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The puzzle of how higher education learning does in post-COVID-19 pandemic

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ABSTRACT

The COVID-19 pandemic has exhibited a significant impact on higher education learning. Campus closure or social distancing has been handled by University management, in limited or emergency situations. However, the pandemic has also provided extraordinary lessons learned for the sustainability of higher education in Indonesia. During the post-pandemic period, online learning or blended patterns can be carried out enthusiastically. This paper emphasizes that post-pandemic learning should be strengthened by an evaluation process and a level of satisfaction. The quality assurance mechanism is carried out systematically, especially ensuring the evaluation of online learning and taking continuous improvement actions. The evaluation process is complemented by a customer satisfaction survey involving students, lecturers, and admin staff to ensure the mechanism meets standards. Students should get a favorable atmosphere to involve in learning with the support of adequate lecturer competence, communicative tutorials, easy-to-understand online platforms, and proper class management.

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INTRODUCTION

The COVID-19 pandemic has revealed many implications in educational learning, particularly higher education. Throughout the early 2020 to mid-2022 period, energy and thoughts were devoted to back up University learning to survive, amidst the pressure of the transmission of the COVID-19 virus in the University community. When the spread of the virus peaked, campuses had to stop learning activities overshadowed by social distancing rules that limited the mobility of the campus community. Higher education management has taken marked initiatives to respond to the change in learning to online classes and the supporting processes that moved through paperless, remote interaction, to support the achievement of learning outcome (Pandey et al., 2022). The adjustment took place smoothly and steady in many learning activities, with its dynamics within the limited abilities of either the lecturers, students, technology instruments, or learning media. Health or vocational education showed a lot of behavior response because the substance of learning requires guidance and skills of practice, which may not meet its goals in online classes.

In the post-pandemic period, online classes will be a primary and significant choice. For theoretical learning material, online class learning is still considered to be effective, supported by the ability and independence of students to review their learning (An, 2021). Experience of working in administration tasks, the availability of learning media platform,

information technology infrastructure, and adjustment initiatives during a pandemic are valuable assets for how this will become a primary concern for higher education learning after the COVID-19 pandemic. This may require a comprehensive set of HR competencies, an online platform design, communication skills, classroom management, and effective use of resources for supporting the blended learning efficiently (Huang et al., 2021).

It is acknowledged that learning during the pandemic is able to support higher education programs. However, one should truly question the extent of the effectiveness of study from home during this pandemic. Another question is whether it is true that online learning will become a basis in the post-pandemic period. The experience of implementing learning during a pandemic provides valuable lessons. We have gone through how learning activities suddenly changed, online learning activities became urgent, lecturer-student communication turned inconvenient, or management made flexible decisions with acceptable solutions. The experience during these two years of the pandemic (early 2020 to mid-2022) may be considered an emergency, but on the other hand it provides real advantages. Fortunately, management and procedures during a pandemic can be a valuable experience to be utilized and optimized in learning mode during a post-pandemic time (Pandey et al., 2022). This can guide elaborating the extent of the learning process and effectiveness that will occur in post-pandemic (Yoo et al., 2021). Experience during the pandemic can be a new approach to formulating the future of education and ensuring sustainable education in complex and uncertain atmosphere (Huang et al., 2021).

LESSONS FROM THE PANDEMIC

University Management

The issue of online learning is a huge challenge that leads to the needs of introducing digital platforms in all learning programs as well as enabling digital technology to share the knowledge. This requires institutional changes and resources, as well as University's support to provide facilitation, managerial, or training needs for admin staff (Szopiński & Bachnik, 2022). This experience provides leadership capable of transforming change into positive and useful values for overseeing the post-pandemic period (Nugroho et al., 2021).

Based on experience during the pandemic, post-pandemic measures should require more focus on implementing a flexible curriculum, learning across study programs/universities, creative internship programs, entrepreneurship programs, or recognition of community social activities by students. Before the pandemic, in 2019, the Indonesian government launched the Independent Learning Independent Campus (*Merdeka Belajar Kampus Merdeka*/MBKM) program which became a reference for higher education management to recognize various student activities that are aligned with the curriculum. This program is very relevant to be the safety valve of higher education during pandemic. However, the University management is required to carry out evaluation mechanisms to ensure standards of learning activities are met, such as instructional objectives, student involvement, and other aspects of the curriculum (Szopiński & Bachnik, 2022).

When the pandemic first spread-out in China, many international students then returned to their home countries, including Indonesia. While they were waiting for the pandemic to end, students could continue their studies or even transfer their studies to Indonesian universities. This cooperation provides managerial experience for the development of University collaboration and increasingly complex education management.

Blended learning experiences will be an alternative choice, adjusting the needs of the parties according to the achievement of learning outcomes. University management needs to identify online or offline learning modes, which provide motivation for independent learning, student satisfaction and achievement of learning participation (Dai & Qin, 2021; Huang et al., 2021; Yoo et al., 2021). To provide convenience for implementing online tutorials, the University pays attention to the availability of online platform, lecturer competencies, good communication, class management, and effective use of resources (Huang et al., 2021).

Online learning in universities has been known for a long time. The pandemic stimulated higher interest in online classes in the student admission. University management can acquire the demand for online classes, especially for programs or fields of management and business, or other social sciences, by developing administrative and learning applications that provide social media interaction and student engagement. This online class education is expected

to support more revenue for University (Szopiński & Bachnik, 2022).

Meanwhile, the spread of COVID-19 may not have completely stopped. University management still requires anticipatory measures to reduce the incidence of similar infectious diseases on campus (Shah et al., 2020). To ensure the safety of the campus community, it is necessary to implement strict health protocols (Fernanda et al., 2021) or regulate social activities among students on and off campus, including suppressing post-holiday transmission, supported by the test-trace-isolate-quarantine rules (Ashcroft et al., 2022; Gillespie et al., 2021; Thompson et al., 2018).

Lecturer

Lecturers are the forefront of implementing online learning and academic activities on campus. It is not easy to manage learning changes, curriculum adjustments, implementation of learning media platforms, and their various implications for lecturers' relations with students. Lecturers demonstrate a variety of responses to manage these changes. A study showed that only 13.6% of professors prefer online courses and half (52.3%) want to return to offline courses (Kim et al., 2020). This is probably due to the rather low ability of lecturers to adapt to online learning platforms, not preparing online learning media (modules, audio, video or other visual aids), or perceiving that online learning is unable to meet the target learning outcomes. It must be acknowledged that immersion is significantly higher in offline classes for both theoretical and practical subjects. Also, the interaction between lecturers and students is significantly greater in offline classes for both theoretical and practical courses (An, 2021).

On the other hand, lecturers may face psychological problems in front of the camera when learning online using video platform. The online class atmosphere, for a lecturer, can disrupt the hierarchical power paradigm that he/she gets in conventional classes (Hemy & Meshulam, 2021). This can disturb lecturers and make it difficult to accept the presence of online learning. Meanwhile, a study (Yuan et al., 2021) found that the image and sound of lecturers in video platform have a positive relationship with student involvement, learning satisfaction and enjoyment, while they have a negative relationship with student boredom. Instructor image is positively related to student achievement. The study suggested that video-audio media planning is integrated with instructional design enable to assist online video course development.

The attitude of lecturers towards online education regarding the usefulness and advantages felt by lecturers is a strong indicator that they accept it (Szopiński & Bachnik, 2022). This is an important point, which determines the success of online education. Therefore, this is a challenge for University management to support lecturer involvement. Lecturers need to obtain a variety of training and information about learning information technology and educational administration in general. It is hoped that the achievement of online learning will provide the same level of knowledge and competence as conventional learning.

Student

The success of online learning is determined by the extent to which students receive learning material. In the process of online video courses, success is determined by student satisfaction or attitudes toward online class delivery (Pandey et al., 2022). Psychologically, students feel the presence of a faceless lecturer showing better performance. However, the appearance of lecturers' faces also increases student satisfaction and excited interactions during online tutorials (Yuan et al., 2021).

Student engagement shows high interest during online video learning. A study (Kim et al., 2020) showed that students find satisfaction during the online course and 62.2% of them prefer the online course to the offline course. Meanwhile, 84.3% of students wanted online learning after the pandemic. The student have a positive perception of communication, technical or tutorial methods, and is enthusiastic about sending assignments or exams on schedule. This happens because students show independence in reviewing their learning (An, 2021). Students are also able to motivate themselves to add their learning time, adapt their individual learning styles, and repeatedly review video lectures (Huang et al., 2021; Yoo et al., 2021).

Meanwhile, it was also found that low engagement of student during online video learning. Studies (Szopiński & Bachnik, 2022) showed that students absent themselves in video learning, or delay in submitting assignments and exams due to technical difficulties or reasons beyond the student's control. Many factors influence student obstacles in online learning, including limited internet connections, low

socio-economic conditions of students (Nugroho et al., 2020), or political factors faced by international students (Szopiński & Bachnik, 2022).

Fundamentally, students have different capabilities in studying and receiving learning material apart from socio-economic factors. Students who are less able to absorb learning material, less involved, or for other reasons, need to get offline tutorials to catch up for their learning. Offline meetings open lecturer-student interactions to shape cognition, affection and behavior in learning aspects. The blended learning approach is a way out or a solution to the weaknesses or obstacles to online learning, and can trigger students' self-learning motivation (Huang et al., 2021; Yoo et al., 2021). Furthermore, students need a comfortable atmosphere through adequate lecturer competency support, communicative tutorials, easy-to-understand online platforms, and proper class management (Huang et al., 2021).

CONCLUSION AND SUGGESTION

This paper provides an optimistic view that online learning or blended patterns can be carried out in the post-pandemic period. Even though many obstacles were found during the pandemic, the two years' experience is considered to have provided a lot of lesson learned on how to manage change and provided a way out for better online learning implementation. The significant improvements have occurred including: (i) adjustments to University management related to curriculum, learning across study programs/universities, use of online learning platforms, or adjustments to learning administration; (ii) lecturers are able to adapt to changes in curriculum, learning methods and use online platforms; (iii) students are able to take part in online learning with various limitations, and generally wish to continue online learning after the end of the pandemic.

What is of concern during the post-pandemic period is related to the process of evaluating and satisfying online learning. University management should carry out a steady and periodic quality assurance mechanism, especially ensuring online learning evaluations and taking continuous improvement actions. The evaluation process is complemented by a customer satisfaction survey involving students, lecturers, and admin staff to ensure content and mechanisms meet online learning program standards.

REFERENCES

An, H.-K. (2021). A study on the differences of online and offline classes in college beauty education caused by COVID-19. Journal of the Korean Society of Cosmetology, 27(5), 1184–1195. https://doi.org/10.52660/jksc.2021.27.5.1184

Ashcroft, P., Lehtinen, S., & Bonhoeffer, S. (2022). Test-trace-isolate-quarantine (TTIQ) intervention strategies after symptomatic COVID-19 case identification. PLoS ONE, 17(2 February). https://doi.org/10.1371/journal.pone.0263597

Dai, J., & Qin, T. (2021). Blended teaching with mobile applications in smart classroom: A new method for chinese language teaching for international medical students in the post epidemic era. Proceedings - 2021 2nd International Conference on Artificial Intelligence and Education, ICAIE 2021, 720–723. https://doi.org/10.1109/ICAIE53562.2021.00158

Fernanda, E. F., Nisa, S. A., Santoso, R. K., Wening, G. R. S., Setijanto, R. D., Setyowati, D., Wulandari, P. Y., & Siswantara, P. (2021). Improving school health literacy for teachers-students-parents as steps to control covid-19 transmission regarding school re-opening attempts. Indonesian Journal of Dental Medicine, 4(2). https://doi.org/10.20473/ijdm.v4i2.2021.48-54

Gillespie, D. L., Meyers, L. A., Lachmann, M., Redd, S. C., & Zenilman, J. M. (2021). The experience of 2 independent schools with in-person learning during the COVID-19 pandemic. Journal of School Health, 91(5). https://doi.org/10.1111/josh.13008

Hemy, A. D., & Meshulam, A. (2021). 'Is that okay, teacher?' The camera as a tool to challenge power relations in a participatory action research classroom. Qualitative Research, 21(5). https://doi.org/10.1177/1468794120952008

Huang, R., Tlili, A., Wang, H., Shi, Y., Bonk, C. J., Yang, J., & Burgos, D. (2021). Emergence of the online-merge-offline (OMO) learning wave in the post-COVID-19 era: A pilot study. Sustainability (Switzerland), 13(6). https://doi.org/10.3390/su13063512

Kim, J. W., Myung, S. J., Yoon, H. B., Moon, S. H., Ryu, H., & Yim, J. J. (2020). How medical education survives and evolves during COVID-19: Our experience and future direction. PLoS ONE, 15(12 December). https://doi.org/10.1371/journal.pone.0243958

Nugroho, I., Paramita, N., Mengistie, B. T., & Krupskyi, O. P. (2021). Higher education leadership and uncertainty during the COVID-19 pandemic. Journal of Socioeconomics and Development, 4(1), 1–7. https://doi.org/10.31328/jsed.v4i1.2274

Nugroho, M. M., Syamsuar, A., Syamsuar, A., Yunaryo, H. M. A., Pramesti, L. A., Nurrudin, M., Darmamulia, M. A., Fasya, R. A., Haniffah, S. H., Gaol, S. I. P. L., & Ernawati, E. (2020). Analisis kesiapan pelaksanaan kegiatan pembelajaran tatap muka di Indonesia pada tahun 2021. Journal Publicuho, 3(4), 523. https://doi.org/10.35817/jpu.v3i4.15522

Pandey, D., Ogunmola, G. A., Enbeyle, W., Abdullahi, M., Pandey, B. K., & Pramanik, S. (2022). COVID-19: A framework for effective delivering of online classes during lockdown. Human Arenas, 5(2). https://doi.org/10.1007/s42087-020-00175-x

Shah, M., Ferra, G., Fitzgerald, S., Barreira, P. J., Sabeti, P. C., & Colubri, A. (2020). Containing the spread of infectious disease on college campuses. MedRxiv, 2020.07.31.20166348. https://doi.org/10.1101/2020.07.31.20166348

Szopiński, T., & Bachnik, K. (2022). Student evaluation of online learning during the COVID-19 pandemic. Technological Forecasting and Social Change, 174. https://doi.org/10.1016/j.techfore.2021.121203

Thompson, B. S., Gillen, J., & Friess, D. A. (2018). Challenging the principles of ecotourism: insights from entrepreneurs on environmental and economic sustainability in Langkawi, Malaysia. Journal of Sustainable Tourism. https://doi.org/10.1080/09669582.2017.1343338

Yoo, H., Kim, D., Lee, Y. M., & Rhyu, I. J. (2021). Adaptations in anatomy education during COVID-19. Journal of Korean Medical Science, 36(1). https://doi.org/10.3346/jkms.2021.36.e13

Yuan, M., Zeng, J., Wang, A., & Shang, J. (2021). Would it be better if instructors technically adjust their image or voice in online courses? Impact of the way of instructor presence on online learning. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.746857

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Ethnicity and the return to education in Indonesia

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ABSTRACT

Using data from the Indonesia Family Life Survey (IFLS) from 2014–2015, this study seeks to analyze the ethnic differences in the return to education in Indonesia. We discovered that IV models, as opposed to OLS estimation, are more suitable to evaluate returns to education in Indonesia. Additionally, rather than treating the ethnicity variable as an instrumental variable, it is preferable to use it as a grouping variable. After segmenting our samples into six ethnic groups, this study discovered that all ethnic groups, with the exception of the Chinese group, match the IV estimation. The non-Chinese groups with the best returns on schooling are Bataknese and Minangnese. The high return on education in these ethnic groups is attributed to the intense excitement for learning that permeates Bataknese and Minangnese cultures as native cultural assets. Earnings are also influenced favorably by marital status, masculinity, employment in the public sector, and urban-rural location. These findings suggest that ethnic and cultural topics should be covered in the national curriculum as well as local curricula. Since these characteristics have a direct impact on salaries, the government should also pay attention to gender segregation, career opportunities, and urban-rural growth.

