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Diversifying the Livelihoods of Small-Scale Fishermen Through Welding Skills Improvement in Kragan District, Rembang

Hendrix Noviyanto Firmansyah*, Dony Hidayat Al-Janan, Haryadi, Febrian Arif Budiman

Universitas Negeri Semarang, Indonesia

*Corresponding Author: hendrix@mail.unnes.ac.id

Abstract
Karangharjo Village, Kragan Subdistrict, Rembang Regency, is a coastal village where the majority of the population works as traditional fishermen using boats <5 GT. Fish catch productivity is greatly influenced by the seasons, especially during the west wind period when catches drop dramatically to <10 kg/day. The low level of education, with 48.22% of the population only completing primary school, further limits skills and income levels. This situation leads to poverty and livelihood uncertainty. The objective of this community service programme is to develop alternative livelihoods through welding training using Shield Metal Arc Welding (SMAW) techniques as a strategy for diversifying fishermen's livelihoods. The implementation methods include planning, theoretical training, basic welding practice, application of workplace safety standards, and evaluation of participants' skills. The results of the programme show an increase in welding knowledge and skills among the 20 trainees, with some of them having the potential to develop their own welding businesses. This programme contributes to the achievement of the Sustainable Development Goals (SDGs), particularly Goal 8 (Decent Work and Economic Growth) and Goal 17 (Partnerships for the Goals), and supports the strengthening of the local economy through the empowerment of fishermen.

Keywords: coastal fishermen, welding, SMAW, alternative livelihoods, community empowerment

INTRODUCTION

Karangharjo Village, Kragan District, Rembang Regency, covers an area of 99.32 ha and consists of two community units (RW 1 with 7 RTs, RW 2 with 6 RTs). It is located less than 1 km from the sub-district capital, 40.5 km from the district center, and 159 km from the provincial capital. The majority of residents work as fishermen using boats with engines <5 GT, catching fish such as scads, ribbonheads, mackerel, pompano, anchovies, squid, shrimp, and cockles. Productivity is strongly influenced by the season; during the west wind season, catches drop drastically to <10 kg/day (Nurhayati, 2020) . Waves of 1.5–2 m during this period further limit fishing activities (Hanan et al., 2015) .

On the other hand, the majority of fishermen in Karangharjo Village only have an elementary school education, with a percentage of 48.22% or 1,270 people. Poverty and economic limitations are the main problems of coastal fishermen, especially traditional fishermen, caused by many factors, one of which is low levels of education (Bengkel Ginting, 2022) . Education level is one indicator of the quality of human resources. Where those with low education, productivity is low. Low productivity will affect low income (Hamdani & Wulandari, 2016) . Lack of skills, experience, knowledge, and low levels of education limit a person's abilities in life (Annur, 2013) .

Uncertain incomes of fishermen due to seasonal fluctuations and low levels of education have prompted the need for alternative livelihoods as a source of income when they are unable to go to sea due to natural conditions. Developing alternative livelihoods is one of the government's policies in the marine and fisheries sector, implementing Law of the Republic of Indonesia Number 31 of 2004

concerning Fisheries (Jumardi et al., 2018) . This is also related to sustainable livelihoods, the ability to survive and adapt to pressures while maintaining and increasing assets and capacity, both now and in the future, despite the decline in natural resources (Agung Pangarso & Daniel Bayu Anggara, 2021) . This strategy is one of the alternative efforts undertaken by fishermen to meet their living needs and maintain the sustainability of their livelihoods.

One potential alternative is welding technology (Di & Fakfak, 2024) . Boats, as the primary assets of fishermen, often experience propeller damage, which reduces performance (Ramadhan et al., 2023) . Correct welding techniques can increase the strength of ship structures, making them more resistant to harsh sea conditions (Rozi, 2024) . Not only in the shipping sector, but this alternative can create job opportunities in meeting community needs, which can be used as a welding business workshop for welding purposes on construction products, vehicle frame products (chassis), household products, and children's play equipment. On the other hand, welded construction requires high skills from welders to produce quality joints (Bukhari et al., 2023) .

