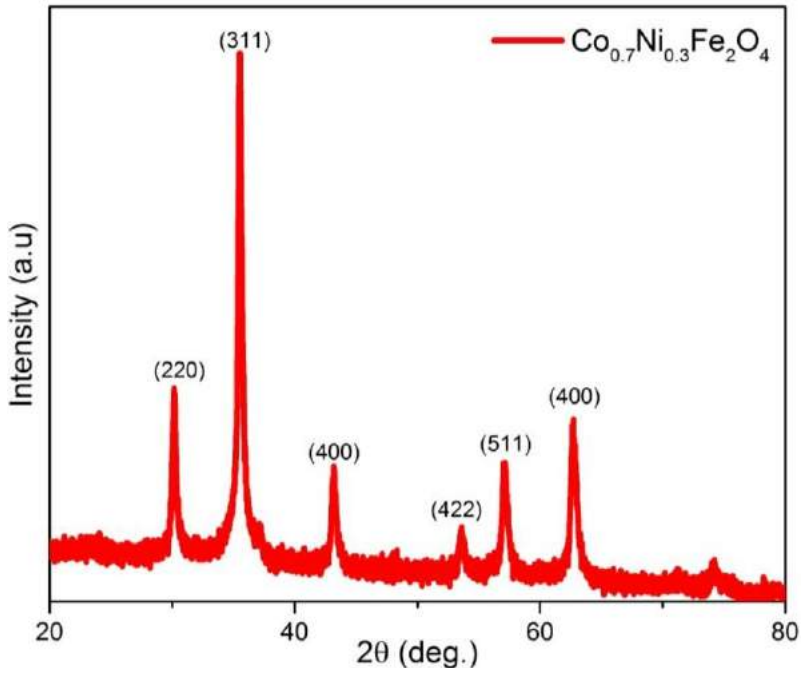
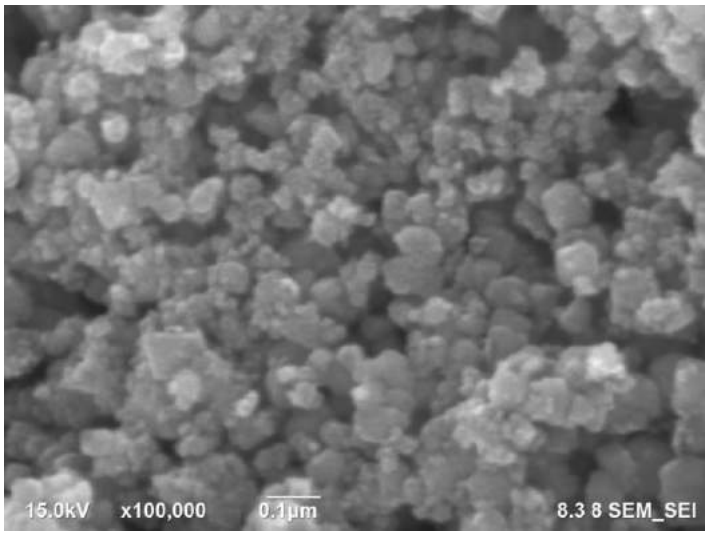
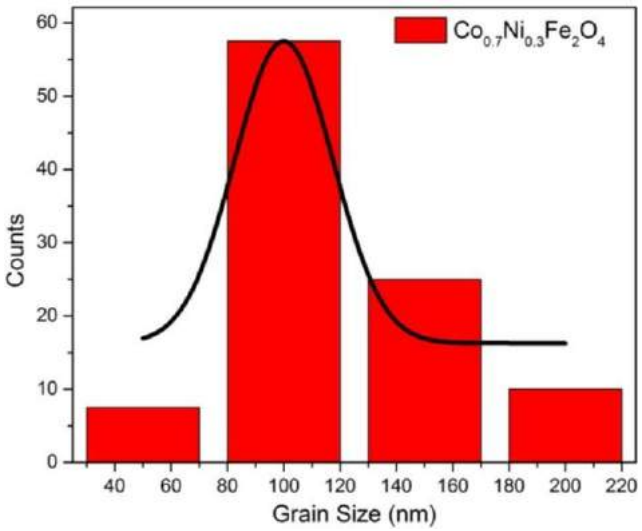


Figure 1. XRD Pattern of $Co_{0.7}Ni_{0.3}Fe_2O_4$

According to Figure 1's peaks, impurities don't have a diffraction peak. A single phase without a secondary phase is depicted in the formation in Figure 1. The findings are consistent with the absence of a secondary phase in cobalt-nickel ferrite due to the differing atomic radius of cobalt and nickel [11]. Based on previous research, the actual cation distribution by calculating the intensity ratio, (220), (400), and (440) planes have been considered, as these are in good condition to the cation distribution [12]–[14]. The intensity of the (220) and (440) planes shows on the cations on tetrahedral sites [15] and the (400) plane depends on that of the octahedral site [16], [17]. The morphology of $Co_{0.7}Ni_{0.3}Fe_2O_4$ is evaluated in Figure 2. The grain size distribution histogram was then calculated from the Field Emission Scanning Electron Microscope (FE-SEM) findings using Image-J software.



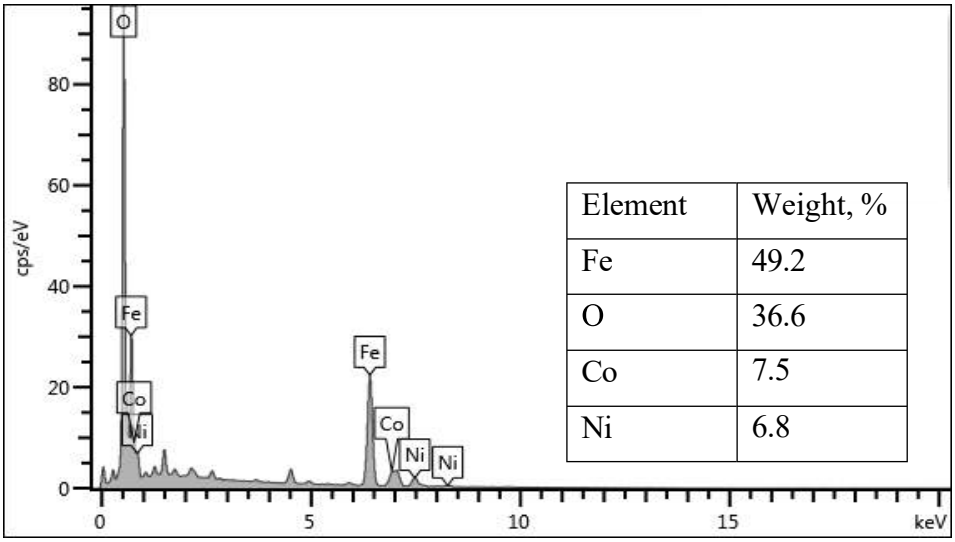
(a)



(b)

Figure 2. (a) Morphological structure and (b) distribution histogram of $Co_{0.7}Ni_{0.3}Fe_2O_4$

FE-SEM results as in Figure 2 the shape of the nanoparticles is almost spherical. The average particle size of $Co_{0.7}Ni_{0.3}Fe_2O_4$ is found with a range of 80 to 120 nm. FE-SEM image shows some of the agglomerations. Agglomeration phenomena are caused by chemical reactions during the synthesis of raw materials. [18]. Agglomeration results from contamination of the source material during the stirring process.



Element	Weight, %
Fe	49.2
O	36.6
Co	7.5
Ni	6.8

Figure 3. EDX spectra of $Co_{0.7}Ni_{0.3}Fe_2O_4$

The elemental composition evaluation has been carried out using energy dispersive X-ray (EDX) spectra, attached with FESEM. The EDX spectra for $Co_{0.7}Ni_{0.3}Fe_2O_4$ are shown in Figure 3. The peaks of Fe, Ni, Co, and O elements as in Figure 3 with variations of weight %. The ratio of iron to oxygen (Fe:O) and the chemical composition of metal ions (Co: Ni) in the spectra were both in accordance with the predicted composition ratio [19], without traces of any impurity element and that confirms the single phase purity of $Co_{0.7}Ni_{0.3}Fe_2O_4$.

Magnetic characterization of $Co_{0.7}Ni_{0.3}Fe_2O_4$ has been evaluated using Vibrating Sample Magnetometer (VSM) and is shown in Figure 4. From the hysteresis loop, the saturation magnetization (Ms) of 34.46 emu/g, remanent magnetization (Mr) of 14.91 emu/g, and coercivity (Hc) of 671.58 Oe, respectively.

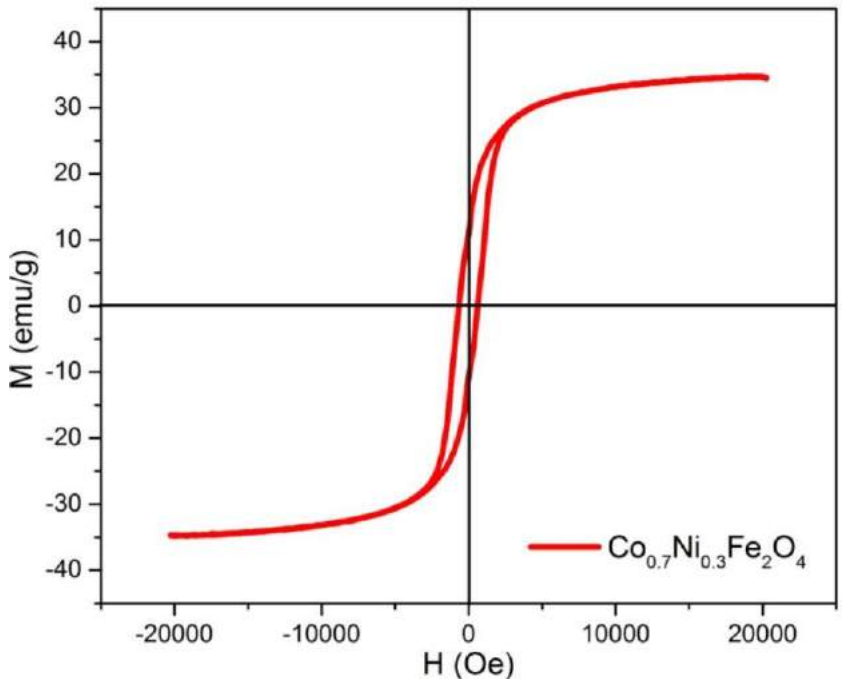


Figure 4. Hysteresis loop of $Co_{0.7}Ni_{0.3}Fe_2O_4$

These results suggested that soft magnetic material based on coercivity (Hc) of 671.58 Oe at $Co_{0.7}Ni_{0.3}Fe_2O_4$ whereas Debnath et al [12] reported that $Ni_{0.5}Co_{0.5}Fe_2O_4$ of 1003 Oe. It is suggested that the coercitivity value increases with the same condition as the molar ratio of cobalt and nickel. Nanoparticle powder $Co_{0.7}Ni_{0.3}Fe_2O_4$ in this characterization will be used to absorb heavy metal waste. The heavy metal used is lead ion Cu^{2+} and Cr^{3+}. Heavy metal powder Cu^{2+} and Cr^{3+} first dissolved with Aquadest until it becomes a solution. Then the nanoparticle powder $Co_{0.7}Ni_{0.3}Fe_2O_4$ was mixed with heavy metal solution Cu^{2+} and Cr^{3+} and shaken for 30 minutes. The results of the mixing in the form of a liquid were analyzed to determine how much the nanoparticles' adsorption capacity was $Co_{1-x}Ni_xFe_2O_4$ against heavy metal waste Cu^{2+} and Cr^{3+}. The formula to determine the adsorption capacity and removal efficiency *:*

$$q = \frac{Co - Ce}{w} \quad (1)$$

$$\%R = \frac{Co - Ce}{Co} 100\% \quad (2)$$

with: q = Adsorption capacity (mg/L)
Co = initial concentration (mg/L)
Ce = Final concentration (mg/L)
W = mass of magnetic powder (grams)
V= waste volume (L)
R= Removal Efficiency (%)

Results of Atomic Absorption Spectrophotometer (AAS) on $Co_{0.7}Ni_{0.3}Fe_2O_4$ based on formula (1) and (2) is concentration total, Cr of 22.5 mg/L, concentration ion Cr absorbed of 0.03 mg/L, removal efficiency of 99.86 % with capacity adsorption of 11.23 mg/L.