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INTRODUCTION

There is a general concern that incomes are significantly impacted by the educational level of the labor market. Due to the country's extreme geographic and ethnic diversity, education has long been seen as a crucial social change strategy for attaining equitable socioeconomic development in Indonesia. Unfortunately, there has been little progress in Indonesia's educational system over the past ten years. Indonesia's education level in 2018 was only 8.17 years, according to data on the average number of school years. In other words, the average Indonesian merely completed junior high school. The problem is made worse in many places, including Papua and Nusa Tenggara Barat, where students spend an average of 6–7 years in school (Badan Pusat Statistik, 2018). Since higher salaries are linked to more years of education and escaping poverty, education and training programs targeted at increasing the incomes of the least qualified workers are frequently supported (Barrow & Rouse, 2006; Carneiro & Heckman, 2003; Krueger, 2003).

While it is obvious that education has a big impact on people's income, the return on education might vary depending on the subgroup of the population, such as gender, marital status, age, working industry, urban/rural location, and ethnicity. Numerous studies

have been done on the impact of factors like gender, marital status, age, place of employment, and industry on income disparities, such as in Comola & de Mello (2010), Dumauli (2015), Magdalyn (2013), Purnastuti, Salim, & Joarder (2015), and Sohn (2015). Happiness element also determines the return on education, notably for monetary return on education, in addition to typical economic and demographic considerations (Hendajany, Widodo, Sulistyaningrum, 2016; Sohn, 2013). Studies on the impact of ethnicity on returning to school, though, are still few and far between. Ethnicities in Indonesia, which are very diverse, commonly live together with their own ethnic members. Ethnic diversity in Indonesia may have an impact on the return to education because education becomes a part of an ethnic group's culture. To the author's knowledge, however, there is no quantitative study that extensively correlates ethnicity with return to education in Indonesia. In other multicultural nations, the variation in the return on education may be explained by the average level of education held by members of the ethnic group (ethnic capital). Several previous studies, such as Arshad (2016), Barrow & Rouse (2006), Borjas (1992), Shahiri & Park (2018), and Trentini (2014), showed that return on education may vary across ethnicities.

Besides varying according to sub-group characteristics, the return on education may vary depending on how it is measured. Empirical research has long debated the best way to assess the returns to education. The earlier studies on return to education, such as Becker & Chiswick (1966) and Mincer (1974) scrutinized education as an exogenous variable in the regression model with Ordinary Least Square (OLS) estimation. Several recent studies used OLS estimation (Arshad, 2016; Trentini 2014). However, the OLS method on return to education measurement is criticized due to the endogeneity of the education variable. One of the techniques to avoid endogeneity problems is the instrumental-variables (IVs) approach. This approach is used to determine variation that is exogenous in treatment and to estimate causal inferences, as recent studies (Dickson, 2013; Fossen & Büttner, 2013; Gong, 2019).

Since a poor decision can worsen already-existing issues, choosing the suitable instrument variables is difficult and not a simple design issue (Sturm, 1998). Factors related to family background are among the most often used instrumental variables in return to education models. The family background, especially the educational level of the parents, may have a considerable impact on earnings without being mediated by schooling, which is one potential problem with these parameters. Concerns about a relationship between parental education and income being directly correlated were disproved by Hoogerheide et al. (2012). By loosening the rigorous exclusion criteria, they discovered that the bias resulting from a potential direct impact of a father's education on salaries is smaller than the posterior interval of the important education coefficient in the IV model. They came to conclusion that, given the inadequacies of the alternatives mentioned above, employing a father's degree as an instrument in earnings regressions is a viable option based on this finding. In Indonesia, whose curriculum changes regularly, parents' education not only influences the educational choices they make for their children, but also plays a crucial role in ensuring their involvement in their children's education. In their study, Akresh, Halim, & Kleemans (2018) demonstrated the benefits of greater parental education for children's education through an analysis of a particular education program in Indonesia. In order to raise the caliber of human resources, they contend that intergenerational education is natural and sustainable education is essential.

The recent studies focused on ethnicity and parental education as an instrument variable since it affects family's behaviors to advance on higher education. Although the significance of ethnic capital on educational attainment is still debatable, Postepska (2019) conducted a recent study that shows that ethnic capital and parent capital in education have a positive and significant effect on the education period. Regarding the effect of ethnicity on education, Chua & Ng (2015) claimed that race plays a role in the effect of class on educational attainment in three ways. First, it's possible that parents of a particular ethnicity will apply knowledge (and intentional nurturing) to their children's academic success more deliberately. How teachers evaluate their students is the second thing to take into account. Based on the definitions given to categories like gender, ethnicity, and class, people frequently assume that some groups are better (or worse) than others. Finally, it's important to make a distinction between the amount and quality of education. The assumption that one group can enroll in more prominent and qualified institutions than other ethnic groups is based on the stereotype that it is richer than the others. Hence, as an alternative to the

ethnic approach on return to education, we also treat ethnicity as a grouping variable as that in studies conducted by Arshad (2016) in Malaysia and Trentini (2014) in Bulgaria.

Given the foregoing justification, the primary research objective of this study is to determine if ethnic capital and parent capital, which are components of community indicators, can account for variations in return to education. This study also compares the economic benefits of education among Indonesian ethnic groups.

This study primarily offers three contributions. To begin with, this analysis employs imputation on the microdata to prevent the bias brought on by missing data. Secondly, based on an empirical investigation, this study employs the ethnic component to justify why the IV technique is more likely to be reliable when examining return to education for particular ethnic groups. Thirdly, this study uncovers disparities in return to education measurement among Indonesia's ethnic groups and adds to the discussion on whether return to education research should use control variables or instrumental variables.

RESEARCH METHOD

The academic community is divided over how to calculate the benefits of education. OLS estimation, in the opinion of certain academics, is a trustworthy method for calculating the educational return. OLS estimate has been a common methodology in the first studies on the return to school, including Mincer (1974). But given the current state of the education variable, this method is controversial. Since it ignores the effects of parental education on the individual's earnings through the individual's educational attainment, it has been suggested in several previous research that the return to education using OLS estimation results frequently exhibits the downward bias. The study conducted by Card (2001) revived the debate regarding the (dis)advantages of the applications of the OLS and IV estimation approaches in estimating returns to education. The result is that OLS estimation is biased and it is preferable to utilize IV estimation, which needs the consideration of instrument variable selection. In calculating the return on education, it must therefore account for these unobservable variables. Selecting the unobservable variables that will serve as instrumental variables for schooling needs a number of considerations, including correlation, relevance, and exogeneity. Consequently, many tests are required to guarantee that the choosing variables meet the requirements.

Due to its substantial correlation with educational attainment, the intergenerational transmission factor is among the options for the appropriate instrumental variable of education. As a component of the intergenerational transmission factors, parental education is the most frequently used instrumental variable in past research estimating the return on education. This hypothesis was tested by Hoogerheide et al. (2012) and Lemke & Rischall (2003), despite criticism of the use of parental education as an instrument in return to education regression due to its close correlation with incomes. Accordingly, they determined that employing parental education as an instrument to return to education regression is a viable solution to the endogeneity problem. Several prior research on the return to education in Indonesia have considered the use of IV estimation to address the possibility of endogeneity bias. In addition, the IV is utilized to determine the significance of the omitted variables (especially the ability bias) in the OLS model. Many studies, including Dumauli (2015), Mugijayani (2020), Purnastuti (2013), and Xue (2019), have attempted to identify the most appropriate instrumental variables for education in Indonesian situations. The most common IV identified by these investigations is parental education.

An additional factor of intergenerational transmission is ethnicity. In contrast to parental capital, ethnic capital as an instrumental variable is less well-known. It is only utilized in a few studies, such as Damm (2009), with a modified definition of ethnic capital. Also, ethnicity is frequently utilized as a grouping variable as opposed to an instrumental variable. In Indonesia, where it is common to see ethnic neighborhood preferences, it is considered that ethnic culture influences educational attainment.

To examine the return to education, the most widely-used model is Mincer earning regression model, which evaluates education's effect while controlling age and other factors. Basically, this study uses the equation in Mincer (1974), known as the classical Mincer model of return to schooling. The model is as below:

$$\log[y] = \alpha_0 + \rho_s S + \beta_1 X_1 + \beta_2 X_2 + \varepsilon \qquad (1)$$

Where y, S, X1, X2, ρ_s, ε are income, years of schooling, age, other independent factors, rate of return to education, and residuals, respectively.

Many studies, such as Arshad (2016) and Gong (2019), use a quadratic function of age in the earnings equation to catch the life-cycle effects in the form of an inverse U-shaped relationship between age and income implies a diminishing marginal income as experience is accumulated. A dummy variable for gender was also included to control the difference between men and women. At the same time, marital status and working sectors were used in the models to control the variation between married and unmarried and the difference among the working sector types. In this equation, we divided the working sector into three groups: public, private, and others consisting of self-employed, unpaid, and casual workers. For the working sector dummy variable, we used others as a control variable. Moreover, to control the difference between urban and rural areas, a dummy variable of residential was also used in the models. Thus, equation (1) is transformed as:

$$\ln wage_i = \beta_0 + \beta_1 educ_i + \gamma_1 age_i + \gamma_2 age2_i + \gamma_3 married_i + \gamma_4 male_i + \gamma_5 Public_i + \gamma_6 Private_i + \gamma_7 urban_i + \varepsilon_i \quad (2)$$

Furthermore, to clearly examine the effect of ethnicity on return to education, this study not only divided the sample into ethnicity subgroup, but also use interaction term in general samples. We added interaction term in equation (2), so the modified equation is as below:

$$\ln wage_i = \beta_0 + \beta_1 educ_i + \gamma_1 age_i + \gamma_2 age2_i + \gamma_3 married_i + \gamma_4 male_i + \gamma_5 Public_i + \gamma_6 Private_i + \gamma_7 urban_i + \beta_2 ethnic\_gr_i + \beta_3 educ_i * ethnic\_gr_i + \varepsilon_i \quad (3)$$

Due to the limitation of each ethnicity's samples, using equation (3) we only categorized the sample into maximum three subgroups. First, we categorized the samples into majority and minority, in which majority group consists of Javanese, Sundanese, Bataknese, and Minangnese, while minority group consists of other ethnicities. In the second estimation using interaction term, we also categorized the samples into majority and minority, but we classified Chinese into majority group due to their significant role in the economy. In the third estimation, we divided the samples into three groups based on their rooted island. Hence, the classifications were Sumatra-rooted, Java-rooted, and others.

This study adopts a basic Mincer earning model as in equation (2) rather than more complicated models, such as the control function method or matching method that required an excluded instrument for each treatment or plausibility of such identifying conditional independence, for several reasons. Firstly, this research used the Indonesia Family Life Survey, and the chosen variables should be available in the database. Secondly, an advanced wage determination equation that involves more control variables may not apply to all ethnic groups. Finally, the main focus of the study is to compare the return to education among the ethnics and clarifying the effect of IV variables on income.

Intergenerational transmission refers to the propagation of disparities in competence between generations. The abilities of the following generation are determined by parental contributions and the structure of the ethnic community in which parents engage, commonly referred to as "ethnic capital." The empirical research demonstrates that the skills of the current generation are influenced not only by the skills of their parents, but also by the average skills of the ethnic group in the generation of their parents (Borjas, 1992). The relationship between parental and child skills exists because parents invest in their children's human capital. People who grow up in high-quality ethnic environments are more likely to be exposed to social, cultural, and economic forces that enhance their productivity as adults; the greater or more frequent this exposure, the higher the quality of the ensuing workforce. The production function assumes the ethnic group's average human resource has an external effect on the production process. Consequently, the quality of the student is dictated not just by parental inputs, but also by the average quality of the ethnic community in which the individual grows up.

Regarding the intergenerational transmission of education through parental capital and ethnic capital, there are two main equations. The first equation is from Borjas (1992) as below:

$$k_{t+1} = \beta_0 (s_t k_t)^{\beta 1} \bar{k}_t^{\beta 2} \quad (4)$$

This production function represents the relation between children's human capital (kt+1), parental capital (kt), and ethnic capital ($k\bar{t}$). In this equation, parental capital is the average of parents' education years, and ethnic capital is the average of ethnic's

education years in the parent generation. The second equation is from Postepska (2019) as below:

$$edu_i = \gamma_1 edup_i + \gamma_2 eduav_i + \delta_0 X_i + u_i \qquad (5)$$

Where edu, edup, and eduav are the education level, the average of parents' education, and the average ethnic's education level.

Based on those above equations, in this study we followed the definition of parent capital and ethnic capital as in Postepska (2019). Thus, parent capital is the average of parents' education years and ethnic capital is the average of ethnic's education years.

Our study employed two methodologies to assess parental capital and ethnic role in Indonesia's return on education, taking into account the methods used to measure the return on education in previous research. First, to demonstrate that parental capital and ethnic capital influence wages through their effect on education, we utilized two instrumental variables of parental and ethnic capitals in the model estimate to test the hypothesis. Secondly, using the instrumental variable parental capital and the grouping variable ethnic, we demonstrated that the returns to education vary by ethnic group.

The research used the Indonesia Family Life Survey 5 (IFLS5). The IFLS5 was conducted between the end of October 2014 and the end of April 2015, with long-distance monitoring extending to August 2015. This survey was a joint project of RAND and Survey Meter and sponsored by the National Institute for Aging (NIA), the National Institute for Child Health and Welfare (NICHD), the Department of Foreign Affairs and Trade (DFAT) of Australia, and grants from the World Bank, Government of Indonesia, and GRM International. The IFLS dataset is suitable for this study since it is the only survey in Indonesia that collects information relating to community variables such as ethnicity. In addition, unlike other Indonesia's household surveys, IFLS5 covers the information about the parents of the household members that live even in different locations from the target household members. Therefore, this study incorporated the variable of parents' education level as an instrumental variable. Due to the minimum age limit for work and the type of education covered, this study only utilized 22,242 observations.