The welding technique that will be used is the SMAW (*Shield Metal Arc Welding*) technique. Using an electric arc electrode that has a flux (coated), has a close relationship with the electric current where welding defects, toughness and cracks are important things to pay attention to so that the construction that gets SMAW treatment is well maintained and of high quality (Makale et al., 2024) . In addition, Welding requires safe electrical installation planning, as well as the use of personal protective equipment to minimize the risk of accidents (Tripariyanto et al., 2019) . Based on Law No. 13 of 2003 article 86, workers are required to use PPE according to SNI, such as wearpacks, welding helmets, gloves, aprons, *safety shoes, ear plugs,* and masks (Cahyono & Susiati, 2024) .

The empowerment program for fishermen in Karangharjo Village through welding training is relevant to the 2005–2025 Rembang Regency development plan which prioritizes the potential manufacturing industry (Rembang Regency Government, 2010) . This program is in line with SDGs goal 8 (*Decent Work and Economic Growth*) and goal 17 (*Partnerships to achieve the Goals*), as well as Law No. 6 of 2014 concerning Villages which emphasizes improving welfare, quality of life, and poverty reduction (Boekoesoe & Maksum, 2022) .

METHOD

Based on the problems faced by partners, the community service program will be implemented through structured stages designed to provide effective and targeted solutions. Stages of Community Service Activities In Karangharjo Village, some use the SMAW *(Shielded Metal Arc Welding)* approach and method. This technique was chosen for basic welding purposes due to its simplicity, flexibility, and ability to effectively teach welding principles. This method is an ideal first step before moving on to more complex welding techniques.

RESULTS AND DISCUSSION

Coordination of Program Activities

Prior to the implementation of the Diversification Program Livelihood Small Fishermen through Improvement Welding Skills in the District Kragan, Regency Rembang, has done a series coordination strategic with various parties involved on May 20, 2025. Coordination This become step important beginning For ensure harmony goals, effectiveness program implementation, as well as optimization impact devotion to community. Coordination focused on two groups main, namely Karangharjo Village Government, in particular Village Head and Al- Kudzi Fishermen Group as recipient benefit directly. Equalization perception done in a way intensive, good through meeting direct and online communication, with discuss various aspect technical and substantive activity.

Temporary that, the result from existence coordination the summarized in a number of points Main: There is agreement and support active from Karangharjo Village Government and Al-Kudzi Fishermen's Group, the determination curriculum training that includes K3 and welding modules in a way integrated and applicable, and commitment For conducting learning reviews and mentoring post training to ensure the material provided can implemented in a way sustainable.

In support program sustainability, to the front is also involved Extension worker Fishery Field (PPL) Regency Rembang as representation from the Maritime Affairs and Fisheries Service. Involvement agency This aim For align service programs public with government policies and programs areas that have been walking, making sure program sustainability through integration with

formal assistance from government, as well as, open opportunity collaboration advanced like development group business fishermen, access training continued, until facilitation help equipment. With step mature and participatory coordination this, it is hoped program implementation can walk more effective, sustainable, and provide impact real for improvement capacity as well as welfare fishermen in Karangharjo Village.

Figure 1. Coordination with the Karangharjo Village Government and the Al-Kudzi Fishermen's Group

Occupational Safety and Health (K3) Training

The K3 training activity was held on Friday, June 20, 2025, at the Karangharjo Village Community Hall, Rembang Regency. The activity began at 08.30 WIB and ended with 20 fishermen from the Al-Kudzi Fishermen's Group participating. This activity was also attended by one Fisheries PPL from Rembang Regency and three team members from UNNES. The implementation of this activity was a collaboration between the Karangharjo Village Fishermen's Group, the Karangharjo Village Government, and Semarang State University.

This activity was opened with a presentation of basic material on K3 training delivered directly by Hendrix Noviyanto Firmansyah, ST, MT Aspek this is very important remembering the welding process own potential risk tall to safety, good consequence heat, light, electricity, gas, and dust results welding. One of the danger main is exposure welding light, which consists of on ultraviolet light, light visible, and infrared rays. The three type radiation This can cause irritation, fatigue, or even eye damage If No handled with appropriate protection. Therefore that, participants trained For use a welding helmet, protector eyes, and clothing that covers all over body.

In addition, the training also discusses about dangerous gas and dust produced during the welding process. For reduce risk this, participants taught importance use adequate ventilation as well as protection breathing such as masks or respirators. Training materials closed with introduction draft *"The Dirty Dozen",* namely twelve factor reason error the most common human in context work, including the lack of communication, fatigue, stress, and lack of knowledge. Understanding to factors This expected can increase vigilance and thoroughness participant in do work welding, so that can prevent occurrence accident In addition, fishermen participating in this program are able to apply the knowledge they gain safely, productively, and sustainably as part of their livelihood diversification efforts.