4. Conclusion

The co-precipitation method was used to study the structural, morphology, and magnetic characteristics of cobalt nickel ferrite for use as a heavy metal adsorbent in Cu, Cr material. The characterization was evaluated by XRD, FE-SEM, EDX, VSM, and AAS. XRD study that the six peaks and well-defined reflection planes of (220), (311), (400), (422), (511), and (400) at the 2θ values of 30.12^{o}, 35.57^{o}, 43.29^{o}, 53.71^{o}, and 62.72^{o} and there is no secondary phase in cobalt-nickel ferrite. The ferrite nanoparticle's almost spherical shape was confirmed by FE-SEM characterization. The average particle size of $Co_{0.7}Ni_{0.3}Fe_2O_4$ is found with a range of 80 to 120 nm. The peaks of Fe, Ni, Co, and O elements as energy dispersive X-Ray (EDX) spectra studied the ratio of chemical composition of metal ions (Co: Ni) and iron to oxygen (Fe:O), The magnetic properties from VSM results evaluated that Ms of 34.46 emu/g, Mr of 14.91 emu/g, Hc of 671.58 Oe, respectively. Correspondingly, AAS results in removal efficiency of 99.86 % with capacity adsorption of 11.23 mg/L of $Co_{0.7}Ni_{0.3}Fe_2O_4$. These results that $Co_{0.7}Ni_{0.3}Fe_2O_4$ was good material for Heavy Metal Absorbent in Cu, Cr.

5. Acknowledgments

The authors acknowledge the facilities, scientific and technical support from Universitas Sumatera Utara by Talenta Research 2022 of National Collaboration Research in World Class University (WCU) Scheme with contract number 357/UN5.2.3.1/PPM/KP-TALENTA/2022 and Advanced Characterization Laboratories Serpong, National Research and Innovation Agency through E-Layanan Sains, Badan Riset dan Inovasi Nasional.

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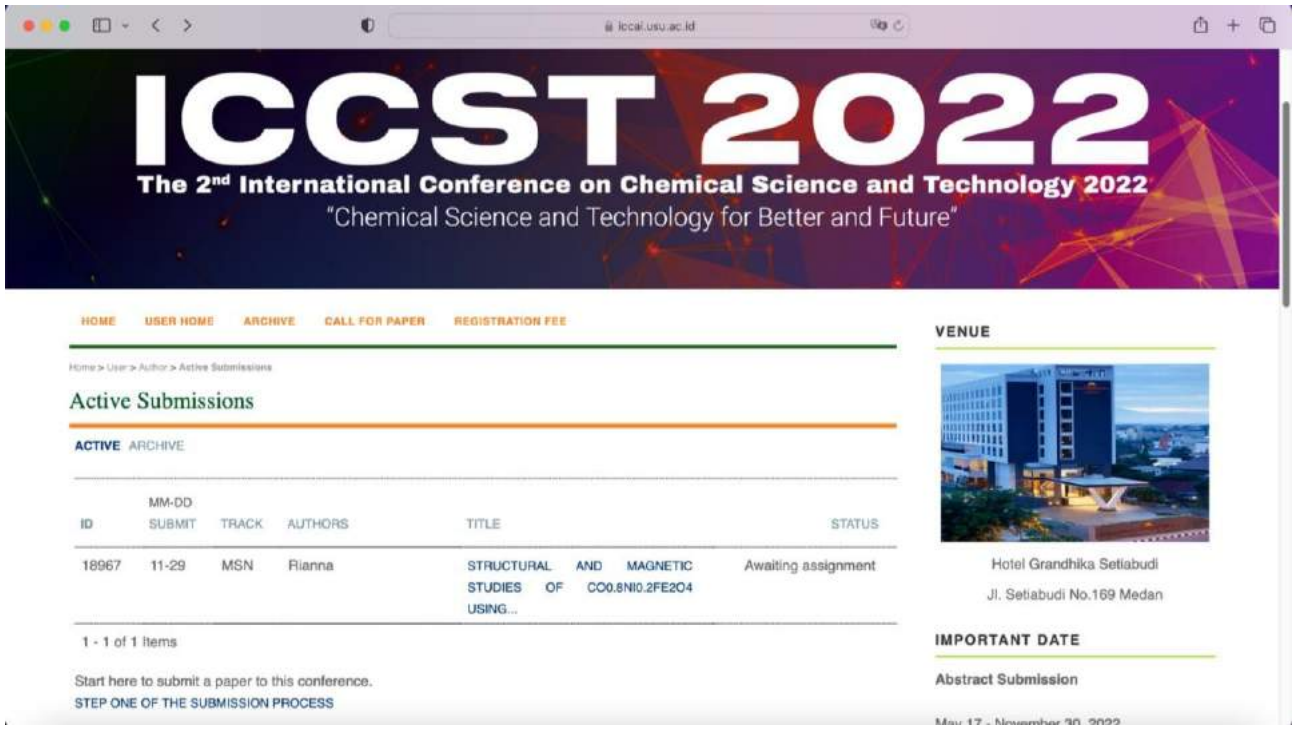

Structural and Magnetic Studies of $Co_{0.8}Ni_{0.2}Fe_2O_4$ using Co-precipitation Method

Martha Rianna[1], Aknes Talanda[1], Yoga Pratama[1], Eko Arief Setiadi[2], Anggito P. Tetuko[2], Lukman Faris Nurdiyansah[2], Syahrul Humaidi[1], Timbangen Sembiring[1], Perdamean Sebayang[2]
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Abstract

In this research, synthesis of $Co_{0.8}Ni_{0.2}Fe_2O_4$ has been conducted using co-precipitation method with calcined at 900ºC for 2 h. The sample were characterized using X-Ray Diffraction (XRD), Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS) and Vibrating Sample Magnetometer (VSM) to confirm structural and magnetic studies. The XRD results shows the peaks can be indexed as (220), (311), (400), (422), (511), and (440). SEM-EDX results shows the sample has unifom particle size with average of 1 μm. The variation of saturation magnetization (Ms) of 37.54 emu/g, remanence magnetization (Mr) of 17.31 emu/g, coercive field (Hc) of 747.25 Oe and squareness of hysteresis loop (Mr/Ms) of 0.46, respectively.
Keywords: Structural, Magnetic Studies, Hysteresis Loop

1. Introduction

The ferrite magnetic particles are good material and unique physical peculiarities like structural and magnetic properties [1]. They are also technologically important materials as they are widely utilized in magnetic permanent material, absorbing microwave and electronic devices [2], [3]. The properties of cobalt and nickel ferrites can be greatly influenced by doping nickel atoms and cobalt atoms [4]. Ferrites can be prepared by various methods including sol-gel method, co-precipitation method, hydrothermal method, solid state reaction, precursor method etc [5]–[7] . Iron sand is a potential natural resource in Indonesia. Iron sand has four phases: maghemite (γ-Fe_2O_3), hematite (α-Fe_2O_3), goethite (FeO(OH)) and magnetite (Fe_3O_4). Of the four phases, only maghemite (γ-Fe2O3) and magnetite (Fe_3O_4) have magnetic properties and besides that magnetite (Fe_3O_4) is also amphoteric and has high absorption [8]. The magnetite compound is black with a spinel structure and contains Fe^{2+} and Fe^{3+} ions. Iron sand has the potential to be made of nanometer-sized of Fe_3O_4 [9]–[11]. In this research, the preparation and characterization of Fe_3O_4 synthesized from natural iron sand will be made using the co-precipitation method.

2. Materials and Methods

Doped cobalt nickel ferrite powders were synthesized by iron sand using co precipitation method with NaOH as the main precursors. The main precursor was dissolved in 100 ml deionized water taken in a hotplate. Then stoichiometric amounts of iron sand, nickel chloride and cobalt chloride were added into the HCl solution. NaOH solution was added with continuous stirring for 2 hours at 100ºC. The solution containing powders of $Co_{0.8}Ni_{0.2}Fe_2O_4$ was removed by washing with

water and ethanol. The resultant powder was dried in the oven for 24 hours at 100°C. The resulting powder was calcined at 900°C for 2 hours. The sample were characterized using XRD, SEM-EDS and VSM to confirm structural and magnetic studies.

3. Results and Discussion

The characterization of X-ray diffraction (XRD) of $Co_{0.8}Ni_{0.2}Fe_2O_4$ are shown in Figure 1. XRD pattern observed that $Co_{0.8}Ni_{0.2}Fe_2O_4$ crystallize in cubic spinel morphology of Fd3m space group. The peaks can be indexed as (220), (311), (400), (422), (511), and (440), respectively. All peaks are in diffraction patterns with JCPDS Card Number 22-1086.

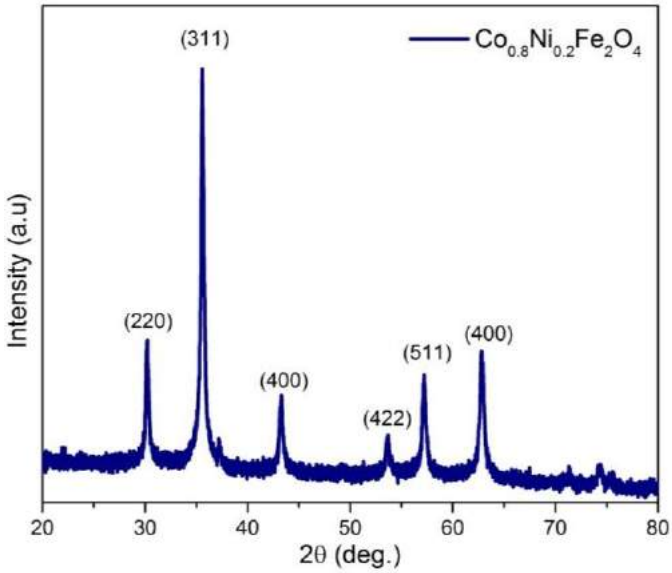

Figure 1. XRD Patterns of $Co_{0.8}Ni_{0.2}Fe_2O_4$ sample

Based from Figure 1, cobalt content has been substitution to nickel content. It is indication that substitution of Ni^{2+} with a smaller ionic radius (0.69 Å) whereas Co^{2+} with a larger ionic radius (0.74 Å) [12]. SEM-EDS results of $Co_{0.8}Ni_{0.2}Fe_2O_4$ are shown in Figure 2 and Table 1.

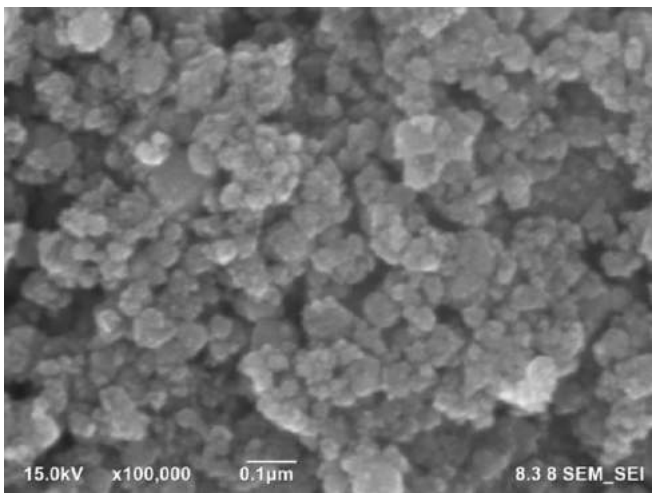

Figure 2. SEM image of $Co_{0.8}Ni_{0.2}Fe_2O_4$ sample

Table 1. The element of $Co_{0.8}Ni_{0.2}Fe_2O_4$ sample

Element	At%
O	55.7
Fe	37.5
Co	5.6
Ni	1.2

From Figure 2 shows that the sample has unifom particle size with average of 1 μm. It show that the other particle content several structural. This is also to substitution of Co and Ni contents as additive concentrations at $Co_{0.8}Ni_{0.2}Fe_2O_4$. The magnetic studies can be seen in Figure 3. Figure 3 shows room temperature M-H loops of $Co_{0.8}Ni_{0.2}Fe_2O_4$.

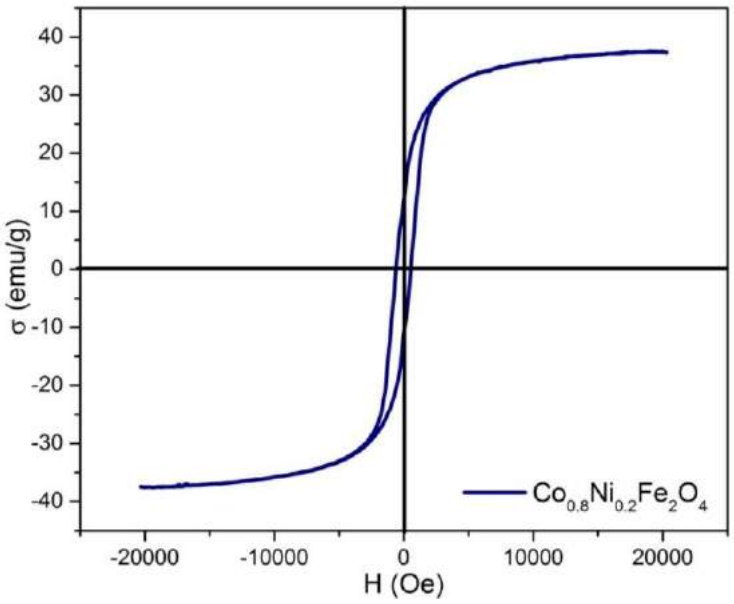

Figure 3. M-H loops of $Co_{0.8}Ni_{0.2}Fe_2O_4$ sample

Figure 3 shows variation of saturation magnetization (Ms) of 37.54 emu/g, remanence magnetization (Mr) of 17.31 emu/g, coercive field (Hc) of 747.25 Oe and squareness of hysteresis loop (Mr/Ms) of 0.46. Velhal et al [13] suggested that the coercivity field with metal logam as Ni and Co can be confirmed on the strain, magneto crysrallite anisotropy and shape anisotropy of crystallite structure.