The null hypothesis that all group means are equal was rejected by our one-way Analysis of Variance (ANOVA) test. In addition, our multiple-comparison test indicated that the Chinese group had a much greater mean income than all other groups. The mean earnings of Bataknese and Minangnese differed from those of the other categories. This analysis revealed that there were substantial differences in income between ethnic groups.

The Missing Data

In many surveys, missing observations or incomplete data cannot be avoided. In spite of the fact that the IFLS5 dataset contains all variables necessary for studying the relevant determinants of the return to education, the absence of observations is one of the key limitations that cannot be avoided throughout the survey procedure. If the number of missing observations is negligible, they may be excluded from the analysis. In the absence of the correct treatment, sample bias is derived from the estimation. In IFLS5, over half of the income variable's observation units are missing.

Rubin (1976) classified missing data patterns into three categories: (a) Missing completely at random (MCAR), (b) Missing at random (MAR), and (c) Missing not at random (MNAR). The MCAR pattern indicates that the probability of being missing is the same for all cases and that causes of the missing data are unrelated to the observed data. The MAR pattern indicates that the probability of missing is the same only within groups defined by the observed data. A systematic relationship exists between the missing data in one variable and the observed data in other variables. If neither MCAR nor MAR holds, we have the MNAR pattern of a systematic relationship between the missing data in one variable and the missing data in other variables. The treatment for the missing observations varies by pattern. If the missing pattern follows MCAR, we can simply delete the non-missing variables with corresponding missing observations. If the pattern follows MAR, the imputation must handle the statistical bias (Takahashi & Ito, 2012).

Following the treatment rule, we applied Little's MCAR test to test the missing observation pattern empirically. Our MCAR test rejected the null hypothesis that the missing observations occur completely at random. In other words, our dataset followed the pattern of either MAR or MNAR. Assuming that our dataset follows the MAR pattern, the truncated regression-based single imputation approach with the bootstrap method was employed because the mean estimates from this method produce unbiased estimated parameters (Enders, 2010). Its steps were

as follows: (1) Estimate the relationship between observed values and missing values, using truncated regression, (2) Predict missing values with bootstrapping techniques 20 times, and (3) Calculate mean values of the predicted values in step 2. Finally, we created the dataset with the sample size (n = 22,242).

Table 1. Little's MCAR Test

Test	Chi-square distance	Degrees of freedom	Sig. level
Little's MCAR test	1,531.567	1	0.000
Number of observations		22,242	
Number of missing data		11,136	

RESULT AND DISCUSSION

Descriptive Statistics

Table 2 presents a description of the 22,242 Indonesian respondents from the IFLS wave 5. They were made up of 44.9% Javanese, 11.1% Sundanese, 4.9% Minangnese, 4.8% Bataknese, 0.5% Chinese, and 33.8% other ethnicities. The sample consisted of slightly more men than women, and almost a third quarter of them was married at the time of the survey. These conditions were in almost all ethnicities, except for the Chinese group in which only 62.75% of the sample were married.

Some groups, such as the Chinese, Minangnese, and Batak, had a considerably greater level of education than others. The oldest sample's age was approximately ninety years old, and the distribution of ages among ethnicities was comparable. The Chinese, the Minangnese, and the Batak had a relatively greater income than other ethnic groups. This pattern paralleled the educational years. The following specific descriptive statistics for each variable are presented in Table 2.

Since income is the primary subject of this study, it is vital to explain the pattern of income among ethnicities. Using an estimate of Kernel density, Figure 1 displays the distribution of income in each group. The Chinese group had the highest average income and the smallest income disparity compared to other groups. This phenomenon is conceivable due to the fact that the majority of Chinese resided in urban. This result sheds light on our core research question. In addition, the descriptive income figure demonstrates that the minimum income of Chinese ethnicity was more than the median income of the entire population.

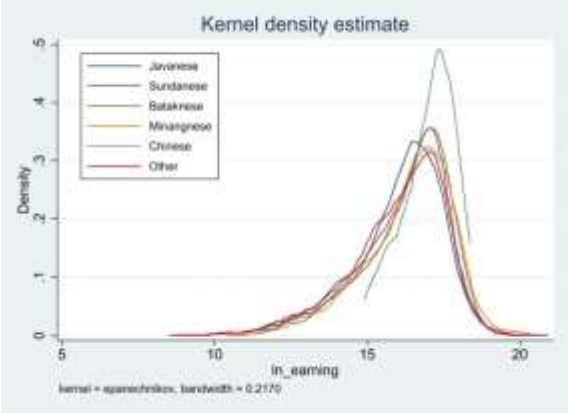

Figure 1. Income distribution by ethnic group

Table 2. Descriptive Statistics

Variable	Statistics	All	Java	Sundanese	Bataknese	Minang-nese	Chinese	Other
earning	Observation	11,106	5,161	1,387	410	581	48	3,519
(million rupiah)	Mean	21.100	20.100	22.100	22.800	28.000	31.900	20.800
	Median	12.000	12.000	14.000	16.900	15.600	30.000	12.000
	Std. Dev.	32.400	31.900	35.300	22.300	46.400	21.400	29.900
	Min	0.005	0.008	0.005	0.100	0.020	3.000	0.006
	Max	1000.00	1000.00	910.00	140.00	673.00	93.60	888.00
educ years	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
(education years)	Mean	8.627	8.566	8.53	9.915	10.049	11.441	8.31
	Median	9	9	9	12	12	12	9
	Std. Dev.	4.735	4.585	4.337	4.4	4.708	4.311	5.025
	Min	0	0	0	0	0	0	0
	Max	22	22	20	18	20	16	22
parent_cap	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
(parental capital)	Mean	3.176	3.06	3.88	4.485	4.226	3.353	2.757
	Median	2	2	3	4	3	0.75	0.500
	Std. Dev.	3.744	3.633	3.745	4.203	4.177	4.131	3.645

Variable	Statistics	All	Java	Sundanese	Bataknese	Minang-nese	Chinese	Other
	Min	0	0	0	0	0	0	0
	Max	18.5	17	16.5	16	17	16	18.5
ethnic_cap (ethnic capital)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Observation	22242	9985	2472	1074	1090	102	7519
	Mean	9.985	10.04	9.599	10.735	11.677	11.330	9.67
	Median	10.040	10.040	9.599	10.735	11.677	11.330	9.701
	Std. Dev.	0.658	0	0	0	0	0	0.78
	Min	7.479	10.04	9.599	10.735	11.677	11.330	7.479
	Max	20.45	10.04	9.599	10.735	11.677	11.330	20.45
residential (location dummy variable, 1 if individual lived in Java; 0 otherwise)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Proportion (%) if dummy=1	53.8	79.9	91.6	5.5	6.1	36.3	20.8
Age	Observation	22,236	9,984	2,472	1,073	1,090	102	7,515
	Mean	38.545	39.475	38.667	37.58	37.052	39.029	37.617
	Median	36	37	37	35	35	36	35
	Std. Dev.	13.756	13.969	13.805	13.682	12.594	14.697	13.527
	Min	15	15	15	15	15	15	15
	Max	99	93	91	84	99	73	92
Marital status (marital status dummy variable, 1 if individual was married; 0 otherwise)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Proportion (%) if dummy=1	76.66	77.79	77.95	71.14	73.85	62.75	76.11
Gender (gender dummy variable, 1 if individual was male; 0 otherwise)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Proportion (%) if dummy=1	57.1	57	58.9	53.4	56.3	63.7	57.1
Public (public sector dummy variable, 1 if individual worked in public government sector; 0 otherwise)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Proportion (%) if dummy=1	6.8	4.9	5.2	8.7	12.7	1	8.8
Private (private sector dummy variable, 1 if individual worked in private sector; 0 otherwise)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Proportion (%) if dummy=1	34.2	37	40.3	22.5	31.6	47.1	30.5
urban1 (location dummy variable, 1 if individual lived in urban area; 2 otherwise)	Observation	22,242	9,985	2,472	1,074	1,090	102	7,519
	Proportion (%) if dummy=1	57.3	57.6	69.3	42.6	70.4	99	52.5

Ethnic Capital and Parental Capital

The regression results of Equation (2) for original and imputed data are presented in Table 3. For each of these two datasets, both OLS and IV estimations are provided. The IV model includes ethnic capital and parental capital as instrument variables.

Using OLS estimation, both original and imputed data regression findings indicated that the returns to education are significant. In each of these datasets, the rates of return to education are roughly eight percent. In contrast to OLS estimation findings, IV estimation results are extremely diverse. Although the return to education and the effect of other variables

were still statistically significant in both datasets, the amount of the return to education varied. In the actual data, an additional year of education raised income by 18.5%. However, in the imputed data, the return on education was only 13.6%. This result is consistent with previous studies, such as Comola & de Mello (2010), Dumauli (2015), Magdalyn (2013), Patrinos, Ridao-Cano, & Sakellariou (2006), Purnastuti, Miller, & Salim (2013), and Purnastuti, Salim, & Joarder (2015), which found that the return to education in Indonesia is about 5% - 17.3% depending on the research method. When comparing the OLS estimation to the IV estimation in both the observed and imputed datasets, the OLS estimation tended to be conservative.

The IV-estimated return to education was unbiased and consistent estimators. In addition, the results of the Durbin Wu Hausman Test, the Sargan Test, and the Weak Instrument Test verified its validity. The Durbin Wu Hausman Test is a test to assess whether the expected endogenous independent variable is endogenous or not. This test's null hypothesis was that the assumed endogenous independent variable is actually exogenous. In columns 3 and 4 of Table 3, Durbin Wu Hausman Test p-values are less than the 0.01 significance threshold. Therefore, it suggests that the variable education is an endogenous independent variable. In addition, the Sargan test investigates whether or not the chosen instrument variables are exogenous. The p-values of the Sargan test were greater than 5% in this study. The test result therefore did not reject the null hypothesis of exogenous instrumental factors. This result suggests that when used as instruments, ethnic capital and parental capital are unrelated to the error term. The weak test, on the other hand, which assesses the conformity of instrument variables and endogenous independent variable, rejected the null hypothesis that instrument variables are weak instruments. Consequently, it suggests that ethnic capital and parental capital are not weak instruments. Therefore, since education is an endogenous independent variable and parental capital and ethnic capital are exogenous and not weak instrument variables, the IV estimation method is preferable for estimating the return on education.

Table 1. OLS and IV Regression Using Original and Imputed Data

VARIABLES	OLS original (1)	OLS imputed (2)	IV original# (3)	IV imputed# (4)
educ_years	0.079***	0.084***	0.185***	0.136***
	(0.003)	(0.002)	(0.011)	(0.005)
age	0.104***	0.0388***	0.0861***	0.0364***
	(0.006)	(0.002)	(0.008)	(0.003)
age2	-0.001***	-0.0003***	-0.0008***	-0.0002***
	(7.56e-05)	(2.82e-05)	(9.76e-05)	(2.91e-05)
married	0.204***	0.345***	0.213***	0.326***
	(0.032)	(0.016)	(0.035)	(0.018)
male	0.586***	0.591***	0.595***	0.579***
	(0.024)	(0.012)	(0.027)	(0.013)
Public_Gov	1.333***	1.332***	0.615***	1.024***
	(0.047)	(0.027)	(0.086)	(0.044)
Private_Sector	0.916***	0.924***	0.677***	0.855***
	(0.032)	(0.014)	(0.045)	(0.018)
urban1	-0.350***	-0.343***	-0.209***	-0.253***
	(0.026)	(0.013)	(0.032)	(0.016)
Constant	12.36***	13.34***	11.52***	12.76***
	(0.120)	(0.056)	(0.167)	(0.085)
Observations	11,101	22,242	11,101	22,242
R-squared	0.299	0.477	0.226	0.450
p-value of Sargan Test	-	-	0.892	0.511
p-value of Durbin Test	-	-	0.000	0.000
p-value of Weak Test	-	-	0.000	0.000

Robust standard errors in parentheses
***, **, and * denote significant level at 0.01, 0.05 and 0.1
ethnic capital and parental capital as the instrument variables

The correlation between the instrument variable(s) and the endogenous independent variable must be somewhat strong. Even if ethnic capital and parental capital passed the weak instrument test, the association between these factors and the education variable must be examined.

Table 2. Correlation Between Education, Ethnic Capital, and Parental Capital

Variables	(1)	(2)	(3)
(1) education	1.000		
(2) ethnic capital	0.095	1.000	
(3) parent capital	0.411	0.088	1.000

The association between ethnic capital and education was weaker than the correlation between parental capital and education, as seen in Table 4. Consequently, we analyzed the returns of education on individual incomes by ethnic group, using parental capital as an instrumental variable.

Parental Capital on Return to Education Model by Ethnicity

Since the link between ethnic capital and educational attainment was rather weak, this study employed ethnicity as a grouping variable to analyze the return to education across Indonesia's many ethnic groups. The estimation of return to education is provided in Table 5 for all samples and six ethnic groups in Indonesia.

It is evident that the Chinese group had a distinct pattern than other groups. Only the Chinese group demonstrated an insignificant connection between parental education and educational attainment. Based on the p-value of the Durbin test, the educational attainment of the Chinese population was an exogenous independent variable. Also, the F-statistics value demonstrated that parent capital was a weak instrument variable in the case of the Chinese group. It implies that parental education has no effect on educational attainment.

In contrast, in other groups, educational attainment was an endogenous independent variable whose value is impacted by parental education. Different estimations of the return on education were made for each of these categories due to their diverse educational characteristics. In estimating the return on education for the Chinese group, OLS estimation was preferrable than IV estimation, in contrary to other groups.

The rate of return to education for the Chinese group was 0.076. It suggests that every additional year of school improves income by around 7.6%. In the Chinese group, we did not establish a causal association between parental education and their children's earnings via the equivalent schooling. As a result, the return to education in this group cannot be compared to the return to education in other groups due to the different estimating methodologies used.

The return on education for five additional categories, however, may be estimated using IV estimation. Education is an endogenous independent variable, and parental education is an appropriate instrument variable for describing educational attainment. Bataknese earned the highest return on schooling among these communities. Each additional year of schooling raised Bataknese's earnings by 17.3 percent. The Bataknese are considered to be competitive, especially when it comes to their children's accomplishments. They believe that they can reach three main achievements in their life, which are known as *hamoraon* (wealth), *hagabeon* (having descendants), and *hasangapon* (honor), through education. They also believe in an old Bataknese proverb, "*Anakhonki do hamoraon in ahu*," which implies that children are the treasure of parents, highlighting how valuable the children of the Batak family are (Situmorang, 2017; Valentina & Martani, 2018). The second highest return to education was Minangnese, in which for an additional year of education, the income increased by 15.1 percent. Like Bataknese, Minangnese is also known for persistence and ingeniousness in their effort to escalate their economic status through education (Navis, 1984; Sutantoputri, Murniati, & Purwanti, 2015). The returns to education in the rest ethnicities were 14.1 percent, 13.9 percent, and 12.9% for Sundanese, Javanese, and other ethnicities, respectively.