Figure 2. Documentation of K3 Training Activities

Basic Welding Training Using the SMAW Method

Welding practice activities were carried out on June 21, 2025. Welding practice was carried out using two types of welding equipment, namely Lakoni brand electric welding equipment with a voltage

of 900 W and 1300 W. The training began with how to turn on the welding equipment, adjust the voltage according to the electrode. In the first part, participants were introduced to the basic concept of welding as a process of joining two or more metal objects through the application of heat and/or pressure. This process can be carried out in three main ways, namely with only heat without pressure, using a combination of heat and pressure, and with pressure alone without additional external heat. In its implementation, some welding methods also involve filler materials to facilitate the union between metals.

Welding is generally classified into two types: *fusion welding,* which uses heat to melt metal, and *solid-state welding,* which joins metals under pressure without melting them. One of the most common methods taught in this training is arc welding, a welding process that uses heat from electrical energy to melt metal at the joint. Some types of electric welding explained include SMAW (*Shielded Metal Arc Welding*), GTAW/TIG (*Gas Tungsten Arc Welding*), GMAW/MIG (*Gas Metal Arc Welding*), and FCAW (*Flux-Cored Arc Welding*). Of these four types, SMAW is the main focus because it has the simplest tools and equipment and is suitable for basic training needs for fishermen.

Welding techniques include welding methods in accordance with Standard Operating Procedures (SOPs) including the use of welding glasses, welding gloves, welding techniques, discussions of obstacles when welding on ships, and introduction to the types of welding equipment according to their voltage levels, starting from 900 W to 1,300 W welding equipment and parts of welding equipment such as introduction to the size of electrodes or welding wires. The discussion session took place with several questions from fishermen regarding the use of electrodes that are appropriate to their needs.

Figure 3. Basic Welding Training Using the SMAW Method

Facilitation of Tools and Materials to Support Welding and PPE/K3 Needs

As part of its commitment to supporting the success of the welding skills training program for the Al-Kudzi Fishermen's Group in Karangharjo Village, this activity also provided support in the form of tools and supporting materials needed for the training and hands-on practice. This support included not only welding equipment but also personal protective equipment (PPE) to ensure the implementation of Occupational Safety and Health (K3) principles throughout the activity.

Some of the core equipment provided includes two Lakoni brand portable electric welding machines equipped with ground cables and electrode holders, as the main current source for the welding process using *the Shield Metal Arc Welding* (SMAW) method. To support metal cutting and cleaning, a hand grinder unit is also provided along with several cutting discs *and* rolled welding wire. The facilities also include Nikko Steel brand welding electrodes which are the main filler material during metal joining practices. In addition, an angle-shaped magnetic clamp is also available which functions to hold the metal in position during welding, ensuring precise joint results according to the working angle.

In terms of OHS, participants are provided with personal protective equipment (PPE) consisting of a manual welding helmet/mask, clear goggles, and heat-resistant leather gloves. This PPE is designed to protect participants from potential hazards while working, such as exposure to ultraviolet and infrared rays from electric arcs, sparks, and metal fragments. As a complement, thick cloth rags, wire brushes, and chipping hammers are also provided, which are used to manually clean the slag from welding.

The provision of these tools and materials aims not only to facilitate the smooth running of the training but also to introduce participants to proper and safe welding equipment standards. With this complete and standardized equipment, it is hoped that participants will be able to comprehensively

understand the welding process and implement safe and professional work practices. This facilitation is a crucial component in supporting the success of community service activities and the sustainability of the skills developed within the fishermen's livelihood diversification program.

Figure 4. Facilitation of Tools and Materials for Welding

CONCLUSION

Activity results show existence change positive for participants, both from aspect knowledge, skills, and awareness will importance diversification livelihood as a coping strategy uncertainty economy consequence condition the sea which is seasonal. A total of 20 fishermen has follow training with satisfactory results, and some participant show potential For develop business welding in a way more continue. This program contribute to the achievement objective development sustainable development (SDGs), especially in the aspect of work worth and growth economy (SDG 8) and partnership For reach goal (SDG 17), while support development economy local through strengthening capacity fisherman.

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