4. Conclusion

The synthesis of $Co_{0.8}Ni_{0.2}Fe_2O_4$ material has been conducted using co-precipitation method. The sample were characterized using XRD, SEM-EDS and VSM to confirm structural and magnetic studies. The XRD results shows the peaks can be indexed as (220), (311), (400), (422), (511), and (440). SEM-EDX results shows the sample has unifom particle size with average of 1 μm. The variation of saturation magnetization (Ms) of 37.54 emu/g, remanence magnetization (Mr) of

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5. Acknowledgments

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Kode Talenta/ Kode Fakultas : 03/ 09

Menyasar SDGs No : 6 (Air Bersih dan Sanitasi Layak)

LAPORAN AKHIR
PENELITIAN TALENTA USU
SKEMA PENELITIAN TERAPAN

POLITIK KEBIJAKAN: (SEBUAH STUDI PADA IMPLEMENTASI PROGRAM MASTER METER DALAM PENYEDIAAN AKSES AIR BERSIH, SANITASI DAN KEBERSIHAN UNTUK MENINGKATKAN KESEJAHTERAAN MASYARAKAT MISKIN KOTA MEDAN)

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Nomor: 11119.1/UN5.1.R/PPM/2022, tanggal 08 Agustus 2022

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SUMMARY

POLICY POLITICS: (A STUDY ON THE IMPLEMENTATION OF THE MASTER METER PROGRAM IN THE PROVISION OF ACCESS TO CLEAN WATER, SANITATION AND HYGIENE TO IMPROVE THE WELFARE OF THE POOR IN MEDAN CITY).

The current achievement of access to clean water in Indonesia has only reached 72.55 percent. This figure is still far below the Sustainable Development Goals (SDGs) target of 100 percent. In detail, there are 33.4 million people in Indonesia who lack clean water. In addition, there are 99.7 people in Indonesia who lack access to good sanitation facilities. The problem of lack of clean water and lack of access to good sanitation facilities is also experienced by residents in North Sumatra, including Medan City which is the capital city. The purpose of this study is to describe how the Implementation of the Master Meter Program Policy in Providing Access to Clean Water, Sanitation and Hygiene to improve the Welfare of the Poor in Medan City and to analyze the Supporting and Obstructing Factors. The method used is descriptive research method with qualitative approach. In-depth interviews with various stakeholders in the policy. Analysis is done qualitatively.

` The results of the research conducted in Medan City show that the Implementation of the Master Meter Program in Providing Access to Clean Water, Sanitation and Hygiene to Improve the Welfare of the Poor has run quite well. The entire series or process of activities starting from initial socialization, poverty reflection, program implementation, program monitoring all run quite well. The success of the Master Meter Program is very necessary so that it can provide access to clean water to community members in need. The obstacle that occurs in the implementation of this policy is that there are still poor people who have not received the benefits of the Master Meter Program. The North Sumatra Provincial Government, PDAM Tirtanadi, and Stakeholders continue to make efforts to be able to develop the Master Meter Program to all areas in Medan City where residents do not have access to clean water.

Keywords: Politics, Policy, Master Meter Program

Kode Talenta/Kode fakultas : 05/03

LAPORAN FINAL
PENELITIAN TALENTA USU
SKEMA PENELITIAN DASAR

Kajian Morfometri dan Profil Kualitas Air Danau Pesisir di Danau Anak Laut, Aceh Sigkil, Provinsi Aceh

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SUMMARY

MORPHOMETRIC STUDY AND WATER QUALITY PROFILE OF COASTAL LAKES AT ANAK LAUT LAKE, ACEH SIGKIL, ACEH PROVINCE

This study aims to describe the physical conditions and dynamics of coastal lake waters which include water level conditions, bathymetry, and lake morphometry. Tidal and water level data were obtained from real time measurements of the Geospatial Information Agency from January - December 2022. Depth measurements using a Garmin 585 echosonder. Spatial data processing using ArGis. The results of the analysis show that the tidal type in Anak Laut Lake is a mixture of double daily tides, which means that in one day there are two tides and two low tides with different periods and heights. the mean sea level is 1.27m. The type of tide in Singkil waters is mixed tide prevailing semidiurnal, which means that in one day there are two tides and two low tides with different periods and heights. The results of tidal measurements at the study site obtained the highest water level elevation (HAT) value is 1.92 in May 2022. The lowest water elevation (LAT) was 0.62 m in February. The measured MSL was 1.27 m. This difference in water level results in differences in the hydro-morphometry of the lake. In general, Anak Laut Lake is very dynamic and fluctuating, following the dynamics of the tidal cycle in the Indian Ocean.

Keywords: Bathymetry, coastal lake, morphometry, ArGIS

BAB 4
HASIL DAN PEMBAHASAN

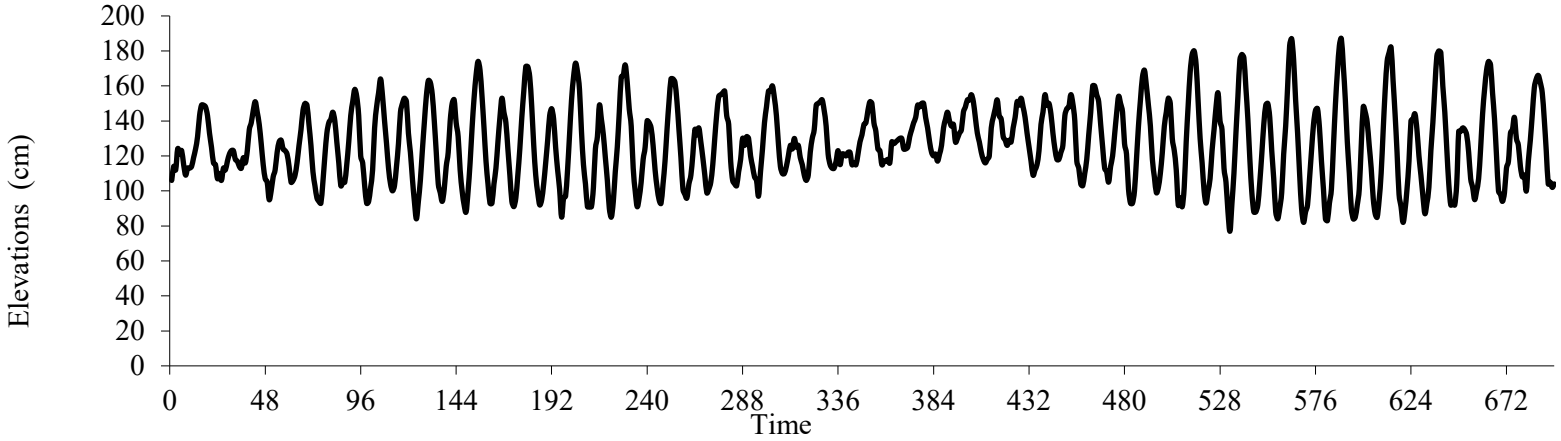
4.1. Pasang-surut dan tinggi muka air.

Tipe pasut perairan Singkil adalah campuran condong ke harian ganda (*Mixed Tide Prevailing Semidiurnal*) yang berarti dalam satu hari terdapat dua kali pasang dan 2 kali surut dengan periode dan tinggi yang berbeda (grafik pasang surut). Hal ini merujuk pada nilai Formzahl yang diperoleh di Singkil adalah 0.43. Tinggi rata-rata muka air laut (mean sea level) adalah 1.27 m (Tabel 3 dan Gambar 4). Pasang surut di danau ini merupakan rambatan pasang surut dari Samudera Hindia yang bertipe ganda yang merambat ke pantai barat Pulau Sumatera (Wyrtki 1961).

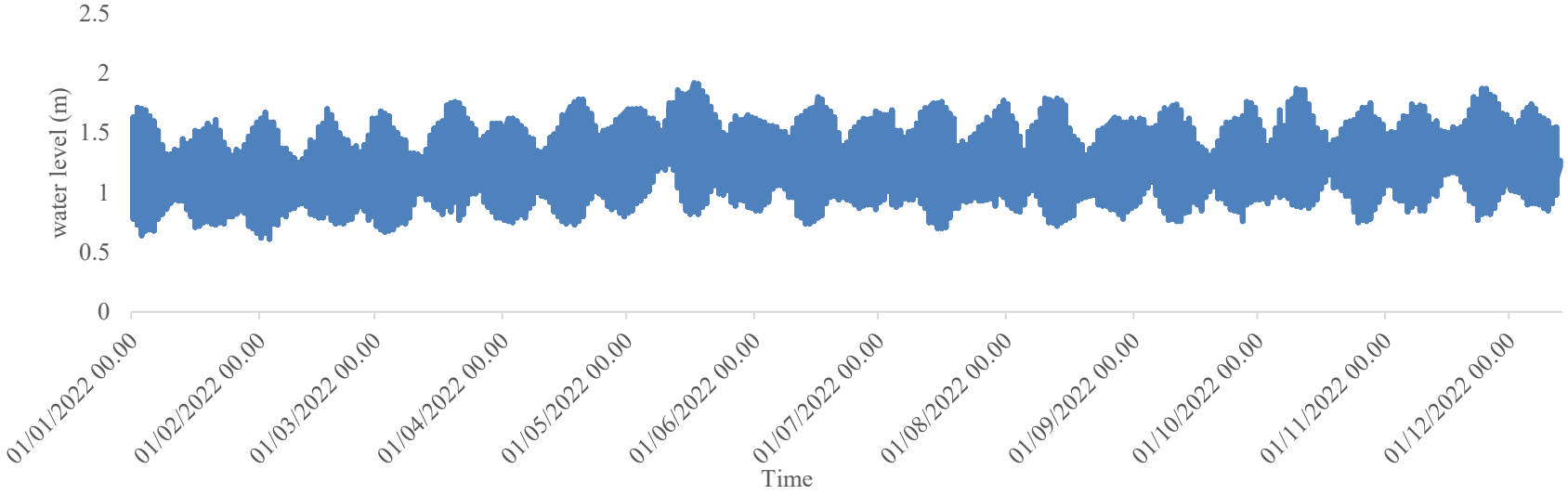
Elevasi muka air tertinggi (HAT) di sekitar Singkil adalah 1.92 m pada bulan Mei 2022 (Tabel 3 dan Gambar 4). Elevasi air terendah (LAT) adalah 0.62 m pada Bulan Februari 2022 (Tabel 3 dan Gambar 4). MSL yang terukur adalah 1.27 m. Secara harian maupun bulanan (siklus pasut) terjadi perubahan elevasi (muka air) di Anak Laut. Hal ini juga terjadi pada Danau Anak LAut dimana sejauh 6 km dari pinggir laut, dinamika pasut mempengaruhi tinggi muka air di Danau Anak LAut (Muhtadi et al. 2020). Hasil pengukuran pasut di Danau Anak LAut diperoleh nilai elevasi muka air tertinggi (HAT) adalah 2.66 m saat hujan dan 2.23 m saat kemarau. Elevasi air terendah (LAT) adalah -0.43 m saat hujan dan -0.04 m saat kemarau. MSL yang terukur adalah 1.12 saat hujan dan 1.10 saat kemarau (Muhtadi et al. 2020a). Adanya dinamika pasut ini, selain mempengaruhi tinggi muka air juga akan mempengaruhi kualitas air (Elshemy et al 2016; Ratnayake et al 2018; Muhtadi et al. 2023a), dan termasuk terhadap komposisi serta sebaran biota perairan di danau pasang-surut (Pérez-Ruzafa et al 2019; Muhtadi et al 2020b; 2022; 2023b; Yulianda et al. 2020).