Table 5 also provides statistics about non-educational factors that influence wages. Chinese ethnicity, which utilizes different estimating techniques, has different income determinants. According to OLS estimates, only education and employment that considerably impacted income.

Table 5. Return to Education by Ethnicity Using OLS and IV Estimation

	All		Other		Javanese		Sundanese		Bataknese		Minangnese		Chinese	
VARIABLES	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
educ_years	0.084***	0.137***	0.078***	0.129***	0.087***	0.139***	0.098***	0.141***	0.080***	0.173***	0.068***	0.151***	0.077***	-0.360
	(0.002)	(0.005)	(0.002)	(0.009)	(0.002)	(0.008)	(0.005)	(0.017)	(0.006)	(0.029)	(0.007)	(0.033)	(0.017)	(0.828)
mi_age	0.039***	0.036***	0.048***	0.044***	0.032***	0.031***	0.023***	0.021***	0.051***	0.039***	0.055***	0.055***	0.033	0.197
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)	(0.008)	(0.011)	(0.012)	(0.012)	(0.013)	(0.032)	(0.322)
mi_age2	-0.0003***	-0.0002***	-0.0004***	-0.0003***	-0.0002***	-0.0002***	-0.00016*	-9.95e-05	-0.0004***	-0.0002	-0.0005***	-0.0004***	-0.0003	-0.0028
	(2.82e-05)	(3.04e-05)	(4.94e-05)	(5.36e-05)	(4.07e-05)	(4.33e-05)	(9.06e-05)	(9.45e-05)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0004)	(0.0049)
married	0.345***	0.325***	0.335***	0.326***	0.348***	0.322***	0.340***	0.316***	0.356***	0.314***	0.425***	0.345***	0.064	-0.085
	(0.0165)	(0.017)	(0.028)	(0.029)	(0.025)	(0.026)	(0.054)	(0.055)	(0.064)	(0.072)	(0.077)	(0.087)	(0.159)	(0.508)
male	0.591***	0.579***	0.614***	0.589***	0.593***	0.578***	0.578***	0.575***	0.545***	0.634***	0.528***	0.570***	0.169	-0.174
	(0.012)	(0.013)	(0.022)	(0.022)	(0.018)	(0.019)	(0.041)	(0.041)	(0.048)	(0.059)	(0.059)	(0.065)	(0.135)	(0.743)
Public_Gov	1.332***	1.017***	1.189***	0.868***	1.450***	1.151***	1.348***	1.071***	1.536***	1.116***	1.506***	1.075***	2.441***	3.977
	(0.027)	(0.040)	(0.042)	(0.067)	(0.045)	(0.063)	(0.098)	(0.142)	(0.090)	(0.163)	(0.098)	(0.195)	(0.663)	(3.400)
Private_Sector	0.924***	0.853***	0.873***	0.792***	0.904***	0.844***	1.027***	0.964***	1.008***	0.873***	1.036***	0.921***	1.360***	1.652**
	(0.014)	(0.016)	(0.025)	(0.029)	(0.021)	(0.023)	(0.046)	(0.052)	(0.062)	(0.080)	(0.067)	(0.084)	(0.149)	(0.680)
urban1	-0.343***	-0.251***	-0.391***	-0.312***	-0.301***	-0.202***	-0.326***	-0.240***	-0.298***	-0.181***	-0.315***	-0.245***	-0.164	-1.084
	(0.013)	(0.016)	(0.022)	(0.026)	(0.019)	(0.025)	(0.046)	(0.056)	(0.050)	(0.066)	(0.064)	(0.073)	(0.656)	(2.464)
Constant	13.34***	12.75***	13.26***	12.73***	13.40***	12.78***	13.57***	13.11***	13.06***	12.10***	13.15***	12.22***	13.94***	18.00**
	(0.056)	(0.079)	(0.094)	(0.128)	(0.084)	(0.125)	(0.182)	(0.252)	(0.221)	(0.382)	(0.259)	(0.450)	(0.911)	(8.061)
Observations	22,242	22,242	7,519	7,519	9,985	9,985	2,472	2,472	1,074	1,074	1,090	1,090	102	102
R-squared	0.477		0.482		0.471		0.460		0.575		0.460		0.617	
F-stat of weak identification		1124.6		724.899		1065.220		292.436		57.387		56.646		0.292
p-value of Durbin test		0.0000		0.0000		0.0000		0.006		0.000		0.005		0.142
Preferred				Yes		Yes		Yes		Yes		Yes	Yes	

Standard errors in parentheses

***, **, and * denote significant level at 0.01, 0.05 and 0.1

In contrast, in five other racial groups, all independent factors had a substantial effect on income when estimated using the IV method. The age and age-squared variables were utilized to analyze the influence of the life cycle on income. The data show that in the Other, Javanese, and Minangkabau groups, wages would first grow and then gradually dropped with age, ceteris paribus. In contrast, the quadratic shape of age variables was not significant in the models of the Sundanese and Bataknese, indicating that in both populations, earnings grow with age. In the remaining five ethnic groups, marital status had a major impact on income. On average, married people earned between 31 and 34% more than unmarried people. This conclusion seems reasonable, given that married individuals often have greater expenditure and more dependents. Therefore, they necessitate a greater salary to meet their daily requirements (Arshad, 2016; Trentini, 2014).

Variables based on gender and residence also indicated the same patterns. In some categories, there were considerable economic disparities between men and women, with males earning a greater salary. According to Arshad (2016), in the family, the male breadwinner works hard to ensure a better living for his dependents. In addition to that, this statistic implies that there is a salary disparity between men and women in Indonesia. The presence of the wage disparity parallels the conclusion of Taniguchi and Tuwo (2014). Perhaps patriarchal society is to blame for this chasm. In the Chinese group, there was no difference in income between men and women. In addition, the Chinese group demonstrated that there was no major economic gap between urban and rural residents. Nonetheless, some studies indicated that urban residents have a greater income than rural residents. The average salaries of urban employees were 18-31% higher than those of rural workers. This conclusion is comparable to that observed by Arshad (2016), who discovered that the income disparity between rural and urban regions is around 20%. Occupation factors were the only variables that demonstrated similarities between Chinese and other ethnicities. All categories indicated that government and private sector employees earned more than informal sector employees. Regardless of the unique findings of the Chinese group in relation to equation models, we must take these results with caution due to the small sample size of the Chinese group in comparison to other groups.

To ensure the effect of ethnicity on return to education, this study also used interaction term on all samples (Table 6).

Table 6. Return to Education with Interaction Term

Variables	(1)[+]	(2)[++]	(3)[#]
educ_years	0.160***	0.160***	0.358***
	(0.00718)	(0.00716)	(0.0310)
age	0.0351***	0.0352***	0.0373***
	(0.00260)	(0.00260)	(0.00285)
age2	-0.000194***	-0.000196***	-0.000246***
	(3.09e-05)	(3.08e-05)	(3.26e-05)
married	0.325***	0.324***	0.322***
	(0.0171)	(0.0171)	(0.0189)
male	0.587***	0.586***	0.614***
	(0.0128)	(0.0128)	(0.0144)
Public_Gov	1.070***	1.068***	0.976***
	(0.0383)	(0.0382)	(0.0509)
Private_Sector	0.859***	0.860***	0.854***
	(0.0160)	(0.0160)	(0.0178)
urban1	-0.248***	-0.250***	-0.238***
	(0.0162)	(0.0161)	(0.0184)
eth_minor1	0.601***		
	(0.0565)		
int_minor1	-0.0716***		
	(0.00616)		
eth_minor2		0.597***	
		(0.0563)	
int_eth_minor2		-0.0705***	
		(0.00616)	
Other-island_rooted			2.461***
			(0.286)
Jawa_rooted			2.413***
			(0.284)
int_jawa			-0.255***
			(0.0295)
int_oth_isl			-0.272***
			(0.0296)
Constant	12.56***	12.56***	10.64***
	(0.0935)	(0.0932)	(0.318)
Observations	22,242	22,242	22,242
R-squared	0.443	0.443	0.326

[+] eth_minor1 is a dummy variable for minority group, 1 if minority, 0 otherwise. Chinese is excluded from a minority group.
[++] eth_minor2 is a dummy variable for minority group, 1 if minority, 0 otherwise. Chinese is included as a minority group.
[#] The samples are grouped into three groups based on their rooted island. Sumatra-rooted ethnicity is the base of the comparison.
Variable with "int_" means interaction variable between groups and education years.
Standard errors in parentheses
***, **, and * denote significant level at 0.01, 0.05 and 0.1

This finding demonstrated that the return to education varied dramatically between ethnic groups. Assuming that all other factors stayed unchanged, based on the results in columns (1) and (2), minority ethnic groups earned approximately 7% less return on schooling than the majority group. This conclusion is consistent with Trentini's (2014) study in Bulgaria that

minorities earned a lower return to education than the majority.

We also estimated using ethnicity by island of origin, as shown in column 3 of Table 6. Results indicate that ethnic groups with roots on Sumatra Island earn a greater return on schooling than those with roots on Java Island and other islands. This conclusion is consistent with Table 5 in which Bataknese and Minangnese, who rooted in Sumatra Island, obtained greater return to education compared to others. Additionally, ethnicities with origins on other islands earned the lowest return to education.

In Indonesia, the results may also be impacted by the location of minority ethnic groups, the majority of whom reside in Eastern Indonesia, where the average income is often lower than in Western Indonesia. However, further research on return to school, race, and geography should be undertaken properly to bolster this argument.

Research Implication

These findings propose a number of policy suggestions. First, the cultural aspect is crucial to the education process in order to get a greater return on investment in education. In addition to transfer of knowledge, educational process also involves transmission of culture. Through cultural socialization, the government may employ the cultural heritage strategy to increase educational attainment. Since the return on education varies significantly among ethnicities, culture distinguishes the income of the people. Therefore, ethnic-cultural factors should be included in the formation of the national curriculum, not merely the local curriculum. It will increase people's awareness and capacity to absorb the positive cultures of diverse ethnic groups, particularly among the younger generation. Khamsini (2010) made a similar proposal, stating that community mobilization programs can improve their socioeconomic condition and eradicate harmful customs prior to achieving considerable increase in educational attainment.

Second, sustained education is required since parental wealth corresponds substantially with educational attainment. The cultural riches that children receive from their parents is often strongly tied to their ethnicity's culture. The children's cultural capital is subsequently converted into academic credentials. In industrialized economies, educational qualifications play a crucial role in the reproduction of society. Consequently, investments in current education have an effect not only on the current generation but also the future ones. Government involvement is required to interrupt the vicious cycle of poor education among low-class families, given that not all children live in privileged households. Creating an inclusive environment for less affluent persons in the process of accumulating human capital can have a significant impact on social mobility over the long run (Azomahou, 2016).

Third, education and employment policies must be integrated. Therefore, beginning in the classroom, integration initiatives should strive to improve the employability and skill sets of vulnerable groups (Trentini, 2014). To reduce racial prejudice and enhance the education and skills of children and teenagers in order to increase their employability, integration of public education and a substantial improvement in its quality are necessary. The public education providing strategy will also be effective, particularly in low-income areas. Public financing to reduce the opportunity cost of education will boost the chances for students from disadvantaged origins to catch up to their more privileged peers (Pohan & Vitale, 2016).

Moreover, policy debates need not be restricted to narrow ethnically-focused schooling subjects related to regional issues. Additionally, gender segregation, career opportunities, and urban-rural development must be emphasized since they have direct effects on incomes. Gender segregation, for instance, is a significant issue. The findings of this study indicate that the gender factor continues to distinguish the return to education across nearly all ethnic groups. In Indonesia, male obtains a greater return to education than female. Despite the nation's rapid industrialization and the significant progress women have achieved in the job and in school, a convergence of social, religious, and cultural norms still limits women to their house (Sohn, 2013). Nevertheless, it is crucial to define the target group of women more specifically, as the extent of prejudice may vary among industries and job types. Targeting the populations who face a substantial gender wage disparity due to discrimination may be a policy focus.

A further factor to take into account is the occupational prospect. According to this study, the different types of jobs significantly affect how much education pays off. A minimum wage policy that takes into account specific local circumstances is crucial to

reducing the discrepancy between the industries (Fajnzylber, 2001). Although there are disagreements about this policy in a number of developing nations, as in Bird & Manning (2008) and Chun & Khor (2010), minimum wage policy appears to suggest that slightly raising the minimum wage could be just as effective as raising monthly salaries as a whole in terms of raising wages at the bottom of the wage distribution.

The mismatch in educational outcomes caused by differences in geography (urban-rural group) is a challenge, particularly in a developing and archipelagic nation like Indonesia. In comparison to people who live in rural areas, those who reside in urban areas typically get a larger return on their educational investment. Regarding this matter, the policy suggestions concern spending on planned urbanization, infrastructure development, and spending on the educational systems in rural areas (Su & Heshmati, 2013). Indonesia's economy relies mainly on the agriculture sector. Family farms on a small scale are regularly affected by natural disasters. The government should provide more financial and technical support in order to boost the productivity and crop diversity of family farms and to expand the number of agro-processing businesses in towns and villages. Additionally, as non-agricultural industries often have greater incomes than the agricultural sector, additional non-farm work options should be made available to persons with low income levels. Finally, the rural educational system must be transformed in order to give rural kids the same opportunities as urban students. Raising the standard of rural schools to meet that of urban schools is necessary. Thus, it is possible to close the gap in return to education in the whole Indonesian archipelago.

CONCLUSION AND SUGGESTION

This study compares the returns to education among ethnic groups in Indonesia and examines at how parental education and ethnicity affect income through educational attainment. Estimations of instrumental variables and ordinary least squares were used to gauge how much education affects income.

According to the research, Bataknese and Minangnese has the highest returns on education among the six ethnic groups. This is due to the culture of the Bataknese and Minangnese people, who hold the conviction that their children's education will help them fulfill their primary life goals. As a result, the children are encouraged to pursue better and higher education, even if they must relocate to other cities or nations. This study also discovered that the Chinese group differs from other groups in terms of its characteristics. OLS estimation was therefore a better method for estimating the return to school in the Chinese group. It implies that parental education has no bearing on the education of their kids. For the other groups, it is preferable to estimate the return to schooling using IV estimation. Additionally, this study discovered that nearly all Indonesian ethnic groups' salaries are highly impacted by gender, occupational options, and urban/rural location.

There are some drawbacks to this study. Evaluation of the influence of parental education and ethnicity on return to education and comparison of return to education by ethnicity are the primary objectives of this paper. However, additional characteristics, such as skill and experience, are not included. Consequently, the anticipated return to education may continue to be skewed. In addition, this study utilizes only cross-sectional data, as opposed to panel data, which may provide additional light on the impact of intergenerational transmission in return to education. Also, years of schooling are used less frequently than education level. This variable's bias is greater than that of the education level variable.