Tabel 3. Analisis elevasi penting pasut di Danau Anak laut

Design water level	Symbol	Calculation	Referensi	
			LAT (m)	MSL [m]
Highest Astronomical Tide	HAT	Z_0+(all constituents)	1.92	0.65
Higher High Water Level	HHWL	Z_0+(M_2+S_2+K_2+K_1+O_1+P_1)	1.84	0.58
High Water Spring	HWS	Z_0+(M_2+S_2+K_1+O_1)	1.78	0.52
Mean High Water Spring	MHWS	Z_0+(M_2+S_2) or Z_0+(K_1+O_1)	1.63	0.36
Mean High Water Level	MHWL	Z_0+(M_2+K_1+O_1)	1.68	0.41
Mean Sea Level	MSL	Z_0	1.27	0.00
Mean Low Water Level	MLWL	Z_0−(M_2+K_1+O_1)	0.86	-0.41
Mean Low Water Spring	MLWS	Z_0−(M_2+S_2) or Z_0-(K_1+O_1)	0.90	-0.36
Chart Datum Level	CDL	Z_0−(M_2+S_2+K_1+O_1)	0.75	-0.52
Lower Low Water Level	LLWL	Z_0−(M_2+S_2+K_2+K_1+O_1+P_1)	0.69	-0.58
Lowest Astronomical Tide	LAT	Z_0−(all constituents)	0.62	-0.65



Gambar 4 Graph tide in location site

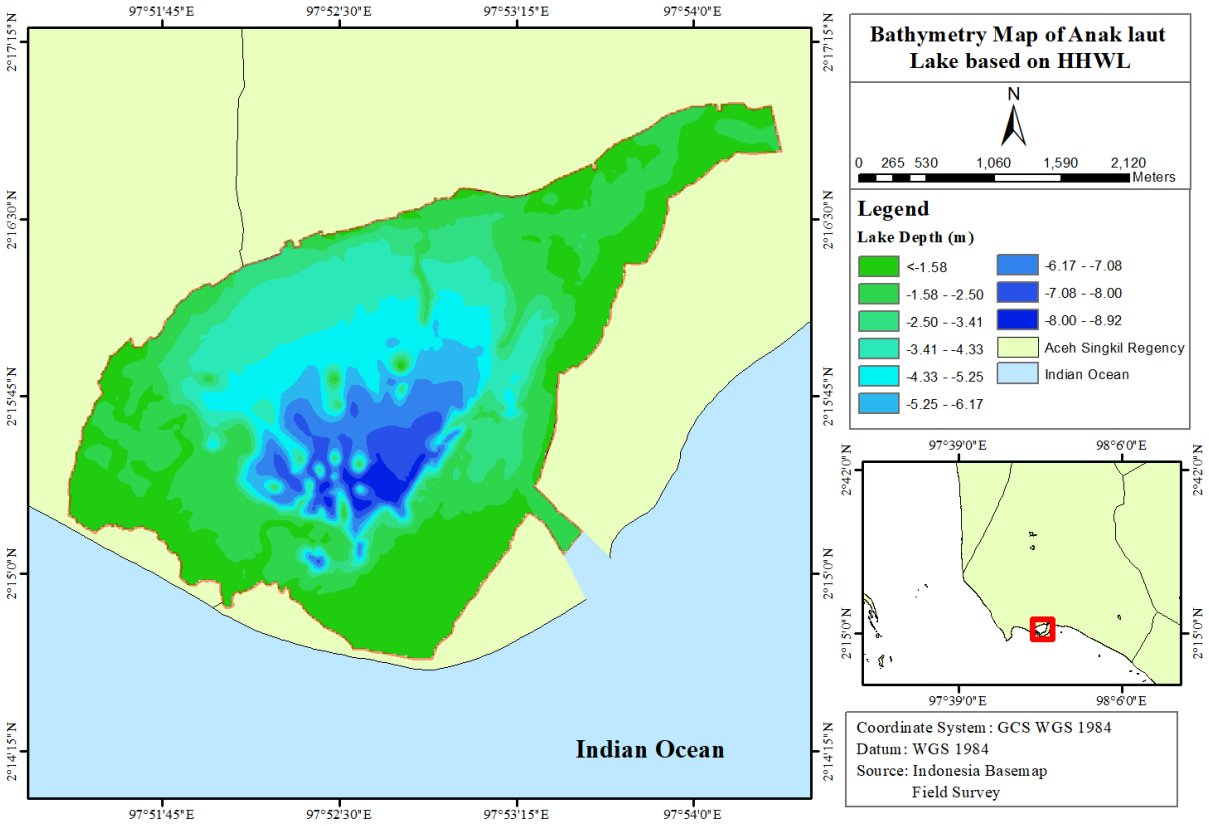


Gambar 5. Water level in coastal lake January – December 2022

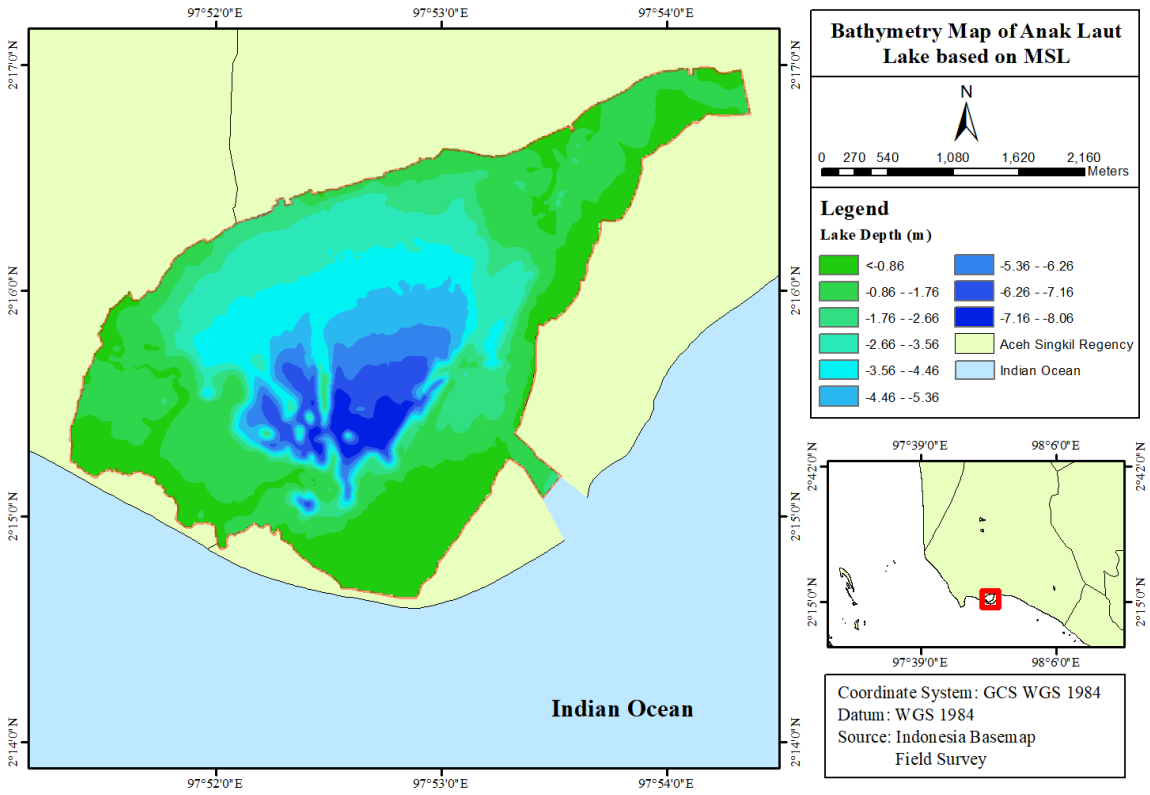
4.2. Bathymetry.

Peta batimetri Danau Anak Laut memperlihatkan bahwa daerah yang dalam terdapat pada bagian tengah arah barat daya (Gambar 6-8). Daerah yang paling dalam ditandai dengan warna biru pada peta dan daerah dangkal pada sepanjang pinggiran danau dengan warna hijau. Berdasarkan Gambar 3-5 terlihat bahwa ada pengaruh pasang-surut terhadap kondisi batimetri danau saat pasang, surut dan MSL. Pada saat pasang kedalaman tertinggi terlihat pada kisaran 7-9 m. Pada kondisi surut dan MSL kedalaman kedalaman tertinggi terlihat pada kisaran 6-8 m.

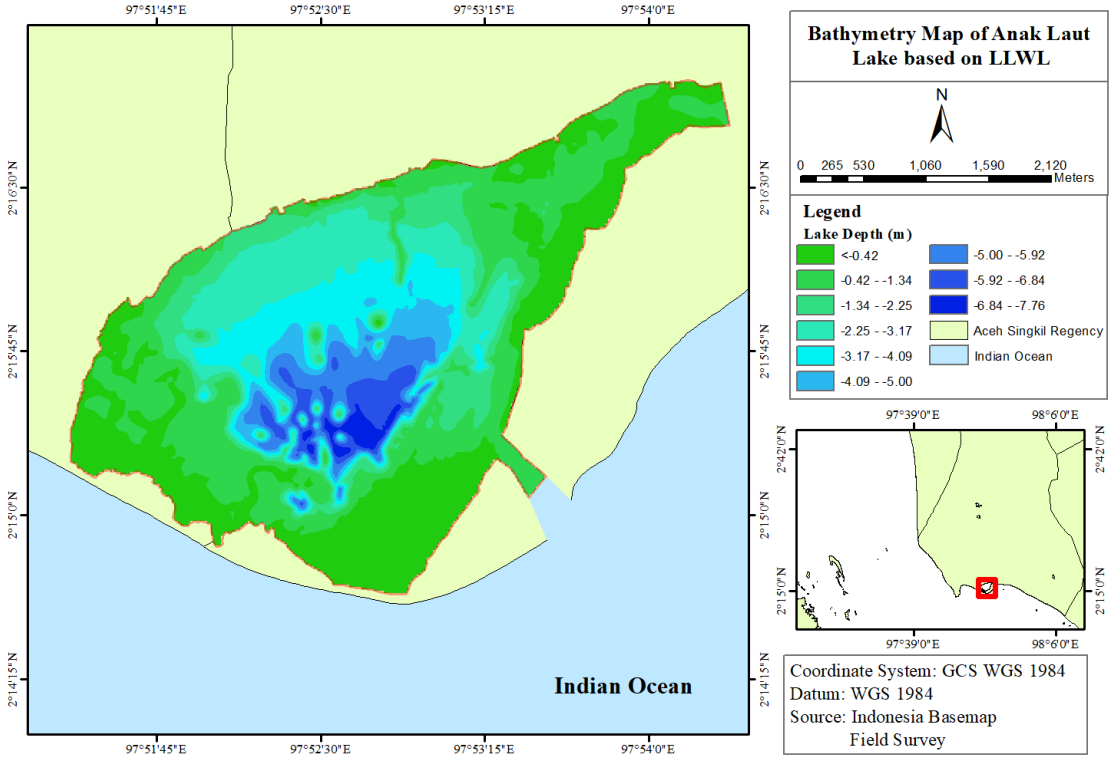
Bentuk kontur batimetri Danau Anak Laut terlihat beraturan dimana semakin ke tengah semakin dalam. Pada umumnya danau-danau alami memiliki bentuk dasar danau yang lebih beraturan (Muhtadi et al. 2020b). Danau-danau alami coastal lake lainnya menunjukkan bentuk batimetri danau yang lebih teratur (Hasudungan et al 2008; Umgiesser et al 2014; Panda et al 2015; Mahanty et al 2016; Zandagba et al 2016). Danau-danau buatan pada umumnya memiliki bentuk dasar danau yang tidak beraturan (Ridoan et al 2016; Muhtadi et al., 2020). Ketidak teraturan bentuk dasar buatan pada mumnya disebabkan oleh pembentukan danau dari kegiatan pengerukan (Muhtadi et al., 2020).



Gambar 6. Peta batimetri Danau Anak Laut saat pasang



Gambar 7. Peta batimetri Danau Anak Laut saat MSL



Gambar 8. Peta batimetri Danau Anak Laut saat surut

4.2.1. Lake size metrics

Danau Anak Laut memiliki luas 10.55 km^2 pada saat MSl, 11.26 km^2 pada saat pasang dan 9.84 Saat surut km^2 (Tabel 1). Volume total air Danau Anak Laut mencapai 16.51 juta m^3 saat MSL, 17.61 juta m^3 saat pasang, dan 15.40 juta m^3 saat surut. Adanya dinamika pasut di Danau Anaka Laut menyebabkan adanya perbedaan antara pasang, surut maupun kondisi MSL. (Tabel 1-3). Sebagian kecil di wilayah badan air pada bagian selatan dan timur terdapat mangrove dimana saat surut akar mangrove dari speseies Rizophora stylosa kelihatan lebih jelas dan tenggelam saat air pasang.

Panjang keliling Danau Anak LAut (SL) mencapai mencapai 11.52 km saat MSl, 18.54 m saat pasang, dan 11.12 km saat surut. Panjang maksimum mencapai 6.35 km dengan lebar maksimum masing-masing 2.64 km saat MSl, 3.38 km saat pasang, dan 2.64 km saat surut. Danau Anak Laut termasuk kategori danau sedang yaitu luas dari 100 -10,000 ha dan volume kurang dari 100-10,000 juta m^3 (Straskraba & Tundisi 1999).

Danau Anak Laut merupakan danau pesisir terbesar di Indonesia. Beberapa danau pesisir lainnya yaitu Danau Teluk Belukar (Nias-Sumatera Utara) dengan luas 47.4 Ha (Hasudungan et al. 2008) dan Danau Anak LAut (Medan-Sumatera Utara) yang hanya 29 Ha (Muhtadi et al. 2020a). Danau pesisir lainnya di daerah yaitu: Songkhla lagoon mencapai 1,042 km^2 (Ganasat et al 2005); Laguna Lake (Filipina) mencapai 100 km^2 (Herrera et al 2014); Chilika Lagoo mencapai 815 km^2 saat kemarau dan 992 km^2 saat musim hujan (Mohanty et al 2001); Nokoue Lake (Benin) mencapai 150 km^2 (Zandagba et al 2106). Danau pesisir di kawasan Mediterania (sub tropis) yaitu mencapai 31 – 41.500 ha, kecuali Faro Lagoon (Italy) dengan luas 26 ha (Umgiesser et al 2014).

Tabel 4. Lake size metrics **Danau Anak Laut**

No.	Parameter	Satuan	MSL	Pasang	Surut
1.	Panjang Maksimum (L_{max})	Km	6.35	6.35	6.35
2.	Panjang Efektif (Le)	Km	6.35	6.35	6.35
3.	Lebar Maksimum (W_{max})	Km	2.64	3.38	2.64
4.	Lebar Efektif (Le)	Km	2.64	3.38	2.64
5.	Luas Permukaan Total (Ao)	Km^2	10.55	11.26	9.84
8	Panjang Keliling Danau (SL)	Km	11.52	18.54	11.12
9.	Volume (V)	m^3	28,736,505	30,662,156	26,810,854
10.	Kedalaman maksimum (Z_{max})	m	8.00	8.58	7.42

4.2.2. Lake form metrics

Danau Anak Laut merupakan danau dangkal, dengan kedalaman danau rata-rata ($\bar{Z}$) berkisar antara 2.61-3.57 m. Danau dangkal biasanya memiliki potensi produktivitas biologi yang tinggi karena lapisan epilimnionnya lebih tebal daripada lapisan hipolimnion (Aldama et al. 2013; Barroso et al. 2014; Muhtadi 2022). Nilai $\bar{Z}$ (61-3.57 m) dan Z_r (0.03%) di Danau Anak Laut termasuk rendah yang menunjukkan danau ini akan mudah mengalami pengadukan karena

danau seperti memiliki tingkat stabilitas stratifikasi danau yang rendah (Muhtadi et al. 2020b). Danau-danau pesisir pada umumnya memiliki nilai Z_r yang rendah seperti di danau Anak LAut yang memiliki Zr sebesar 0.59% saat MSl, 0.61% pada saat pasang dan 0.57% pada saat surut (Muhtadi et al., 2020a).

Nilai perkembangan volume (VD) Danau anak Laut adalah adalah 0.80 saat MSL, 0.94 saat pasang, dan 0.62 saat surut. Nilai VD > 0.5 yang menggambarkan suatu danau yang relatif dangkal dan dasarnya rata (Wetzel 2001). Bentuk dasar danau anak laut yang tidak jauh berbeda antara MSL dan pasang karena perubahan volume air yang tidak begitu signifikan, namun saat surut cukup signifikan karena perbedaan volume air sukup besar antara pasang dan surut. Kemiringan rata-rata danau anak laut sebesar 5 % yaitu termasuk kemiringan yang landai (Syah and Hariyanto, 2013). Nilai ini menggambarkan perairan yang relatif datar dengan daerah litoral yang luas. Perairan dengan daerah litoral yang luas mempunyai potensi produktivitas biologi yang tinggi (Bohn et al., 2011; Aldama et al., 2013; Muhtadi et al. 2020ab). Hal ini disebabkan wilayah litoral memiliki tumbuhan berakar yang memberi kontribusi terhadap bahan organik; (Welch, 1952; Barroso et al., 2014; Stefanidis et al., 2014). Tumbuhan berakar di danau anak laut terdapat pada sekeliing danau terutama pada bagian timur-selatan dimana ditemukan vegetasi mangrove.

SDI Danau Anak Laut adalah 2.00 saat MSl dan surut serta 3.12 saat pasang. Pada saat saurut dan MSL bentuk badan perairan Danau Anak Laut memiliki mendekati teratur (elips). Akan tetapi, pada saat pasang, bentuk danau lebih tidak beraturan. Bentuk suatu perairan danau sangat berhubungan dengan peluang suatu badan air untuk kontak langsung dengan daratan yang dapat mempengaruhi asupan baik berupa nutrien maupun padatan tersuspensi dari daratan ke perairan (Wetzel 2001; Håkanson 2005). Pada saat surut dan MSL Danau Anak Laut berbentuk elips yang menunjukkan kontak tepian danau dengan sekitar termasuk rendah sehingga asupan baik berupa nutrien maupun padatan tersuspensi dari daratan ke perairan menjadi rendah. Masukan nutrien dan bahan-bahan tersuspensi lainnya berasal dari inlet danau pada bagian timur dan sedikit dari limpasan pemukiman pada bagian utara.

Pada saat pasang danau anak laut berbentuk tidak beraturan dimana nutrient dapat berasal dari air laut yang terbawa dari Samudra Hindia dimana pada bagian barat Danau Anak laut terdapat estuary Sungai Alas-Singkil. Hal ini menunjukkan bahwa bentuk badan perairan danau Siais adalah tidak beraturan. Tingkat produktivitas perairan tersebut sangat berkaitan dengan semakin tidak beraturannya bentuk danau sehingga semakin banyak bagian yang berteluk dan berhubungan dengan daratan sehingga kemungkinan masuknya nutrien dari daratan juga akan semakin besar (Bohn et al., 2011). Pada umumnya perairan danau baik alami maupun buatan memiliki SDI yang lebih besar dari 2 seperti, Danau Toba sebesar 3,61 (Lukman and Ridwansyah, 2010), Danau Kelapa Gading sebesar 3,55 (Ridoan et al., 2016), Danau Pondok Lapan sebesar 4.93 (Muhtadi et al., 2017a), Danau Siais sbesar 2.83 (Muhtadi et al. 2020b). Namun demikian, danaudanau pesisir di Indonesia emnunjukkan bentuk danau yang beraturan (SDI < 2) yait 1.6 di Danau Teluk Belukar (Hasudungan et al. 2008) dan 1.96 di Danau Anak LAut (Muhtadi et al. 2020a).

Tabel 5. Lake form metrics Danau Anak Laut

No.	Parameter	Satuan	MSL	Pasang	Surut
1.	Lebar Rata-Rata ($\bar{W}$)	m	1.66	1.77	1.55
2.	Indeks perkembangan garis tepi (SDI)	m	2.00	3.12	2.00
3.	Kedalaman rata-rata ($\bar{Z}$)	m	3.11	3.67	2.51
4.	Kedalaman relatif (Zr)	%	0.03	0.03	0.03
5.	*Volume Development* (VD)	m	0.80	0.94	0.62
6.	Kemiringan rata-rata ($\bar{S}$)	%		0-5	

4.2.3. Water column structure

Nilai wave base depth (Zwb), di Danau Anak Laut yaitu 2.14 yang menunjukkan indikator kedalaman pencampuran turbulen pada kedalaman 2.14 m. Volume lapisan permukaan (yaitu, lapisan pencampuran) adalah 11-13 juta m^3 atau 43 % dari total volume danau. Dengan demikian, volume perairan dasar adalah 15-17 juta m^3 atau 47 % dari total volume danau. Kedalaman kompensasi Danau Anak Laut pada kedalaman 2.98. rata-rata kedalaman kompensasi danau termasuk rendah disbanding dengan peraiarn laut. Hal ini disebabkan oleh tingkat penetrasi cahaya yang masuk ke danau cukup rendah.

Tabel 6. *Water column structure di* Danau Anak Laut

No.	Parameter	Satuan	MSL	Pasang	Surut
1.	Kedalaman kompensasi	M	2.98	2.98	2.98
2.	Wave base depth (Zwb)	m	2.14	2.14	2.14

4.2.4. Special metrics for lake morphometry

Niiali A/V ratio Danau Anbak Laut yaitu 0.15-0.24 yang menandakan bahwa danau ini merupakan danau dangkal dengan zona litoral yang luas. Zona litoral yang luas juga didukung oleh nilai kemiringan dan kedalaman relatif yang rendah dimana banyak ditemukan pohon mangrove di sekeliling danau. Nilai A/V ratio ini juga menandakan cekungan drainase yang relatif luas dan potensi debit yang besar dari sungai masuk ke danau. Rasio dinamis (DR) Danau Anak laut yaitu 2.62-4.11 yang menunjukkan dominasi proses angin/gelombang terhadap danau tergolong tinggi, sehingga Danau Anak Laut sangat mudah mengalami pengadukan. Angin yang masuk ke danau anak laut dapat berasal dari Samudra Hindia dimana danau ini berbatasan langsung dengan laut lepas di pantai Barat Sumatra.

Indeks Permanen Cekungan (BPI) danau anak laut adalah 2.53 $m^3.km^{-1}$ saat pasang, 4.73 $m^3.km^{-1}$ saat MSL, dan 5.82 $m^3.km^{-1}$ saat surut. nilai BPI menunjukkan lebih rendah saat air surut dibanding air pasang. Nilai BPI ini juga mengindikasikan bahwa Danau Anak Laut memiliki zona litoral yang luas dan berpotensi akan tumbuhnya tanaman air yang berakar di pinggiran danau dimana dalam hal ini mangrove tumbuh terutama di sepanjang timur hingga barat danau.

Debit (Q) air masuk (pasang) di Danau Anak laut adalah 56.5 m^3/ detik dan debit air keluar (surut) adalah 33.75 m^3/ detik. Sementara debit air saat MSL adalah 0 m^3/ detik kaena posisi air stagnan. Debit air yang masuk dan keluar dari danau jelas sangat dipengaruhi oleh pasang-surut, sehingga dinamika air danau mengikuti pola dan dinamika air laut di Samudar Hindia.

Waktu tinggal air (Rt) di yaitu 5.52-6.31 hari. Waktu tinggal air Anak Laut termasuk singkat karena adanya dinamika pasut, Namun masih lebih singkat di Danau Anak LAut yang hanya tidak lebih dari 11 – 25 jam (Muhtadi et al., 2020a). Namun dmeikian RT di Anak Laut ini sangat jauh berbeda dengan alami (inland lake) yang bahkan mencapai tahunan (Nontji 2017). Semakin tinggi nilai retention time (Rt) maka akan semakin lama waktu tinggal air dalam suatu danau, sehingga kesempatan bahan organik ataupun nutrien berada perairan akan semakin besar (Mitchell et al 2017). Retention time (Rt) Danau Anak LAut termasuk singkat karena dipengaruhi oleh pasang-surut sehingga kesempatan bahan organik diperairan Danau Anak Laut tidaklebih dari satu minggu. Rendahnya retention time (Rt) ini juga menyebabkan sedikitnya kesempatan bahan tersuspensi di perairan untuk mengendap. Hal ini seperti dilaporkan Umgiesser et al (2014), bahwa coastal lagoon di Mediterrania memiliki Rt yang rendah.

Tabel 7. Special metrics for lake morphometry

No.	Parameter	Satuan	MSL	Pasang	Surut
1.	A/V Ratio		0.19	0.24	0.15
3.	Basin Permanence Index (BPI)	$m^3.km^{-1}$	4.73	2.53	5.82
4.	Dynamic ratio (DR)	m	3.33	4.11	2.62
	Debit		0	56.5	33.75
3	*Water retention time*	Hari	5.91	6.31	5.52
4	*Laju penggelontoran*	1/tahun	60.88	57.06	65.26

Gambar 9. Gambarn mangrove yang tumbuh di Danau Anak Laut, Singkil-Indonesia

4.3. Profil Kualitas Air

Danau Anak Laut yang merupakan salah satu danau pesisir memiliki karakteristik perairan dipengaruhi oleh pasang-surut air laut. Ciri khas perairan pesisir dan laut diantaranya adalah konsentrasi salinitas yang tinggi di Danau Anak Laut yaitu berkisar antara 26-31 $^{0}/_{00}$ pada permukaan dan 26-32 $^{0}/_{00}$ pada bagian dasar. Tidaka da perbedaan siginikan anatara salinitas di permukaan dan pada bagian dasar. Konsentrasi slanitas yang tinggi ini merupakan akibat pengarub pasut yang langsung berbatasan dengan perairan laut. Hal ini tidak berbeda jauh dengan konsentrasi slainitas yang terukur di Danau Teluk Belukar berkisar antara 29-34 $^{0}/_{00}$ (Hasudungan et al. 2008). Konsentrasi salinitas perairan Danau Anak Laut ini jauh lebih tinggi disbanding salinitas Danau Anak LAut yang berkisar antara 2 – 16 $^{0}/_{00}$ pada permukaan dasar, namun pada bagian dasar konsentrasi salinitas dapat mencapai 25 $^{0}/_{00.}$ Hasl pengukuran kualitas air di Anak Laut dapat dilihat pada tabel 5.