REFERENCES

Akresh, R., Halim, D., & Kleemans, M. (2018). Long-term and intergenerational effects of education: Evidence from school construction in Indonesia. In NBER working paper. Retrieved from https://www.nber.org/system/files/working_papers/w25265/w25265.pdf

Arshad, M. N. B. M. (2016). Return to education by ethnicity: A case of Malaysia. International Journal of Economics and Management, 10(1), 141–154.

Azomahou, T. T., & Yitbarek, E. A. (2016). Intergenerational education mobility in Africa: Has progress been inclusive? World Bank Policy Research Working Paper, (7843). https://doi.org/10.1596/1813-9450-7843

Badan Pusat Statistik. (2018). Indeks Pembangunan Manusia 2018 (2018 Human Development Index). Badan Pusat Statistik, Jakarta (Vol. 1).

Barrow, L., & Rouse, C. E. (2006). The Economic value of education by race and ethnicity. Economic Perspectives, 20, 14.

Becker, G. S., & Chiswick, B. R. (1966). Education and the distribution of earnings. The American Economic Review, 56(1), 358–369.

Bird, K., & Manning, C. (2008). "Minimum wages and poverty in a developing country: simulations from Indonesia's household survey." World Development, 36(5):916–33.

Borjas, G. J. (1992). Ethnic capital and intergenerational mobility. Quarterly Journal Of Economics, 107(1), 123–150.

Card, D. (2001). Estimating the return to schooling: Progress on some persistent econometric problems. Econometrica, 69(5), 1127–1160. https://doi.org/10.1111/1468-0262.00237

Carneiro, P. M., & Heckman, J. J. (2003). Human capital policy. MIT Press, 2003

Chua, V., & Ng, I. Y. H. (2015). Unequal returns to social capital : The study of Malays in Singapore through a network lens. Asian Ethnicity, 16(4), 480–497. https://doi.org/10.1080/14631369.2015.1004874

Chun, N., & Khor, N. (2010). Minimum wages and changing wage inequality in Indonesia. Asian Development Bank Economics Working Paper Series, (196).

Comola, M., & de Mello, L. (2010). Educational attainment and selection into the labour market: The determinants of employment and earnings in Indonesia. 33(0). Retrieved from http://econpapers.repec.org/RePEc:hal:psewpa:halshs-00564835

Damm, A. P. (2009). Ethnic enclaves and immigrant labor market outcomes: Quasi-experimental evidence. Journal of Labor Economics, 27(2), 281–314. https://doi.org/10.1086/599336

Dickson, M. (2013). The Causal effect of education on wages revisited. Oxford Bulletin of Economics and Statistics, 75, 477–498. https://doi.org/10.1111/j.1468-0084.2012.00708.x

Dumauli, M. T. (2015). Estimate of the private return on education in Indonesia: Evidence from sibling data. International Journal of Educational Development, 42, 14–24. https://doi.org/10.1016/j.ijedudev.2015.02.012

Enders, C. K. (2010). Applied Missing Data Analysis. Guilford press.

Fajnzylber, P. R. (2001). Minimum wage effects throughout the wage distribution: evidence from Brazil's formal and informal sectors. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.269622

Fossen, F. M., & Büttner, T. J. M. (2013). The returns to education for opportunity entrepreneurs, necessity entrepreneurs, and paid employees. Economics of Education Review, 37, 66–84. https://doi.org/10.1016/j.econedurev.2013.08.005

Gong, B. (2019). Like father like son? Revisiting the role of parental education in estimating returns to education in China. Review of Development Economics, 23(1), 275–292. https://doi.org/10.1111/rode.12538

Hendajany, N., Widodo, T., & Sulistyaningrum, E. (2016). The Trend of the returns to educations in Indonesia. Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi Dan Pembangunan, 17(1), 62. https://doi.org/10.23917/jep.v17i1.1595

Hoogerheide, L., Block, J. H., & Thurik, R. (2012). Family background variables as instruments for education in income regressions: A Bayesian analysis. Economics of Education Review, 31(5), 515–523. https://doi.org/10.1016/j.econedurev.2012.03.001

Khamsini, S. J. (2010). Socio-economic factors influencing primary school education attainment in Kisarawe district (Doctoral dissertation, Sokoine University of Agriculture).

Krueger, A. B. (2003). Inequality, too much of a good thing. Inequality in America. Cambridge: MIT Press.

Lemke, R. J., & Rischall, I. C. (2003). Skill, parental income, and IV estimation of the returns to schooling. Applied Economics Letters, 10(5), 281–286. https://doi.org/10.1080/1350485032000078653

Magdalyn, A. (2013). The Rate of Returns to Education : The Case of Indonesia. International Institute of Social Studies, (August).

Mincer, J. (1974). Schooling, Experience, and Earnings. Human Behavior & Social Institutions No. 2. Retrieved from https://eric.ed.gov/?id=ED103621

Mugijayani, W. (2020). Return to Education and Education Mismatch in Indonesia (Cardiff University). Retrieved from http://orca.cf.ac.uk/131497/

Navis, A. A. (1984). Alam Terkembang Jadi Guru: Adat dan Kebudayaan Minangkabau (Nature Develops as A Teacher: Customs and Culture of Minangkabau. Grafiti Pers.

Patrinos, H. A., Ridao-Cano, C., & Sakellariou, C. (2006). Estimating the returns to education: accounting for heterogeneity in ability. The World Bank. Policy Research Working Paper, 1–38.

Pohan, H. L. M., & Vitale, J. D. (2016). Overcoming the poverty trap through education: An intergenerational study on Indonesia. Journal of Indonesian Applied Economics, 6(1), 1–21. https://doi.org/10.21776/ub.jiae.2016.006.01.1.

Postepska, A. (2019). Ethnic capital and intergenerational transmission of educational attainment. Journal of Applied Econometrics, 34(4), 606–611. https://doi.org/10.1002/jae.2682

Purnastuti, L. (2013). Instrumenting education and returns to schooling in Indonesia. Jurnal Economia, 9(2), 166–174. https://doi.org/10.21831/economia.v9i2.1807

Purnastuti, L., Miller, P. W., & Salim, R. (2013). Declining rates of return to education: Evidence for Indonesia. Bulletin of Indonesian Economic Studies, 49(2), 213–236. https://doi.org/10.1080/00074918.2013.809842

Purnastuti, L., Salim, R., & Joarder, M. A. M. (2015). The returns to education in Indonesia: Post reform estimates. The Journal of Developing Areas, 49(3), 183–204. https://doi.org/10.1353/jda.2015.0174

Rubin, D. B. (1976). Inference and missing data. Biometrika, 63(3), 581–592. https://doi.org/10.1093/biomet/63.3.581

Shahiri, H., & Park, K. (2018). Ethnic group returns to education during the early post-colonial period in Malaysia. Asian-Pacific Economic Literature, 32(1), 120–130. https://doi.org/10.1111/apel.12222

Situmorang, B. T. (2017). Gengsi Etnis Batak Toba dalam Pendidikan (Toba Batak Ethnic Prestige in Education) (Universitas Sumatera Utara). Retrieved from http://repositori.usu.ac.id/bitstream/handle/123456789/19190/120905067.pdf?sequence=1&isAllowed=y

Sohn, K. (2013). Monetary and nonmonetary returns to education in Indonesia. The Developing Economies, 51(1), 34–59. https://doi.org/10.1111/deve.12001

Sohn, K. (2015). Gender discrimination in earnings in indonesia: A fuller picture. Bulletin of Indonesian Economic Studies, 51(1), 95–121. https://doi.org/10.1080/00074918.2015.1016569

Sturm, R. (1998). Instrumental variable methods for effectiveness research. International Journal of Methods in Psychiatric Research, 7(1), 17–26. https://doi.org/10.1002/mpr.31

Su, B., & Heshmati, A. (2013). Analysis of the determinants of income and income gap between urban and rural China. China Economic Policy Review, 2(01), 1350002.

Sutantoputri, N. W., Murniati, J., & Purwanti, M. (2015). Educational aspiration, attributions, and motivational goals: A comparative study of 5 sub-ethnicities in Indonesia. Asian Journal of Educational Research, 3(2), 76–85.

Takahashi, M., & Ito, T. (2012). Multiple Imputation of Turnover in EDINET Data: Toward the Improvement of Imputation for the Economic Census. In Work Session on Statistical Data Editing, UNECE. Retrieved from http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.44/2012/Presentations/Topic_5__35__Japan.pdf

Taniguchi, K., & Tuwo, A. (2014). New evidence on the gender wage gap in Indonesia. SSRN Electronic Journal, (404). https://doi.org/10.2139/ssrn.2512096

Trentini, C. (2014). Ethnic patterns of returns to education in Bulgaria: Do minorities have an incentive to invest in education? Economics of Transition, 22(1), 105–137. https://doi.org/10.1111/ecot.12035

Valentina, T. D., & Martani, W. (2018). Apakah Hasangapon, Hagabeon, dan Hamoraon sebagai faktor protektif atau faktor risiko perilaku bunuh diri remaja Batak Toba? Sebuah kajian teoritis tentang nilai budaya Batak Toba (Are Hasangapon, Hagabeon, and Hamoraon as Protective Factors or Risk Facto. Buletin Psikologi, 26(1), 1–11. https://doi.org/10.22146/buletinpsikologi.28489

Xue, Q. (2019). Returns to schooling in Indonesia: A household consumption approach. The Seventeenth Annual Carroll Round- An Undergraduate Conference Focusing on Contemporary International Economics Research and Policy, (4), 185–196. Retrieved from https://repository.library.georgetown.edu/bitstream/handle/10822/1054107/14th (2019) Carroll Round Proceedings.pdf?sequence=1#page=198

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Analysis of competitiveness of sugarcane farming: A case study in Kampung Beru Village, South Sulawesi

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ABSTRACT

The sugarcane based sugar industry is a source of income for sugarcane farmers and workers in the industry. However, farmers often complain about the high price and cost of farming, which result in a decrease in the quality of sugarcane. The survival of sugarcane farmers is threatened, including those in Kampung Beru Village as one of the largest suppliers of sugarcane for Takalar Sugar Factory. This study aims to explore the competitiveness of sugarcane farming based on competitive and comparative advantages. Data collection was carried out through interviews and focus group discussion (FGD) involving 76 farmers. Policy analysis matrix (PAM) was utilized for data analysis. The results showed that the private cost ratio (PCR) value, an indicator of competitive advantage, was >1 (1.048), suggesting that sugarcane farming does not have a competitive advantage. Domestic resource cost ratio (DRCR) as an indicator of comparative advantage had a value of >1 (1.795), indicating that sugarcane farming also has no comparative advantage. Sugarcane farming has extremely low competitiveness. Hence, the government is advised to increase sugarcane productivity by conducting campaigns to use superior seeds, increase the efficiency of production facilities, revise purchase price standards, and regulate the marketing system.

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INTRODUCTION

Indonesia is a country with the largest sugarcane area among the Association of Southeast Asian Nations (ASEAN) member countries (Hermawan, 2012). Based on the data from the Central Statistics Agency (BPS) in 2017, the sugarcane area in Indonesia amounted to 420.15 thousand hectares. Sugarcane is therefore one of plantation commodities with a strategic role in the Indonesian economy and must consequently be developed with a high level of excellence and competitiveness. In reality, however, sugarcane is currently not the main commodity chosen by most farmers. They prefer other commodities to cultivate, such as rice, corn, and shallots. This will result in a shrinkage of sugarcane production and productivity, with a big impact on competitiveness (Yunitasari, 2019).

The study by Pratiwi, Wibowo, and Wibowo (2021) in Probolinggo Regency stated that the lack of attention and strict protection from the government such as fertilizer distribution, the existence of the highest retail price (HET) of sugar, and farm business credit affect the competitiveness of sugarcane farming. The aforementioned factors certainly affects

the shrinkage of sugarcane production and productivity (Pratiwi et al., 2021).

Hani and Mustapit (2016) and Sulaiman et al. (2019) identified the main problems of sugar production in Indonesia, including stagnant harvest areas, productivity, sugar factory inefficiency, productivity fluctuations, and the institutional framework for trade policymaking. The problems suggest the inefficient management of sugarcane. Despite having one of the largest harvest areas, sugarcane production has not been maximized. They therefore represent the biggest challenge in the sustainability of sugarcane farming activities, which can be eroded by other commodities that have more profitable opportunity costs (Hani & Mustapit, 2016; Sulaiman et al., 2019).

A commodity can compete in the market if it possesses high competitiveness, which is reflected in competitive price and excellent quality (Danelon et al., 2023). Problems will arise if the commodities are not able to compete. To increase competitive advantage, a region must increase the creation of production factors, work motivation, profits, and business scale, domestic competition, demand quality, as well as efforts in creating new business opportunities. Competitiveness includes broader aspects beyond production or efficiency at the micro level (Bahati et al., 2022). This is supported by the study conducted by Oghazi, Aliyari, and Pashkevich (2022), which stated that in the era of globalization, with competitiveness challenges faced by advanced economies, growth opportunities and job creation strategies depend heavily on the ability to innovate and succeed in the global market. It can therefore be concluded that the competitiveness of a region can be seen from its economic level, which will affect the level of welfare of its population (Hajighasemi et al., 2022).

Freitas et al. (2021) stated that the potential for bagasse management to obtain valuable products in the economic aspect presents an opportunity to increase the attractiveness to produce a commodity with good quality and low cost according to international market prices. Moreover, the commodity can be marketed with sufficient profit so that production or cultivation activities can be continued in the next planting season (Freitas et al., 2021).

The general approach in measuring the competitiveness of a commodity is through the level of profit and efficiency in commodity management (Carrington et al., 2023). The level of profit can be observed from two aspects, namely private profit and social profit (Contreras et al., 2023), while efficiency consists of competitive advantages and comparative advantages. A more modern theory of comparative advantage includes Heckshcher Ohlin's trade pattern theory which emphasizes the inherent differences in factors of production between countries as the most important determinant of trade and that abundant factors of production will indirectly be exported, while scarce factors of production will be imported (Hunt & Morgan, 1995).

A measurement tool that can be used to determine comparative advantages and serve as a comparison between the ratio of exports of an industry (or commodity) in a country to the country's total exports and the ratio of the world export value of the industry to total world exports is the revealed comparative advantage (RCA) (Danna-Buitrago & Stellian, 2022). This is supported by the research by Stellian and Danna-Buitrago (2022) which stated that a country should have a comparative advantage for a particular product if the share of that product in the country's exports is greater than the share at the level of the trade area under consideration. The next RCA index is calculated as the ratio of the former to the latter (Stellian & Danna-Buitrago, 2022).