Tabel 8. Hasil pengukuran kualitas air di Danau Anak Laut

Lokasi	Kordinat	pH	DO	Kecepatan	Suhu	Kekeruhan	Salinitas	Waktu
Titik 1 (Danau)	Lat 2.273854	8.3	P. 6,1	0,09 - 0,1	29.4	1.6	30	09:30 WIB
	Long 97.874744		D. 5,8		29.2	1.5		
Titik 2 (Danau)	Lat 2.276661	8.4	P. 4,2	0.2	29.7	1.6	29	10:10 WIB
	Long 97.893607		D.5,6		29.6			
Titik 3 (Danau)	Lat 2.256434	8.4	p. 7,8	0.1	29.1		31	10:40 WIB
			1m 7,4		28.9		31	
	Long 97.887106		2m 7		29.1		32	
			4m 6,8		29.1		32	
Titik 4 (Danau)	Lat 2.254762	8.3	P. 7,1	0.05	30		31	11:15 WIB
			1m 7,1		29.8			
	Long 97.872386		2m 7		29.4			
			3m 6,4		29.6			

			4m 6,2		29.6			
Titik 5 (Danau)	Lat 2.263155	8.3	P. 7,8	0.01	29.3		29	11:35 WIB
	Long 97.861520		1m 7,6		28.6		28	
			2m 7,2		29.7			
Titik 6 (Danau)	Lat 2.259689	8.3	P. 7,8	0.05	30		26	11:55 WIB
			1m 2,6		28.6			
	Long 97.872119		2m 7,4		28.7			
			3m 7,4		28.6			
			4m 6,4		29.2		32	

4.4. Biodiversitas

4.4.1. Mangrove

Ada 9 jenis mangrove yang ditemukan disekitar Danau Anak LAut (**Tabel 9**). Rizophora merupakan mangrove yang paling banyak dan menyebar merata di pinggiran Danau Anak LAut. Hal ini cukup wajar karena kisaran salinitas yang cukup tinggi di perairan Danau Anak LAut yaitu 28-30. Jumlah jenis dan sebaran mangrove di Danau Anak LAut jauh lebih rendah dibanding vegetasi mangrove di tidal lake Teluk Belukar (Nias-Indonesia), yaitu sebanyak 20 spesies mangrove dan 17 jenis vegetasi pantai [17] dan di Danau Siombak. Tingginya keragaman mangrove di Teluk Belukar karena jarak danau yang lebih dekat dengan laut. Hal ini dapat dilihat dari nilai salinitas yang berkisara antara 29 – 34,5 ppt [17], sehingga mangrove dapat dengan tumbuh dengan baik di sekitar Danau Teluk Belukar. Sementara biodiversitas mangrove di danau pasang-surut lainnya ditemukan 8 jenis mangrove di lagoos lagoon (Nigeria) [7], sedangkan di Chilika Lake (India) hanya 5 jenis mangrove [5]. Hal ini menunjukkan mangrove di Indonesia lebih tinggi dibanding Afrika dan Asia lainnya.

4.4.2. Fish

Ikan yang ditemukan di Danau Anak LAut sebanyak 66 spesies (**Tabel 9**). Ika-ikan yang ditemukan merupakan ikan estuari dan sebagian besar ikan laut, hal ini seperti yang ditemukan juga di Danau teluk belukar. Namun sangat berbeda dengan ikan yang ditemukan di Danau Siombak yang umumnya masih ditemukan ikan air tawar.

Adanya ikan-ikan estuari di Danau Anak LAut berkaitan dengan kondisi perairan danau yang tergolong payau (estuari). Famili Mugilidae dan Ambassidae merupakan salah satu penghuni perairan estuari. yang menyatakan bahwa Famili ikan Mugilidae dan Ambassidae memiliki distribusi komposisi terluas di daearah estuari termasuk mangrove. Ikan ini hidup pada kisaran salinitas yang luas, karena dapat hidup di air tawar, payau dan laut yang berasosiasi dengan terumbu. Jenis ikan ini sering masuk estuari dan sungai, bersifat katadromous, biasanya membentuk kelompok yang besar di daerah dengan dasar pasir atau lumpur [19][20][21].

Ikan-ikan di danau pasut lainya ditemukan sebanyak 8 spesies di Teluk Belukar. Umumnya ikan di Teluk Belukar merupakan kategori ikan laut, dari kelompok Mugilidae dan Carangidae [17]. Sementara di Chilika Lake 317 spesies [22], di Lagoos lagoon terdapat 80 spesies [23], di Lake Nokoue terdapat 51 spesies [24].

4.4.3. Crustacea

Terdapat 12 krustsea di Danau Anak LAut, (**Tabel 9**). Adanya crustasea laut di Danau Anak LAut karena adanya pengaruh pasut dan tumbuhan mangrove yang terdapat di pinggiran danau. Seperti dilaporkan dari danau pasut lainnya bahwa ditemukan udang laut dan kepiting bakau di danau-danau tersebut [5][6][7][17]. Chilika Lake sendiri ditemukan 28 spesies udang dan 38 spesies kepiting [5]. Pada dasarnya kelompok udang melakukan pemijahan dan asuhan pada daerah mangrove, dan setelah besar akan kembali ke laut. Sementara mangrove merupakan habitat yang cocok dan disukai oleh kepiting bakau [21][25][26].

4.4.4. Mollusca

Molusca merupakan kelompok makrozoobenthos yang banyak ditemukan di perairan baik tenggelam dalam substrat maupun di permukaan substrat, termasuk menempel pada akar atau batang pada zona littoral danau. Mollusca yang ditemukan di Danau Anak LAut terdiri dari kelas bivalva 3 spesies dan gastropda 7 spesies (**Tabel 9**). Pada umumnya mollusca penghuni danau berasal dari kelompok gastropod [16].

4.4.5. Organisme akuatik lainnya

Organisme akuatik lainnya di danau anak laut terdiri dari bulu babi, belangkas, dan teripang. Teripang merupakan salah komoditas utama hasil tangkapan di Danau Anka Laut.

Tabel 9. Flora dan fauna akuatik di Danau Anak Laut

No	Family	Species	Nama local	Nama Indonesia	Nama umum	Status
A	**Mangrove**					
1	Arecaceae	*Nypa fruticans*	Nipah	Nipah	Mangrove Palm	**LC**
2	Rhizophoraceae	*Rhizophora apiculata*	**Bako**	Bakau merah	Red mangrove	**LC**
3		*Rhizophora stylosa*		Bakau	the spotted mangrove	**LC**
4	Primulaceae	*Aegiceras corniculatum*			black mangrove	**LC**
5	Pteridaceae	*Acrostichum aureum*		Paku laut	Leather Fern	**LC**
6	Sonneratiaceae	*Ceriops decandra*				**NT**
7		*Ceriops tagal*			Indian mangrove	**LC**
8		*Sonneratia alba*	Pedada	Berembang		**LC**
9		*Sonneratia caseolaris*	Pedada	Berembang	Mangrove Apple	**LC**
B	**Ikan**					
10	Ambassidae	*Ambassis urotenia*	Gegge	Serinding	Banded-tail glassy perchlet.	
11	Anguilidae	*Anguilla bicolor*	Moa	Sidat	Shortfin Eel	**NT**
12	Apogonidae	*Apogon hyalosoma*	Kaca-kaca	Sirinding	Humpbacked cardinalfish	
13	Ariinae	*Netuma thalassina*			*Giant Catfish*	**LC**
14	Bagridae	*Mystus gulio*		Lundu	Long whiskers catfish	**LC**
15	Carangidae	*Atule mate*			*Yellowtail Scad*	**LC**
16		*Caranx ignobilis,*			*Giant trevally*	**LC**
17		*Carangoides malabaricus,*			*Malabar Trevally*	**LC**
18		*Carangoides chrysophrys*			*Longnose Trevally*	**LC**
19	Chanidae	*Chanos chanos*		Bandeng	*Milkfish*	**LC**
20	Cynoglossidae	*Cynoglossus lingua*		Ikan lidah	Long Tonguesole	**LC**
21	Dasyatidae	*Maculabatis gerrardi*	**Pari ketuk**		Whitespotted Whipray	**EN**
22		*Neotrygon kuhlii.*	**Pari pasir**	Pari	*Kuhl's Maskray*	**LC**
23		*Taeniura lymma*	**Pari**		*Bluespotted Lagoon Ray*	**LC**
24	Eleotridae	*Butis amboinensis*		Gabus pasir	Ambon gudgeon	**LC**
25		*Butis gymnopomus*		Lontok	*Striped Crazy Fish*	**LC**
26		*Ophiocara porocephala*		Lontok	*Spangled Gudgeon*	**LC**
27	Engraulidae	*Stolephorus indicus*		Ikan teri	Indian Anchovy	**LC**
28	Fistulariidae	*Fistularia commersonii*			*Bluespotted Cornetfish*	**LC**
29	Gerreidae	*Gerres filamentosus*			Whipfin Mojarra	**LC**
30		*Gerres longirostris*			*Strongspine Silver-Biddy*	**LC**
31	Glaucosomatidae	*Glaucosoma buergeri*	Ikan pintung		*Deepsea jewfish*	
32	Gobiidae	*Pseudapocryptes elongatus*	Tembakul, gelodok	Ikan janjan		**LC**
33	Hemiramphidae	*Hyporhampus quoyi*		Julung-julung	Halfbeak	
34		*Zenarchopterus beauforti*				

35	Leiognathidae	*Leiognathus splendens*	Paper, kempar, peperek	Ikan petek	Splendid Ponyfish	**LC**
36		*Leiognathus equulus*			*Common Ponyfish*	**LC**
37	Lethrinidae	*Lethrinus lentjan*			*Pinkear Emperor*	**LC**
38		*Lethrinus nebulosus*			*Spangled Emperor*	**LC**
39	Lutjanidae	*Lutjanus russellii*	Gorara	Kakap berisisik besar	Russell's Snapper	**LC**
40		*Lutjanus argentimaculatus*		Kakap	Mangrove Red Snapper	**LC**
41		*Lates calcarifer*		Kakap putih	Barramundi	**LC**
42	Megalopidae	*Megalops cyprinoides*	Bulan-Bulan	Bulan-Bulan	Indo-Pacific Tarpon	**DD**
43	Mugilidae	*Planiliza subviridis*		*Belanak*	Greenback Mullet	**LC**
44		*Valamugil seheli*			Bluespot Mullet	**LC**
45	Nemipteridae	*Nemipterus japonicus*			*Japanese Threadfin Bream*	**LC**
46						
47	Pomacanthidae	*Pomacanthus semicirculatus,*			*Semicircle Angelfish*	**LC**
48	Terapontidae	*Terapon jarbua*	Kerong-kerong	Kerong-kerong	Tiger Perch	**LC**
49		*Terapon puta*	Pepisang	Kerong-kerong	Small-scaled terapon,	
50	Tetrarogidae	*Chelonodon patoca*			*Milkspotted Puffer*	
51		*Tetraroge barbata*			Mangrove Waspfish	**LC**
52	Scatophagidae	*Scatophagus argus*		Ketang	*Spotted Scat*	
53	Sphyraenidae	*Sphyraena barracuda*		Barracuda	Great barracuda	**LC**
54	Scombridae	*Scomberomorus commerson*			*Narrow-barred Spanish mackerel*	**NT**
55		*Rastrelliger kanagurta*			*Indian Mackerel*	**DD**
56		*Rastrelliger brachysoma*			*Short Mackerel*	
57	Serranidae	*Epinephelus areolatus*			*Areolate Grouper*	**LC**
58		*Epinephelus bleekeri,*			*Duskytail Grouper*	**LC**
59	Siganidae	*Siganus fuscescens*	Baronang	Baronang susu	Mottled Spinefoot	**LC**
60		*Siganus canaliculatus*	Baronang lingkis	Baronang	Seagrass rabbit-fish	**LC**
61	Sillaginidae	*Sillago sihama*	Ikan kapur sirih	Perak	Silver Sillago	**LC**
62	Syngnathidae	*Hippocampus kuda*	Kuda laut	Tangkur kuda	Spotted Seahorse	**VU**
63	Kuhliidae	*Kuhlia marginata*			*Silver Flagtail*	**LC**
C	**Krustase**					
64	Eriphiidae	*Menippe rumphii*	Kepiting batu	Kepiting batu	Maroon stone crab	
65	Ocypodidae	*Uca (Tubuca) coarctata*			Compressed Fiddler Crab	
66	Portunidae	*Charybdis feriatus*		Rajungan karang	The Crucifix Crab	
67		*Charybdis natator*		Rajungan batik	Ridged Swimming Crab	
68		*Podophthalmus vigil*		rajungan angin	Sentinel Crab	
69		*Portunus pelagicus*		Rajungan	Blue Swimmer Crab	
70		*Portunus sanguinolentus*		rajungan bintang	Three-Spot Swimming Crab	
71		*Thalamita crenata*		Rajungan hijau	The Mangrove Swimming Crab	