In addition, to identify competitiveness, policy analysis matrix (PAM) analysis is used to analyze comparative advantages (economic analysis). Economic analysis invariably considers the amount of domestic and foreign inputs used and the level of government intervention in subsidizing and taxing imported products (Kassali et al., 2022). All inputs and government policies must be converted into actual prices so that the divergence effect (the difference between farm income, costs, and profits measured by private and social prices) of the government can be identified for subsequent government policies (Paulraj et al., 2015; Tanjung et al., 2023). The three main objectives of the PAM method include (1) calculating the level of private profit, which is a measure of the competitiveness of farming at the market price level, (2) calculating the level of social profit of farming produced by assessing output and costs at the efficiency price level (social opportunity cost), and (3) calculating the transfer effect as an impact of a policy. Comparing revenues and costs before and after the implementation of a policy will determine the impact of the policy. The PAM method calculates the impact

of a policy that affects output and production factors (Darmayanti et al., 2019).

The comparative advantage indicators are used to determine whether a region has an economic advantage to expand production and trade of a commodity, while competitive advantage indicators identify whether a region will successfully compete in the commodity market. The comparative and competitive advantages of a commodity depend on key factors including market performance (Zhu et al., 2022).

Takalar Regency has the second largest sugarcane area and production (after Bone) in the South Sulawesi (Thamrin, 2022). The Central Statistics Agency of South Sulawesi recorded that Takalar had a sugarcane area of 1018 ha and production of 1470 tons in 2016. The data show that Takalar region has less than 200 ha compared to Bone, even though its production is half that of Bone. This confirms that the inefficiency of sugarcane cultivation and processing in Indonesia is at a critical level.

North Polongbangkeng is a district in Takalar that is home to one of the sugarcane factories in South Sulawesi, while the other two factories are located in Bone. According to the data from BPS Takalar in 2017, Polongbangkeng Utara is the center of sugarcane production in the district with 935 tons and an area of 647.50 hectares. Hence, it is natural that sugarcane is a superior commodity in the area, and one area with superior commodity production is Kampung Beru village (BPS, 2018).

Kampung Beru is one of the villages that produce sugarcane in Takalar and is selected as the case study location to assess the level of sugarcane competitiveness in the area due to its larger number of farmers among several villages and adequate land. However, the data of the area and production of sugarcane at the national, provincial and district levels indicates a low level of sugarcane competitiveness. The inefficiency of sugarcane processing is indicated by small productivity values, resulting in competitive and comparative advantages that do not meet the requirements for high competitiveness.

On the other hand, little research has been conducted on whether or not sugarcane is a competitive commodity. Complementing existing research on sugarcane, this study aims to assess the competitiveness of sugarcane, particularly in South Sulawesi, Indonesia. Therefore, research on the competitiveness of sugarcane farming is needed to prove initial conclusions (based on secondary data analysis). If the initial conclusions are incorrect or the competitiveness is not low, the research results can then be used as a standard for policy-makers to develop sugarcane to be more competitive due to its great potential. Conversely, if the initial conclusions are proven correct, the research results can subsequently be used as a benchmark for sugarcane farmers to shift their lands to other more potential commodities.

RESEARCH METHOD

The research was conducted for a month in July 2019 in Kampung Beru Village, North Polobangkeng District, Takalar Regency. The location was deliberately selected since Takalar is the second largest sugarcane production area in South Sulawesi, the highest sugarcane producing area in the district, and the location of the Takalar Sugarcane Factory.

The population in this study included six farmer groups from Kampung Beru Village with a total of 76 respondents. Purposive sampling technique was used for this study with the criteria of sugarcane farming in partnership with the Takalar Sugarcane Factory. To collect study data, two sources of data were required, namely primary data and secondary data, when needed. Interviews and FGDs were the main data sources as well as information in the form of archives as a complementary data source.

Table 1. Policy Analysis Matrix

Item	Revenue	Cost		Profit
		Tradable Input	Domestic Input	
Private Price	A	B	C	D = A-(B+C)
Social Price	E	F	G	H = E-(F+G)
Divergence	I = A-E	J = B-F	K=C-G	L=I-(J+K)

Source: Monke & Pearson (1989)

A = Total sugarcane farming revenue in private price (Rp), B = Total tradable cost of sugarcane farming in private price (Rp), C = Total domestic cost of sugarcane farming in private price (Rp), D = Private profitability, E = Total revenue in social price (Rp), F = Total tradable cost of sugarcane farming in social price (Rp), G = Total domestic cost of sugarcane farming in social price (Rp), H= Social profitability, I = Output transfer (OT), J = Input Transfer (IT), K = Factor Transfer (TF), L = Net Transfer (NT) (Rp)

Table 2. Descriptions of PAM Indicators

Description		Indicator	Result
Competitive Advantage			
a	Private Profitability	D	D > 0 indicates that the commodity system acquires an above-normal profit, indicating that it is capable of expansion. D ≤ 0 indicates that the commodity system has a below-normal profit, indicating that it is not able to expand.
b	Private Cost Ratio	PCR = C/(A-B)	PCR < 1 indicates that the studied commodity system has a competitive advantage. PCR ≥ 1 indicates that the studied commodity system has no competitive advantage.
Comparative Advantage			
a	Social Profitability	H	H > 0 indicates that the commodity system is efficient in a condition with no divergences and efficient policy implementation. H ≤ 0 indicates that the commodity system is unable to compete without government assistance and intervention.
b	Domestic Resource Cost Ratio	DRCR = G/(E-F)	DRCR < 1 indicates that the commodity system has a comparative advantage. DRCR ≥ 1 indicates that the commodity system has no comparative advantage.
Effects of Output Policy:			
a	Output Transfer	OT = A-E	OT > 0 indicates that there is a transfer from communities (consumers) to producers. OT ≤ 0 indicates that there is no transfer from communities (consumers) to producers.
b	Nominal Protection Coefficient on Output	NPCO = A/E	NPCO > 1 indicates that the policy is protective of outputs, and the larger the NPCO value the higher the protection level of the government of the outputs. NPCO ≤ 1 indicates that the policy is a disincentive.
Input Policy:			
a	Input Transfer	IT = B -F	IT > 0 indicates that there is a transfer from farmers to tradable input producers. IT ≤ 0 indicates that there is no transfer from farmers to tradable input producers.
b	Nominal Protection Coefficient on Tradable Input	NPCI = B/F	NPCI < 1 indicates that the policy is protective of inputs, and there is a subsidy policy for the tradable inputs. NPCI ≥ 1 indicates that there is no protective policy of inputs or no subsidy policies for the tradable inputs.
c	Factor Transfer	TF = C -G	TF > 0 indicates that there is a transfer from producer farmers to tradable input producers. TF ≤ 0 indicates that there is no transfer from producer farmers to tradable input producers.
Input-Output Policy:			
a	Effective Protection Coefficient	EPC = (A-B)/(E-F)	EPC > 1 indicates that the policy is protective. The larger the EPC value, the higher the government protection of domestic commodities. EPC ≤ 1 indicates that the policy is not protective, and there is no government protection of domestic commodities.
b	Net Transfer	NT = D -H	NT > 0 indicates additional producer surplus due to the government policy applied to inputs and outputs. NT ≤ 0 indicates that there is no additional producer surplus due to the government policies applied to inputs and outputs.
c	Profitability Coefficient	PC =D/H	PC > 0 indicates that government policies provide incentives to producers. PC ≤ 0 indicates that government policies do not provide incentives to producers.
d	Subsidy Ratio to Producer	SRP = L/E	SRP < 0 indicates that government policies that have been in force have caused producers to incur production costs greater than the offset costs for production. SRP ≥ 0 indicates that government policies that have been in force have not caused producers to incur production costs that are greater than the offset costs for production.

Source: Murtiningrum (2014)

Table 3. Criteria of Competitiveness Assessment

Indicator	Value Criteria				
D	+	-	-	-	-
H	+	+	-	-	-
PRC	+	+	+	-	-
DRCR	+	+	+	+	-
Combined Value	4+	3+ 1-	2+ 2-	1+ 3-	4-
Competitiveness	Very high	High	Medium	Low	Very low

Source: Kohari (2005)

Competitiveness is reflected by a variety of commodities, including very high, high, medium, low, and very low competitiveness. Based on Table 3, the difference in the range of competitiveness of a commodity can be used to determine the priority scale of commodity development, namely (i) commodities with very high competitiveness are prioritized to be developed; (ii) commodities with high competitiveness remain a priority to be developed but commodities with very high competitiveness are prioritized; (iii) commodities with moderate competitiveness have two possibilities, to be developed or not, which depend on field checks, whether due to policy distortions or market failures; and (iv) commodities with low or very low competitiveness should not be developed.

RESULT AND DISCUSSION

Characteristics of Respondents

A total of 76 farmers were sampled in this study. They were sugarcane farmers affiliated with Takalar Sugarcane Factory. The demographic characteristics of respondents, consisting of age and education level, are presented in Table 4.

Table 4 shows that the youngest category of farmers (under 35 years old) was the smallest group (11.84%), indicating that there is less interest among youth in the village to cultivate sugarcane. As a safety measure, they preferred commodities with higher opportunity costs, such as rice and maize compared to respondents aged 35-45 (28.95%) and 46-55 (35.53%). Mature age and experience in growing sugarcane for 10-15 years are their strength in running the rapidly fluctuating sugar industry. Respondents aged 56 or older (23.68%) were experienced, rich farmers who were slowly moving out of their "comfort" zone by starting new businesses or activities or enjoying the fruits of their labor in old age by relaxing at home and delegating the work to their successors.

Table 4. Respondent Characteristics

Characteristic	Frequency	Percentage %
Age		
<35 years old	9	11.84
35 – 45 years old	22	28.95
46 – 55 years old	27	35.53
>56 years old	18	23.68
Level of Education		
SD (elementary school)	34	44.74
SLTP/SMP (junior high school)	22	28.95
SLTA/SMA (senior high school)	14	18.42
D3/S1 (diploma/bachelor deg)	6	7.89
Land Ownership Status		
Owned land	16	21.05
Leased land	40	52.63
Profit-sharing scheme	20	26.32
Land Area		
0.5 – 1 hectare	54	71.05
1.1 – 1.5 hectare	7	9.21
>1.6 hectare	15	19.74

Several studies have suggested that the number of young people in Indonesia who stay in the countryside to work in agriculture is small. This is due to low salaries and limited material sources. In addition, most parents are hesitant to let their children to choose farming as their career choice (Haharap & Siregar, 2018; Yodfiatfinda, 2020). On the other hand, some developed countries provide access to entrepreneurship and job creation, including enabling policies for youth and the agriculture sector that are attractive to the younger generation such as promoting agriculture in schools, making young farmers act as role models for other young farmers, encouraging and supporting young farmers and proactively communicating positive perceptions of agriculture as a career (Hayden et al., 2021; Nguyen-Thi-Lan et al., 2022; Salvago et al., 2019).

The respondents of the study owned lands with a variety of status, such as self-owned lands, leased lands, lands with cultivation right title (HGU), and lands lent by the sugarcane factories to farmers on a profit-sharing basis.

Table 5. PAM Analysis of Sugarcane Farming in Kampung Beru

Item	Revenue	Costs		Profit
		Tradable Input	Domestic Factor	
Private	23,547,979.45	8,611,250.00	15,652,638.89	-715,909.89
Social	19,238,617.608	10,583,223.24	15,544,751.11	-6,889,356.752
Effects of Divergences	4,309,361.842	-1,971,973.24	107,887.77	61,73,447.312

Based on Table 4, owned lands constituted the least proportion (21.5%) and leased lands the largest proportion (52.63%), suggesting that sugarcane farmers are less prosperous. The study was conducted in one of the villages with the highest number of sugarcane farmers (PTR), 56 farmers. Five farmer groups oversaw the PTR, while the remaining one farmer group consisted of 20 HGU landowners. Three categories of land areas were indicated as follows: the largest group is in the 0.5 - 1 hectare category (71.05%), followed by 1.6 hectares (19.74%) and 1.1 - 1.5 hectares (9.21%). When comparing land ownership and land occupation, it is possible that owners of 0.5-1 ha lands were leasing the lands.

Previous studies have suggested that the problem of land ownership through lease, pawn or purchase continues to this day. This potentially increases of the number of landless owners (Bakri et al., 2020). Meanwhile, in other countries such as China, the affirmation of agricultural land rights has a major impact on the welfare of farmers (Guan et al., 2022).

Competitiveness of Sugarcane Farming

1. Personal and social profitability

The domestic component includes labor and land rent. Cost data for these two components were calculated according to private and social costs. It was subsequently summarized in a PAM analysis table to identify its private and social profitability (van Zyl & Pearson, 1990). The results of the two profits determined the level of competitiveness of sugarcane farming in Kampung Beru Village and whether it is worth developing. The results are shown in Table 5.

In Table 5, private and social profitability are both negative and sugarcane farmers experienced losses from their farms in the previous growing season. The social component loss (- Rp6,889,356.752) was due to the shadow fertilizer price (e.g., urea = Rp3,287.53) being higher than its market price (urea = Rp1,916.67), with a difference of 58.30%. However, the farmers also received no gain in their personal profitability (-Rp715,909.89). Other studies showed that one of the reasons for this is the calculation of land rent (Zhang & Song, 2022). Sugarcane farmers in this study made a profit (Rp 1,450,756.78) when land rent was excluded. Another cause was the classic problem of low yield value (6.5%). Several studies stated that the yield value (percentage) determines how much sugar farmers will receive as a final product. The examined planting season had the lowest yield value in recent years, therefore the results were not enough to cover the production costs incurred by farmers resulting in losses (Hanka & Santosa, 2021; Yusvianto & Kuntadi, 2022).

In addition to private and social profitability, the PAM values in Table 4 show the value of output transfer (OT or I) caused by output price divergence or the difference in the value of private and social income. The value is also caused by the presence of input transfers (IT or J) due to the divergence of tradable input costs or the difference in foreign private and social costs. Finally, factor transfers (TF) are caused by divergence of domestic factor costs or differences in private costs of non-tradable factors, and social costs (Nina et al., 2017). The results can be seen in Table 6.

Table 6. Description of the PAM Analysis of Kampung Beru Village

Item	Results	Conclusion
Output Transfer (OT)	4,309,361.842	OT > 0 indicates that there is a transfer from communities (consumers) to producers.
Input Transfer (IT)	-1,971,973.24	IT ≤ 0 indicates that there is no transfer from farmers to tradable input producers.
Factor Transfer (TF)	107,887.77	TF > 0 indicates that there is no transfer from producer farmers to the tradable input producers.

Based on Table 6, positive OT suggests that the community (sugar consumers) contributed Rp4,309,361,842 to the Takalar Sugar Factory as a producer. Negative IT indicates that sugarcane farmers did not contribute to the government as producers of tradable inputs (subsidized fertilizer and

seed providers). Instead, their sugarcane farming activities caused the government to pay Rp11,971,973.24 in exchange for fertilizer and seed subsidies. A positive TF means that sugarcane farmers contributed Rp107,887.77 to the government's minimum labor wage regulation.

Meanwhile, several studies stated that the government has initiated efforts to improve subsidized fertilizer governance through digitalization in the distribution and redemption of subsidized fertilizers, as well as the preparation of data on fertilizer subsidy recipients to be more targeted. Subsidized fertilizers are intended for 9 staple and strategic food commodities, namely rice, corn, soybeans, chili, shallots, garlic, sugarcane, coffee, and cocoa. These nine commodities are expected to support the realization of better food security in the future (Brenneis et al., 2023; Gunawan & Pasaribu, 2020).

2. Competitive advantage analysis

The results of the analysis show that the value of private profitability (D) of sugarcane farming in Kampung Beru Village was (-) Rp715,909.89 or a loss of Rp715,909.89. The details of the results are presented in Table 7.

Table 7. Analysis Results of Competitive Advantage of the PAM Matrix

Item	Results	Conclusion
Private profitability (D)	- 715,909.89	D<0 indicates that the sugarcane farming activities are unable to expand since they have no profit directly accepted by the farmers.
Private cost ratio (PCR)	1,048	PCR>1 indicates that the sugarcane commodity has no competitive advantage.

Based on Table 7, the private profitability is negative (- Rp715,909.89), indicating that sugarcane farmers' farming activities incurred losses and had no competitive advantage in the 2018 growing season. This value indicates that farming activities cannot increase further because it does not provide profits for farmers (Kurniawan et al., 2021). However, this value can still be debated considering that the negative value occurred due to the inclusion of land rent in the calculation, while farmers generally do not calculate land rent in their farming activities (Ariani et al., 2006; Paramitha et al., 2014).

The private cost ratio (PCR) value for sugarcane farming is 1.048 (> 1), suggesting that sugarcane farming in the growing season did not have the potential to be developed further because it did not have a competitive advantage. Several studies also mentioned that sugarcane farming is unable to compete with other commodity farming activities in the domestic market (Pratiwi et al., 2021; Warr, 2014).

3. Comparative Advantage Analysis

The analysis results of the PAM method showed that the value of social profitability (H) of sugarcane farming in Kampung Beru village was (-) Rp6,889,356,752. The results are presented in Table 8.

Table 8. Analysis Results of PAM Matrix Comparative Advantage

Item	Results	Conclusion
Social profitability (H)	- 6,889,356.752	H<0 indicates that there is no efficiency of the commodity system in the condition of no divergences and implementation of efficient policies.
Domestic resource cost ratio (DRCR)	1.795	DRCR>1 indicates that the commodity system has no comparative advantage.

Based on Table 8, social profitability is negative (- Rp6,889,356,752) and sugarcane farming activities at the social price level experienced a loss of Rp6,889,356,752. This implies that sugarcane farming activities in the 2018 growing season were inefficient in the absence of government intervention (in terms of input-output prices or policies). This condition can occur if a perfectly competitive market is created where prices are determined based on an agreement between sellers and buyers without government involvement. The domestic resource cost ratio (DRCR) value of sugarcane farming in Kampung Beru Villageis 1.795 (> 1), indicating that to obtain 1 unit of added value, domestic costs of 1,795 units are required in sugarcane farming.

Based on the results of research conducted by Anggraeni et al. (2018), the value of PCR and DRCR are the main indicator to assess the competitiveness of farming in the research location based on its comparative and competitive advantages. In Table 7, both advantages have a value of >1, which indicates that sugarcane farming activities in the growing season did not have competitiveness. The results are illustrated in a chart in Figure 1.

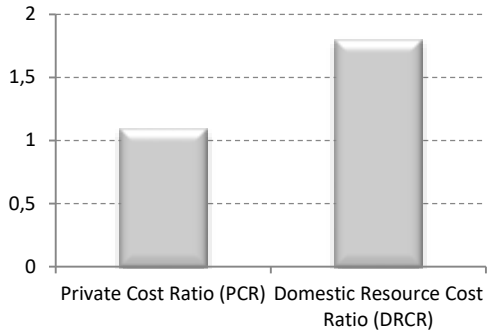

Figure 1. Comparative and competitive advantages of Sugarcane Farming in Kampung Beru Village

Competitiveness of Sugarcane Farming

Based on analysis and interpretation, each competitive and comparative indicator, namely private profitability (D), social profitability (H), private cost ratio (PCR), and domestic resources cost ratio (DRCR), was given a positive or negative value. For example, if D is profitable, then the value is positive, while if it is not profitable, then the value is negative (Amri & Rosiana, 2022; Antriyandarti et al., 2013; Purbaningsih et al., 2019). The combination of positive and negative values of the four indicators becomes the criteria for assessing competitiveness as presented in Table 9.

The assessment results in Table 9 show that D (-Rp715,909.89) and PCR (1,048) are in the negative criteria, therefore farming did not have competitiveness. This is in line with the results of research conducted in Madiun and Kediri districts where sugarcane farming did not have a comparative advantage (Malian & Syam, 2016). Meanwhile, H (-Rp6,889,356,752) and DRCR (1,795) are also in the negative criteria indicating no competitiveness. The combination of these values shows that the sugarcane commodity in Kampung Beru Village, North Polongbangkeng District, Takalar Regency in the 2018 growing season was not competitive at all, both in competitive and comparative aspects.

Similarly, conditions in the field support these results since many sugarcane farmers have gone out of business and switched to cultivating other more potential commodities. The planting season marked the biggest loss in agriculture, with research that supports this include the studies by Mahruf (2022), Riyanto (2018) and Egeskog et al. (2016). Delays in the distribution of subsidized fertilizers disrupted the fertilization schedule, causing the growth of sugarcane stalks to be less than optimal and subsequently a low yield of 5.5%.

Another vital factor that causes losses is the technical factors of the sugarcane mill. (Afsharnia et al., 2021; Misra et al., 2022). The breakdown of the mill's milling machine caused a delay in the milling schedule of up to one week. This triggered long queues of sugarcane trucks in front of the mill. The assessment of the competitiveness of the business is presented in Table 9.

Effects of Government Policy on Input-Output

Government policies were present in the sugar cane farming activities in Kampung Beru Village. Policies in the form of fertilizer and seed subsidies caused disparity in income, costs, and profits in terms of market and social prices. This is in line with previous research which stated that government policy's objectives can be broadly divided into three main objectives, namely efficiency, equity, and resilience. Efficiency is achieved if the allocation of scarce economic resources can generate maximum income. Equity means that the distribution of income between groups of people targeted by the policy market. Food security means food availability at a stable and affordable price (Dianpratiwi, 2005; Perwitasari et al., 2021; Saputri & Respatiadi, 2018).

Identifying the extent to which these impacts affect the input-output of sugarcane farming in the research location requires indicators or parameters to determine the value of their influence. The details can be seen in Table 10.

Table 9. Assessment of Sugar Cane Farming Competitiveness

Indicator	Value	Criteria	Definition	Combination Value	Competitiveness
D	-715,909.89	(-)	Uncompetitive	4-	Uncompetitive
H	-6,889,356.75	(-)	Uncompetitive		
PCR	1.048	(-)	Uncompetitive		
DRCR	1.795	(-)	Uncompetitive		

Table 10. Effects of Policies Based on Sugarcane Farming PAM Analysis

Indicator	Result
NPCO (A/E)	1.2239
NPCI (B/F)	0.8137
EPC (A-B) / (E-F)	1.7942
NPT (D-H)	6,173,446.862
PC (D/H)	0.1039
SRP (L/E)	0.3209

Note: NPCO (Nominal Protection Coefficient on Output) is used to determine the effects of government policies on market mechanisms of the sugarcane output (sugar). NPCI (Nominal Protection Coefficient on Input) is used to determine the effects of government policies on tradable inputs. EPC (Effective Protection Coefficient) is used to determine the effects of overall government policies and input-output market mechanisms. NPT (Net Protection Transfer) is used to illustrate the increase and decrease of producer surplus due to government policies. PC (Profit Coefficient) is used to determine the differences in the private profitability and social profitability levels. SRP (Subsidy Ratio to Producer) is used to measure the overall transfer effects.

1. Effects of government policy on output

The nominal protection coefficient on output (NPCO) value is used to identify the effect of government policy on the market mechanism of sugarcane (sugar) production (Murdy et al., 2021; Poernomo, 2018). The NPCO value for sugarcane farming in Kampung Beru is 1.2239, which indicates that farmers received a price that was 22.39% more expensive than the international price. Meanwhile, with the NPCO value of 1.168 in Kediri, East Java, farmers had to pay higher tradeable inputs than the price they should receive (Isaskar et al., 2010). In other words, there is a government policy that protects the results of sugarcane farming in Kampung Beru.

2. Effects of government policy on inputs

The effects of government policy on tradable inputs can be seen from the nominal protection coefficient on input (NPCI) value (Antriyandarti et al., 2013; Sinaga, 2018; William et al., 2023). The analysis results showed that government policy on tradable inputs had a positive effect on sugarcane farming as indicated by the NPCI value of <1. This means that sugarcane farmers are able to buy inputs at a price that is cheaper than the social price. The NPCI value of sugarcane farming of 0.8137 shows that farmers bought tradable inputs at a price 18.63% cheaper than their social inputs. Widyatami and Wiguna (2019) stated that farmers buy tradable inputs at lower prices, therefore the production costs of sugarcane farming become cheaper.

3. Effective Protection Coefficient (EPC)

Effective protection coefficient (EPC) is used to identify the effects of overall government policy and input-output market mechanisms (Setiawan & Sengadji, 2016; Shang et al., 2019; Farid et al., 2009), whether it provides incentives or disincentives to sugarcane farming in Kampung Beru. Based on the EPC analysis, the net effect of government policies in price formation and commodity market mechanisms has provided incentives (protection) to sugarcane farmers. Raushan, Ahern, and Nor (2022) stated that the EPC value greater than 1 means that the added value enjoyed by farmers is higher than its social value. The EPC value of sugarcane farming in Kampung Beru (1.7942) indicates that the government provided effective incentives to farmers since the added value enjoyed by farmers (79.42%) was higher than its social value.

4. Net Protection Transfer (NPT)

Net protection transfer (NPT) is a value that describes the increase or decrease in producer surplus due to government policy (Firdaus, 2007; Santosa, 2020). Based on the analysis, sugarcane farming in Kampung Beru was positively influenced by government policy, evidenced by the positive NPT analysis. The net transfer value for sugarcane cultivation was Rp6,173,446.862. According to Takeshima and Nkonya (2014), this is due to the tradable input policy in the form of fertilizer subsidies used by sugarcane farmers. In addition, the output price or sugar price at the farm level is higher than the price that farmers should receive or the social price.

5. Profit Coefficient (PC)

The coefficient of profit (PC) is used to determine the difference in the level of private profitability and social profitability (Daryana et al., 2020; Heriyanto, 2020; Irfanda, 2020). Based on the analysis, government policies did not provide incentives to producers. The PC value for sugarcane farming is 0.1039. Harwoto et al. (2022) stated that this is due to government policies overriding taxation on inputs used which can increase production costs and reduce the level of profit.

6. Subsidy Ratio to Producer (SRP)

Subsidy ratio to producer (SRP) is a ratio used to measure the overall transfer effect (Lindawati et al., 2021; Murdy et al., 2021; Nina et al., 2017). Based on the analysis, there was positive protection from the government on sugarcane farming in Kampung Beru Village, evidenced by the positive SRP value. This is supported by the study conducted by Setiawan, Widayanti, and Sudiyarto (2018), which stated that the positive SRP value indicates that government protection can reduce the production costs of sugarcane farming. The SRP value for sugarcane farming is 0.3209, indicating that there was a government policy that reduced production costs by 32.64% for every kilogram of production. The decrease in production costs is a decrease in tradable input costs.

The EPC, NPT, PC, and SRP values in Table 9 show that government policies had a positive effect on both output and tradable inputs for sugarcane farmers in Kampung Beru Village. Government policies in the form of fertilizer subsidies had a positive impact on farm production costs since the costs incurred by sugarcane farmers in Kampung Beru were lower than the added value received by farmers from the social price they should receive. Lestari et al. (2015) stated that apart from private and social profitability, which has a negative value or loss, the statistical figures of the four components that assess government policies provide hope for sugarcane farmers to bounce back in the current planting period (Lestari et al., 2015; Monke & Pearson 1989). This is supported by research from Kos et al. (2023) which stated that as long as the government continues to provide support in the form of subsidized fertilizers and timely delivery, agricultural hope will continue. Moreover, it was anticipated that the Takalar Sugarcane Factory will increase the yield rate by 8%.

Research Implication

The problem identified by this research is the decreasing competitiveness of sugarcane farming in Kampung Beru Village, i.e., inability of the farming to increase further because it does not provide benefits for farmers. Sugarcane farmers are consistently unhappy about the prices they receive from sugar factories, considering that sugarcane farming does not have competitiveness compared to other crops, such as corn and rice.

This is supported by data on competitive and comparative advantages based on personal and social profitability with a value of >1, which shows that sugarcane farming activities do not have competitiveness, including in the aspect of land rent. Several studies explained that lands that were supposed to be used for sugarcane were usually developed for other commodities. In such situation, sugarcane crops have become difficult to compete and the sugarcane farming activity is often defeated by other interests (El Chami et al., 2020) and the potential sugarcane plant lands are used for the benefit of other commodities. Therefore, the government is obliged to set policies to place potential sugarcane lands on top priority so that the lands are not allocated for other land use interests (Bahati et al., 2022; Pratiwi et al., 2021).

Data that support the problem of competitiveness in Kampung Beru Village include policy influence data based on PAM analysis of sugarcane farming in Kampung Beru Village with six indicators to identify the impact of the influence of farm inputs and outputs, which has a positive impact on sugarcane farmers. Based on previous research, efforts that can be made in increasing the competitiveness of sugarcane farming include the utilization of technology, product processing technology, and cultivation technology (Ncoyini et al., 2022; Sulaiman et al., 2019) as well as increasing the institutional capacity of farmers and trade system policies, especially related to sugarcane prices (Robaey et al., 2022). In line with the results of research conducted in Madiun, Kediri, and Malang districts (rice fields), the area will have a comparative advantage if the productivity (yield) of sugarcane increases by about 20% or if the world sugar price becomes 220 US$/ton (Ariani et al., 2006).

Sugarcane farmers also need to gain knowledge on the utilization of sugarcane waste to produce bioenergy, either individually or in groups, and on a large scale. The utilization of bioenergy as a diversification of sugarcane products can increase farmers' income and the competitiveness of sugarcane farming (Borges et al., 2021; Hiloidhari et al., 2021; Negrão et al., 2021). In addition, the current sugarcane farming is still protected by the government both in terms of inputs and outputs, representing a protection for farmers. Consequently, the government must review the existing protection model. Is protection still needed in the current era of globalization and information? The government must

continue to strive to ensure that sugarcane farming becomes the main support for sugar factories which are the basic needs of the community, and continues to be improved so that the welfare of sugarcane farmers is equally guaranteed.