72		*Scylla olivacea*			Orange Mangrove Crab	
73		*Scylla serrta*			Mangrove Crab	
74	Penaeidae	*Metapenaeus ensis*	Udang batu	Udang batu	Greasyback Shrimp	
75		*Lannea coromandelica*			Indian Ash Tree	**LC**
76		*Penaeus merguiensis*			Banana Prawn	
D	**Moluska**					
77	Arcidae	*Anadara antiquata*	Kerang bulu	Kerang bulu	Antique Ark	
78	Corbiculidae	*Polymesoda erosa*	Kerang bakau	Kerang totok	Common Geloina	
79	Pteriidae	*Pinctada maculata*	Simping	Simping	Spotted pearl oyster	
80	Neritidae	*Nerita balteata*			Violet nerite	
81		*Nerita violacea*		Keong merah	violet moon snail	
82	Pachychilidae	*Faunus ater*		Siput air payau	Black Devil Snail	**LC**
83	Pinnidae	*Pinna muricata*			Prickly Pen Shell	
84	Potamididae	*Teloscopium telescopium*	Bla papaco	Keong bakau	The Telescope Snail	
85	Strombidae	*Strombus canarium*	Siput gonggong	Siput gonggong	The Dog Conch	
86		*Strombus triangulates*				
87		*Strombus turturella*	Siput gonggong	Siput gonggong	Pearl conch snail	
E	**Lainnya**					
88	Holothuriidae	*Holothuria scabra*	Kolong	Teripang pasir	sand fish	**EN**
89		*Holothuria atra*	Kolong	Teripang keling	Lollyfish	**LC**
90	Laganidae	*Laganum laganum*	Dolar pasir, kue pasir	Dolar pasir	**Sand dollar**	
91	Limulidae	*Tachypleus gigas*		Belangkas	**Horseshoe Crab**	**DD**
92		*carcinoscorpius rotundicauda*			**mangrove horseshoe crab**	**DD**
93	Diadematidae	*Diadema setosum*		Bulu babi	**Long-spined sea urchin**	

BAB 5
Kesimpulan

Danau Anak Laut termasuk kategori danau sedang (10 hingga 100 km^2) dan dangkal (< 10m) (Straskraba & Tundisi 1999). Danau memiloki kondisi dasar perairan yang relatif datar dengan daerah litoral yang luas dangkal. Perairan dengan daerah litoral yang luas mempunyai potensi produktivitas biologi yang tinggi (Mohanty & Panda 2009; Herrera et al 2014; Elshemy et al 2016). Hal ini disebabkan wilayah litoral memiliki tumbuhan berakar yang memberi kontribusi terhadap bahan organik di dasar; bahan organik yang terdekomposisi menjadi sumber nutrien bagi fitoplankton dan tanaman air; dan lapisan bahan organik di dasar perairan yang terakumulasi akan dimanfaatkan untuk pertumbuhan bentos (Welch 1952; Pratiwi et al 2007; Röderstein et al 2014; Antonietta et al 2016).

Danau Anak laut adalah merupakan danau pesisir tropis, kategori danau pasang-surut yang ada di Indonesia. Hal ini dapat dilihat dari adanya dinamika pasut yang mempengaruhi tinggi muka air danau dimana perbedaan tidal range nya (0.62-1.92) termasuk kelompok micro tidal (< 2 m) (Short 1991). Perbedaan tidal range danau ini tidak berbeda jauh dibanding di danau pessir lainnya, seperti di Lagos and Lekki Lagoons (Nigeria) hanya 0.30 – 1.30 m (Ahmed 2014), di Danau Nokoue berkisar antara 0.15- 1.25 m (Zandagba et al 2016), di Chilika lagoon (India) berkisar antara 0.52 – 1.02 m pada musim kering dan 0.36 – 0.81 m pada musim hujan (Mahanty et al 2016), serta beberapa coastal lagoon di Mediterania (sub tropis) tidal range nya hanya 0.13 – 0.90 m (Umgiesser et al 2014). Namun demikian perbedaan tidal range di Danau Anak LAut (Sumatera Utara, Pantai timur sumatera) cukup lebar yaitu -0.11 – 2.34 m dan di Laguna lake (Filipina) berkisar antara 0.60 – 4.10 m (Herrera et al 2014).

Adanya dinamika pasut yang terjadi di Danau Anak Laut ini tentunya berpengaruh terhadap kondisi hidromorfometri danau tersebut. Hal ini jelas terlihat pada kedalaman dan volume air danau (Gambar 1-3 dan tabel 1). Kedalaman dan volume danau berubah sesuai dengan air yang masuk maupun yang keluar sesuai siklus pasut. Adanya fluktuasi tersebut tentunya akan berpengaruh terhadap karakteristik kualitas air dan struktur komunitas biologi Danau Anak Laut. Oleh karena itu kedepan perlu kajian terhadap pengaruh pasut terhadap dinamika kualitas air dan komunitas biologi di danau tersebut

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LAPORAN AKHIR PENGABDIAN KEPADA MASYARAKAT
MONO TAHUN REGULER

PELATIHAN PEMBESARAN DAN PEMBIBITAN BELUT MEDIA AIR BERSIH SEBAGAI UPAYA PENINGKATAN KAPASITAS WIRAUSAHA MASYARAKAT DESA PAYA GELI

Oleh :

Ketua	**: R. B. Moh. Ibrahim Fatoni, S.Pi., M.P.**	**NIDN: 0006069006**
Anggota	**: Raju, S.T.P., M.Si.**	**NIDN: 0011068903**
	: Tasya Chairuna Pane S.P., M.P.	**NIDN: 0123128903**
	: Amanatul Fadhilah S.Pi, M.Si	**NIDN: 0015088903**

Dibiayai oleh :

NON PNBP Universitas Sumatera Utara
Sesuai dengan Surat Perjanjian Penugasan Pelaksanaan Pengabdian kepadaMasyarakat
Program MonoTahun Reguler
Tahun Anggaran 2022
Nomor 319/UN5.2.4.1/PPM/2022, Tanggal 25 Mei 2022

LEMBAGA PENGABDIAN KEPADA MASYARAKAT
UNIVERSITAS SUMATERA UTARA
MEDAN
2022

Halaman Pengesahan Laporan Akhir
Kemitraan Mono Tahun Reguler (2022)

1.	Judul Pengabdian	:	Pelatihan Pembesaran Dan Pembibitan Belut Media Air Bersih Sebagai Upaya Peningkatan Kapasitas Wirausaha Masyarakat Desa Paya Geli
2.	Nama Mitra	:	Kelompok Tani Mekro Maju Desa Paya Geli
3.	Ketua Tim Pengusul		
	a. Nama	:	R. B. Moh. Ibrahim Fatoni, S.Pi., MP
	b. NIDN	:	0006069006
	c. Jabatan/Golongan	:	Asisten Ahli/ IIIb
	d. Program Studi	:	Agribisnis
	e. Bidang Keahlian	:	Agribisnis Perikanan
	f. Alamat Kantor/Telpn/Faks	:	Jl. Dr. Sofyan No.3 Padang Bulan, Medan Baru, Medan, Sumatera Utara
4.	Anggota Tim Pengusul		
	a. Jumlah Anggota	:	Dosen 3 Orang
	b. Anggota (1)		
	1. Nama Lengkap	:	Raju, S.TP., M.Si
	2. NIDN	:	0011068903
	3. Jabatan/Golongan	:	Asisten Ahli/ IIIb
	4. Fakultas	:	Pertanian
	c. Anggota (2)		
	1. Nama Lengkap	:	Tasya Chairuna Pane, S.P., M.P.
	2. NIDN	:	0123128903
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	4. Fakultas	:	Pertanian
	d. Anggota (3)		
	1. Nama Lengkap	:	Amanatul Fadhilah, S.Pi, M.Si
	2. NIDN	:	0015088903
	3. Jabatan/Golongan	:	Asisten Ahli/ IIIb
	4. Fakultas	:	Pertanian
	e. Mahasiswa yang terlibat	:	3 Orang
5.	Lokasi Kegiatan/ Mitra		
	a. Wilayah Mitra	:	Desa Paya Geli Kecamatan Sunggal
	b. Kabupaten/ Kota	:	Deli Serdang
	c. Provinsi	:	Sumatera Utara
	d. Jarak PT ke Lokasi Mitra (km)	:	12 km
6.	Luaran yang dihasilkan	:	Artikel Jurnal, Vidio, Media Massa (Koran)
7.	Jangka Waktu Pelaksanaan	:	Mei - Agustus
8.	Biaya (70%)	:	Rp25.000.000,-
9.	Sumber Dana	:	Non PNBP USU

Mengetahui
Wakil Dekan III,

Prof. Dr. Ir. Elisa Julianti, M.Si.
NIP.196706161991032003

Medan, 29 November 2022
Ketua Tim Pelaksana

R. B. Moh. Ibrahim Fatoni, S.Pi., MP
NIP.199006062018051001

Mengetahui,
Lembaga Pengabdian Kepada Masyarakat
Ketua

Prof. Tulus, Vor.Dipl.Math., M.Si., Ph.D.
NIP. 196209011988031002

SUMMARY

TRAINING ON CLEAN WATER MEDIA EEL BREEDING AND ENLARGEMENT AS AN EFFORT TO INCREASE THE ENTREPRENEURIAL CAPACITY OF THE PAYAGELI VILLAGE COMMUNITY

The process of cultivating eels that does not require a lot of equipment and maintenance as well as large areas of land is a special attraction in terms of its development potential. The people of Paya Geli Village have long cultivated eels as a side commodity due to the ease of the cultivation process. Until now, the Paya Geli Village Community has only used a conventional system where eels are left alone in mud tanks and fed with leftover food. The use of this conventional system not only has an impact on small productivity but will also encourage a bad and dirty paradigm to the eel consumer community. The conventional system also has an impact on erratic harvest scheduling so that the harvest cannot immediately match market demand. The solution to these problems is the use of eel cultivation methods with clean water media and partial harvesting which will not only increase productivity but also make it easier to control and harvest according to market specifications.

Oleh karena itu kegiatan pengabdian peningkatan kapasitas budidaya belut masyarakat Desa Paya Geli melalui pelatihan budidaya belut dengan media air bersih serta panen parsial menjadi penting. Kegiatan pengabdian ini telah terlaksana pada tahapan penyerahan dan desain kolam belut sekaligus pelatihan mengenai perancangan dan perakitan kolam terpal serta pelatihan budidaya dan pembesaran belut secara personal kepada mitra pengabdian. Kegiatan pengabdian ini juga akan disempurnakan dengan market entry strategy sebagai supplyer/pemasok belut. Diharapkan kegiatan pengabdian ini tidak hanya meningkatkan produktifitas budidaya belut tetapi juga menajadi salah satu sumber baru penggerak perekonomian masyarakat Desa Paya Geli serta perluasan lapangan pekerjaan melalui kegiatan kewirausahaan budidaya belut.

Keywords: Water Media Breeding, Entrepreneurial Capacity, Eel

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PELATIHAN PEMBESARAN DAN PEMBIBITAN BELUT MEDIA AIR BERSIH

PROGRAM PENGABDIAN KEPADA MASYARAKAT KEMITRAAN MONO TAHUN REGULER TAHUN 2022

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TIM PENGABDI

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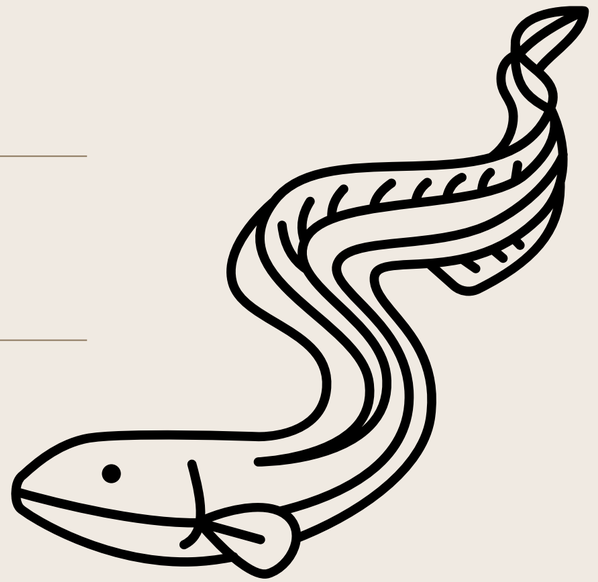
DAFTAR MATERI

- Kolam dan Perlakuan Media Budidaya
- Pembesaran
- Pengelolaan Pakan
- Pembenihan/Pembibitan



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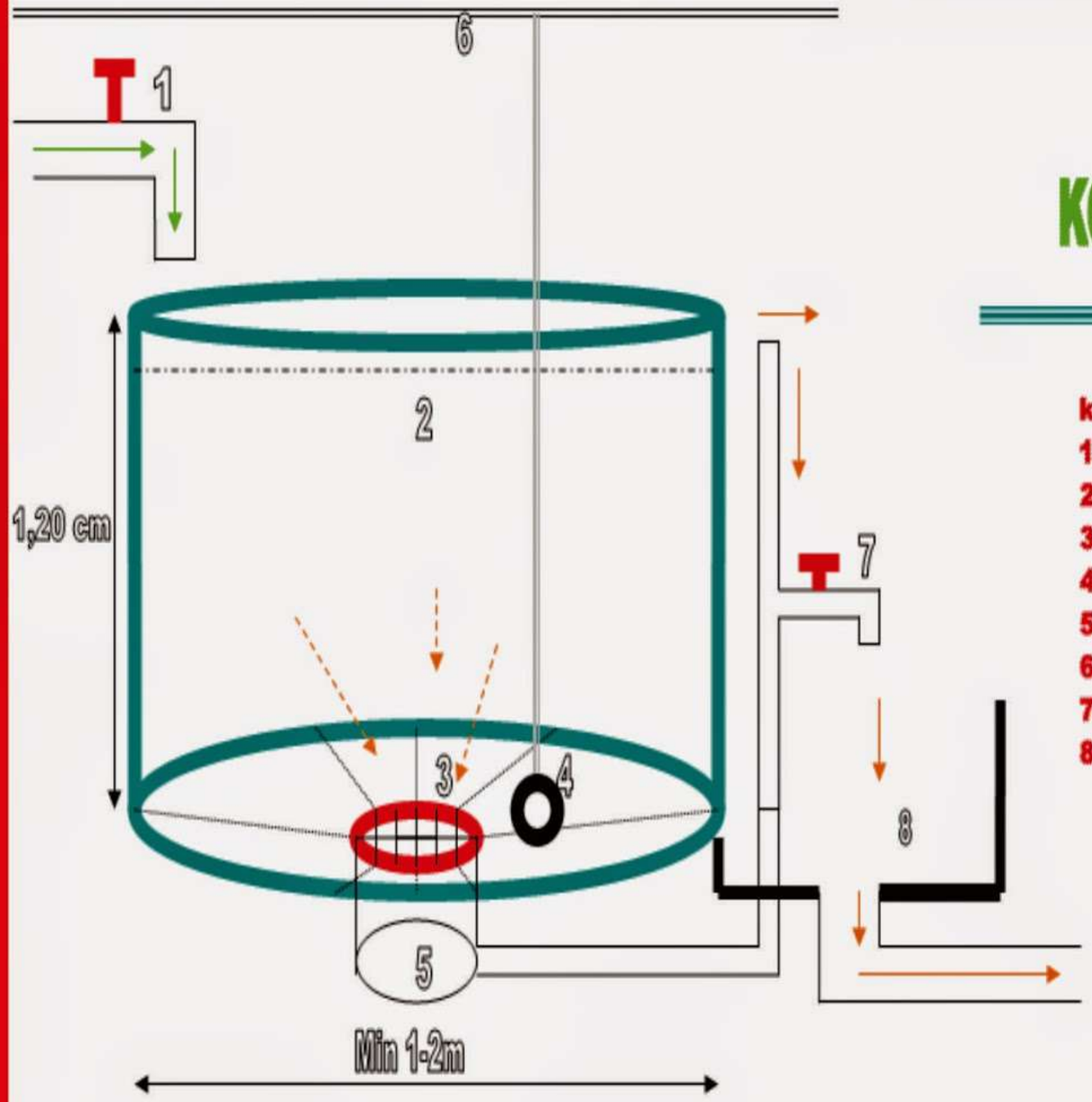
KOLAM

KOLAM BUNDAR



keterangan gambar
1.kran air masuk
2.level air
3.filter drain buang dasar
4.batu aerasi/gelembung udara
5.tabung filter
6.siang aerasi
7.kran buang air dasar kolam
8.parit pembuangan air kotor

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KOLAM

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PERLAKUAN MEDIA BUDIDAYA

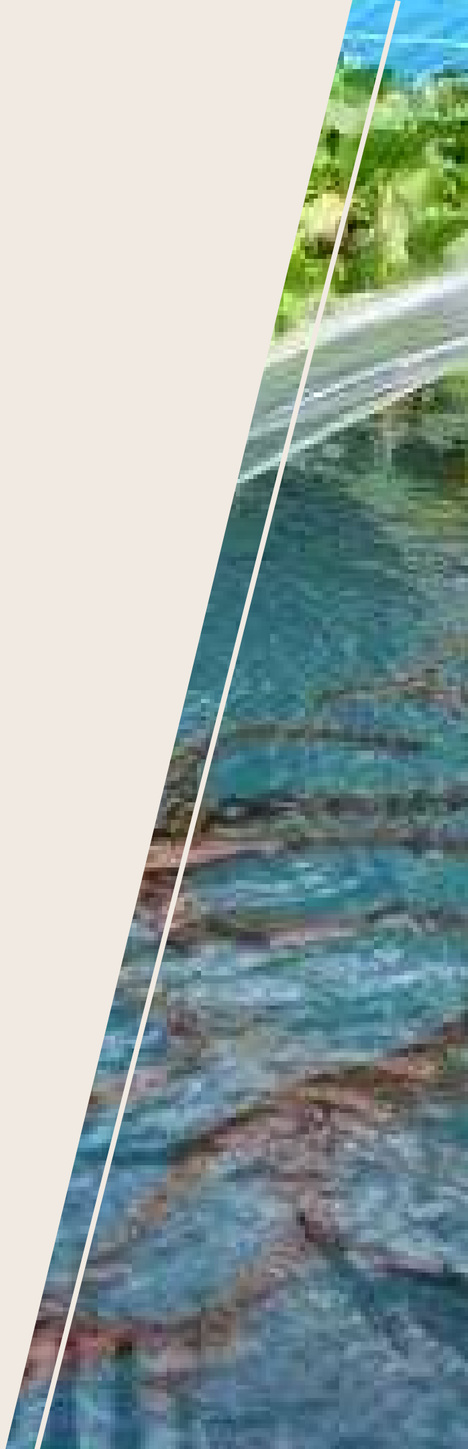
- Suhu air 25-28 C (suhu normal bisa sampai 30)
- PH air sekitar 6-7 (PH air biasa bisa sampai 8)
- Minim Cahaya (ditempat teduh)
- Tempat persembunyian
- DO 7-8 PPM (DO normal 5-7)

PEMBESARAN

- Masa pembesaran : 3-4 Bulan
- ukuran bibit 10-12 cm (1kg sebanyak 50-70 ekor)
- Bibit harus sehat - lincah, agresif, tidak ada luka, ukuran seragam
- penebaran dilakukan pada sore atau pagi hari
- padat tebar 50-100/1 m2 (1-1,5 kg/m2)
- ganti air 2-4 hari sekali

PENGELOLAAN PAKAN

- pakan alami dan buatan
- pemberian pakan 1 kali (sore menjelang malam)
- pemberian pakan sebanyak 5-10% dari bobot belut



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PAKAN ALAMI

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PAKAN BUATAN (PASTA)

- Daging (ikan rucah atau keong atau bekicot) 750 gram.
- Pelet ikan 200 gram.
- Tepung tapioka 1 sendok makan untuk setiap 1 kg pasta yang akan dibuat.
- Air secukupnya


RESPON CHANNEL


Clingak Clinguk
Channel

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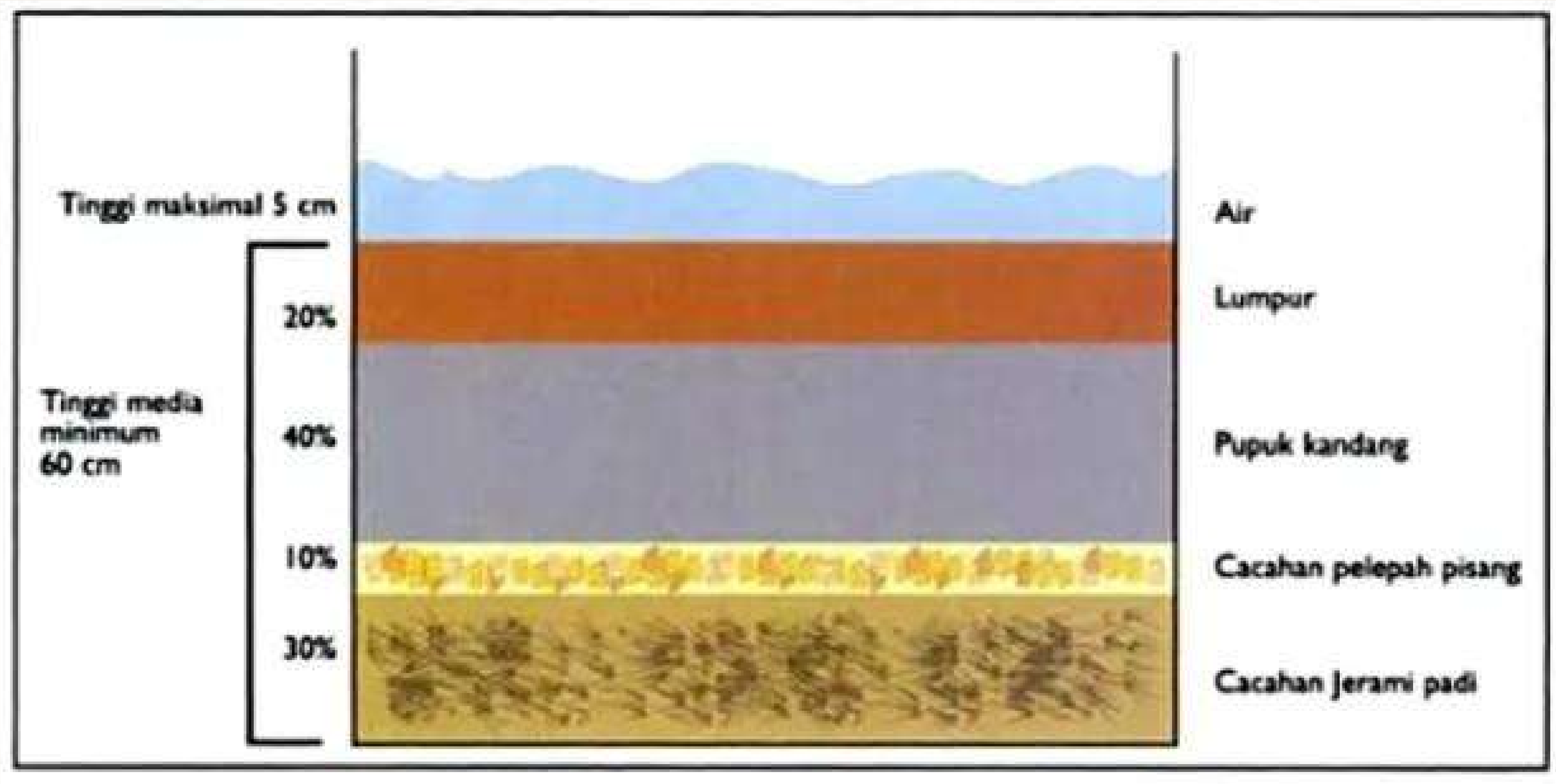
PEMBENIHAN/ PEMBIBITAN

1. Pembuatan Media Pembenihan.
2. Seleksi dan Pemeliharaan indukan.
3. Pemijahan indukan belut
4. Pemanenan bibit belut

nb. perlu menjadi catatan bahwa masa kawin hanya 1 tahun 1 kali (4-5 bulan) yakni dari selama musim hujan

1. Pembuatan Media Pembenihan



Bahan – bahan yang digunakan dalam pembuatan media pembenihan belut

Pupuk Kandang

Jerami

Lumpur

Decomposer (EM4)

Pelepah pisang

Bahan – bahan tersebut kemudian difermentasikan sebelum siap digunakan

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PEMBENIHAN/ PEMBIBITAN

Seleksi dan Pemeliharaan indukan

- memisahkan indukan jantan dan betina
- jantan tubuh lebih besar (ukuran diatas 40 cm),kepala lebih tumpul dan telah berbentuk seperti busur panah, umur lebih dari 8 bulan (ideal 10 bulan keatas)
- betina tubuh lebih pendek (ukuran 20-30 cm) kepala runcing, umur dibawah 8 bulan
- pemeliharaan terpisah selama 2-7 hari

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PEMBENIHAN/ PEMBIBITAN


Ini adalah ciri
1. Bentuk
2. ukuran
3. jika
akan
ketika
4. kepala
tumpul


SKTV


SKTV

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PEMBENIHAN/ PEMBIBITAN

Seleksi dan Pemeliharaan indukan

ciri matang gonad

- Perutnya mengembang ke arah genital, jika diraba terasa lembek, lubang duburnya berwarna agak kemerah-merahan,
- tutup Insang belut betina kalau diraba terasa agak licin, dan ji**ka perutnya diurut dari arah kepala ke anus biasanya keluar cairan kehitam-hitaman**.
- Sedangkan induk jantan yang sudah gonad tutup

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PEMBENIHAN/ PEMBIBITAN

Seleksi dan Pemeliharaan indukan

ciri matang gonad

- Sedangkan induk jantan yang sudah gonad tutup Insan diraba terasa kasar, dan **perutnya jika diurut dari atas menuju anus akan keluar sperma berwarna putih putihan.**

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PEMBENIHAN/ PEMBIBITAN

Pemijahan indukan belut

- Memindahkan indukan ke kolam pemijahan (1 jantan 4-5 betina)
- Pastikan terdapat makanan yang cukup
- Tanda perkawinan sedang berlangsung yakni adanya busa pada lubang/rumah belut
- waktu penetasan telur yakni 8-15 hari

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PEMBENIHAN/ PEMBIBITAN

Pemanenan bibit belut

- Keluarkan media lumpur dari dalam kolam atau drum memakai baskom.
- Lalu anak-anakan belut tersebut ditangkap menggunakan jaring.
- Kemudian anakan belut yang sudah terkumpul di cuci sampai bersih lalu dimasukkan ke wadah penampungan
- ukuran anakan berkisar 3-5 cm

Thank You