CONCLUSION AND SUGGESTION

Based on the research results, the competitiveness of sugarcane farming in the form of competitive and comparative advantages in Kampung Beru village during the 2018 growing season can be seen from the private cost ratio (PCR) value > 1 (1.048), and the domestic resource cost ratio (DRCR) value> 1 (1.795). These values indicate that sugarcane farming is not competitive.

The effect of government policy on the input-output of sugarcane farming can be seen from the NPCO value >1 (1.229), and the NPCI value <1 (0.8137). These values indicate that government policy protects the input-output of sugarcane farming.

Based on the above conclusions, sugarcane farming has very low competitiveness. Therefore, the government is advised to increase sugarcane productivity by conducting campaigns to use superior sugarcane seeds, improve the efficiency of production facilities, revise purchase price standards, as well as regulating the sugarcane marketing system.

From the results of this study, one of the factors causing the absence of competitive and comparative advantages of sugarcane farming is the very low yield value (5.5%-6.5%) in the growing season caused by technical factors at Takalar Sugarcane Factory. It is suggested that the factory pay more attention and think about sugarcane farmers who rely on the value of yields for their income which is solely determined by the factory.

Maximum efforts are needed to achieve competitive and comparative advantages in the form of input-output policies that assist and benefit sugarcane farmers. The absence of competitive and comparative advantages in sugarcane farming in Kampung Beru only occurred in one growing season. This does not guarantee the low competitiveness of their sugarcane farms in the following planting season since competitive and comparative values are not fixed, very sensitive, and fluctuate from year to year. Therefore, intensifying technological assistance in the form of subsidized machinery and seeds as well as increasing the value of yields and the price of yields potentially increase the competitiveness of sugarcane farming.

REFERENCES

Afsharnia, F., Marzban, A., Asoodar, M., & Abdeshahi, A. (2021). Preventive maintenance optimization of sugarcane harvester machine based on FT-Bayesian network reliability. International Journal of Quality and Reliability Management, 38(3), 722–750. https://doi.org/10.1108/IJQRM-01-2020-0015

Amri, M. R., & Rosiana, N. (2022). Competitiveness analysis of robusta coffee In Pamijahan District, Bogor Regency West Java. Journal of Agri Socio Economics and Business, 04(2), 81–94. https://doi.org/10.31186/jaseb.04.2.

Anggraeni, N. W., Roessali, W., & Setiyawan, H. (2018). Competitiveness of soybean business farming analysis in Grobogan Regency Central Java Province. Agroland: The Agricultural Sciences Journal, 5(2), 112. https://doi.org/10.22487/j24077593.2018.v5.i2.11843

Antriyandarti, E., Ferichani, M., & Ani, S. W. (2013). Sustainability of post-eruption socio economic recovery for the community on mount Merapi slope through horticulture agribusiness region development (Case Study in Boyolali District). Procedia Environmental Sciences, 17, 46–52. https://doi.org/10.1016/j.proenv.2013.02.010

Ariani, M., Askin, A., Hestina, & Juni, H. (2006). Analisis daya saing usahatani tebu di propinsi Jawa Timur. Socio-Economic of Agriculturre and Agribusiness), 9–9. Retrieved from http://ojs.unud.ac.id/index.php/soca/article/view/4113

Bahati, I., Martiniello, G., & Abebe, G. K. (2022). The implications of sugarcane contract farming on land rights, labor, and food security in the Bunyoro sub-region, Uganda. Land Use Policy, 122, 106326. https://doi.org/10.1016/j.landusepol.2022.106326

Bakri, S., Zain, M. M., Baso, A. K. T., Syafar, A. A. R., Novita, D., & Arsyad, M. (2020). Small scale corporate model and rice farming efficiency. IOP Conference Series: Earth and Environmental Science, 575(1). https://doi.org/10.1088/1755-1315/575/1/012100

Borges, A. do V., Fuess, L. T., Alves, I., Takeda, P. Y., & Damianovic, M. H. R. Z. (2021). Co-digesting sugarcane vinasse and distilled glycerol to enhance bioenergy generation in biofuel-producing plants.

Energy Conversion and Management, 250, 114897. https://doi.org/10.1016/j.enconman.2021.114897

BPS (Badan Pusat Statistik) (2018). Kecamatan Polongbangkeng Utara dalam Angka 2018. BPS Kabupaten Takalar. Retrieved from https://takalarkab.bps.go.id

Brenneis, K., Irawan, B., & Wollni, M. (2023). Promoting agricultural technologies with positive environmental effects: Evidence on tree planting in Indonesia. Ecological Economics, 204, 107666. https://doi.org/10.1016/j.ecolecon.2022.107666

Carrington, S. J., Herrero Olarte, S., & Urbina, G. (2023). Commodity cycle management in Latin America: The importance of resilience in face of vulnerability. Resources Policy, 81, 103316. https://doi.org/10.1016/j.resourpol.2023.103316

Contreras, H., Korczak, A., & Korczak, P. (2023). Religion and insider trading profits. Journal of Banking & Finance, 149, 106778. https://doi.org/10.1016/j.jbankfin.2023.106778

Danelon, A. F., Spolador, H. F. S., & Bergtold, J. S. (2023). The role of productivity and efficiency gains in the sugar-ethanol industry to reduce land expansion for sugarcane fields in Brazil. Energy Policy, 172, 113327. https://doi.org/10.1016/j.enpol.2022.113327

Danna-Buitrago, J. P., & Stellian, R. (2022). A new class of revealed comparative advantage indexes. Open Economies Review, 33(3), 477–503. https://doi.org/10.1007/s11079-021-09636-4

Darmayanti, N. W. S., Winandi, R., & Tinaprilla, N. (2019). Analisis dayasaing jagung di wilayah sentra produksi di Indonesia dengan pendekatan Policy Analysis Matrix (PAM). Forum Agribisnis, 8(2), 137–154. https://doi.org/10.29244/fagb.8.2.137-154

Daryana, D., Romano, & Arida, A. (2020). Analisis keunggulan komparatif dan keunggulan kompetitif serta dampak kebijakan pemerintah terhadap industri minyak pala di kabupaten Aceh Selatan. Jurnal Ilmu Pertanian, 5, 131–140.

Dianpratiwi, T. (2005). Relationship Between Cane Farmers With Sugar Factory, Cane Farmers Association and Government Post Farmer Sugarcane Intensification Program. 1981, 1–15.

Egeskog, A., Barretto, A., Berndes, G., Freitas, F., Holmén, M., Sparovek, G., & Torén, J. (2016). Actions and opinions of Brazilian farmers who shift to sugarcane: an interview-based assessment with discussion of implications for land-use change. Land Use Policy, 57, 594–604. https://doi.org/10.1016/j.landusepol.2016.06.022

El Chami, D., Daccache, A., & El Moujabber, M. (2020). What are the impacts of sugarcane production on ecosystem services and human well-being? A review. Annals of Agricultural Sciences, 65(2), 188–199. https://doi.org/10.1016/j.aoas.2020.10.001

Farid, M., Ekawati, I., & Fatmawati, I. (2009). Analisis daya saing kedelai di Kabupaten Sumenep. Jurnal Pertanian Cemara, 6 (1), 24–34. https://doi.org/10.24929/fp.v6i1.546

Firdaus, M. (2007). Analisis daya saing kedelai di Jawa Timur. JSEP (Journal of Social and Agricultural Economics), 1(2). 16-27. Retrieved from https://jurnal.unej.ac.id/index.php/JSEP/article/view/450

Freitas, J. V, Bilatto, S., Squinca, P., Pinto, A. S. S., Brondi, M. G., Bondancia, T. J., Batista, G., Klaic, R., & Farinas, C. S. (2021). Sugarcane biorefineries: potential opportunities towards shifting from wastes to products. Industrial Crops and Products, 172, 114057. https://doi.org/10.1016/j.indcrop.2021.114057

Guan, J., Huang, K., Lan, X., Zhang, J., & Li, H. (2022). Impact of confirmation of farmland rights on farmers' welfare: Based on the micro-empirical investigation of farmers in China. Sustainability (Switzerland), 14(15), 1–13. https://doi.org/10.3390/su14159710

Gunawan, E., & Pasaribu, S. (2020). Persepsi petani dan permasalahan program kartu tani mendukung distribusi pupuk bersubsidi. Jurnal Ekonomi Dan Pembangunan, 28(2), 131–144. https://doi.org/10.14203/jep.28.2.2020.131-144

Haharap, N., & Siregar, A. Z. (2018). Factors affecting youth generation interest on agricultural fields (Case study in Deli Serdang District). International Journal of Environment, Agriculture and Biotechnology, 3(5), 1922–1928. https://doi.org/10.22161/ijeab/3.5.45

Hajighasemi, A., Oghazi, P., Aliyari, S., & Pashkevich, N. (2022). The impact of welfare state systems on innovation performance and competitiveness: European country clusters. Journal of Innovation and Knowledge, 7(4), 100236. https://doi.org/10.1016/j.jik.2022.100236

Hani, E. S., & Mustapit. (2016). Stakeholder response to the development strategy of sugarcane dry land agriculture in East Java. Agriculture and Agricultural Science Procedia, 9, 469–474. https://doi.org/10.1016/j.aaspro.2016.02.165

Hanka, M. K. F. & Santosa, B. (2021). Analisis kualitas bahan baku tebu melalui teknik pengklasteran dan klasifikasi kadar gula sebelum giling (Studi kasus pabrik gula PT. XYZ). Jurnal Teknik ITS, 10(2), 100–108. https://doi.org/10.12962/j23373539.v10i2.64924

Harwoto, W. R., Rondhi, M., Rokhani, R., & Suwandari, A. (2022). Direct payment system in sugarcane industry: beneficial or unfavourable solution? Economics Development Analysis Journal, 11(1), 96-109. Retrieved from https://journal.unnes.ac.id/sju/index.php/edaj/article/view/48507

Hayden, M. T., McNally, B., & Kinsella, A. (2021). Exploring state pension provision policy for the farming community. Journal of Rural Studies, 86, 262–269. https://doi.org/10.1016/j.jrurstud.2021.05.032

Heriyanto, H. (2020). Keunggulan Kompetitif dan keunggulan komperatif usahatani kelapa sawit pada lahan suboptimal di kabupaten Musi Rawas. Jurnal Agribisnis, 21(2), 150–162. https://doi.org/10.31849/agr.v21i2.3252

Hermawan, R. (2012). Terkait dengan pencapaian swasembada gula di Indonesia (Analysis of land use of sugar cane and paddy in the framework of achieving sugar self-sufficiency in Indonesia). Jurnal Ekonomi & Kebijakan Publik, 3(1), 47–63.

Hiloidhari, M., Vijay, V., Banerjee, R., Baruah, D. C., & Rao, A. B. (2021). Energy-carbon-water footprint of sugarcane bioenergy: A district-level life cycle assessment in the state of Maharashtra, India. Renewable and Sustainable Energy Reviews, 151, 111583. https://doi.org/10.1016/j.rser.2021.111583

Hunt, S. D., & Morgan, R. M. (1995). The comparative advantage theory of competition. Journal of Marketing, 59(2), 1. https://doi.org/10.2307/1252069

Irfanda, A. I. (2020). Analisis daya saing di Desa Tleter Kecamatan Kaloran Kabupaten Temanggung. Agrisaintifika: Jurnal Ilmu-Ilmu Pertanian, 3(2), 147. https://doi.org/10.32585/ags.v3i2.550

Isaskar, R., Sutrisno, S., & D, D. P. (2010). Studi keunggulan komparatif usahatani tebu (comparative advantage study of sugar cane farming). Agrise, X(2). 129-138. Retrieved from https://agrise.ub.ac.id/index.php/agrise/article/view/43/70

Kassali, R., Adetomiwa, K., & Lasisi, A. L. (2022). Competitiveness of broiler production in Nigeria: A policy analysis matrix approach. Heliyon, 8(5), e09298. https://doi.org/10.1016/j.heliyon.2022.e09298

Kos, D., Lensink, R., & Meuwissen, M. (2023). The role of social capital in adoption of risky versus less risky subsidized input supplies: An empirical study of cocoa farmers in Ghana. Journal of Rural Studies, 97(October 2022), 140–152. https://doi.org/10.1016/j.jrurstud.2022.10.027

Kurniawan, D., Jaenudin, A., & Wachdijono. (2021). Model peningkatan pendapatan agribisnis tebu rakyat. 331–344. https://doi.org/10.25047/agropross.2021.237

Lestari, E. K., Fauzi, A., Hutagaol, P., & Hidayat, A. (2015). Keuntungan petani tebu rakyat melalui kemitraan di kabupaten Jember. Buletin Tanaman Tembakau, Serat & Minyak Industri, 7(2), 79–89.

Lindawati, L., Zulfida, I., & Azmi, A. F. (2021). Analysis of comparative and competitive advantages of organic rice in Beringin Subdistrict of Deli Serdang Regency. IOP Conference Series: Earth and Environmental Science, 782(2). https://doi.org/10.1088/1755-1315/782/2/022021

Mahruf. (2022). Penerapan kebijakan pemerintah dalam penentuan harga jual gula kristal putih melalui Peraturan Menteri Perdagangan Republik Indonesia Nomor 7 Tahun 2020. Populis : Jurnal Sosial dan Humaniora, 7(2), 205–224. http://dx.doi.org/10.47313/pjsh.v7i2.1855

Malian, A. H., & Syam, A. (2016). Daya saing usahatani tebu di Jawa Timur. In Forum penelitian Agro Ekonomi (Vol. 14, Issue 1, p. 1). https://doi.org/10.21082/fae.v14n1.1996.1-11

Misra, V., Mall, A. K., Solomon, S., & Ansari, M. I. (2022). Post-harvest biology and recent advances of storage technologies in sugarcane. Biotechnology Reports, 33(December 2021), e00705. https://doi.org/10.1016/j.btre.2022.e00705

Murdy, S., Nainggolan, S., & Rezeki. R Sihombing, S. (2021). Analysis of the competitiveness of rice farming and its implications on Input-Output price policy scenario of rice in Jambi Province - Indonesia. Jurnal Paradigma Ekonomika, 16(2), 359–368. https://doi.org/10.22437/jpe.v16i2.12658

Ncoyini, Z., Savage, M. J., & Strydom, S. (2022). Limited access and use of climate information by small-scale sugarcane farmers in South Africa: A case study. Climate Services, 26, 100285. https://doi.org/10.1016/j.cliser.2022.100285

Negrão, D. R., Grandis, A., Buckeridge, M. S., Rocha, G. J. M., Leal, M. R. L. V, & Driemeier, C. (2021).

Inorganics in sugarcane bagasse and straw and their impacts for bioenergy and biorefining: A review. Renewable and Sustainable Energy Reviews, 148, 111268. https://doi.org/10.1016/j.rser.2021.111268

Nguyen-Thi-Lan, H., Fahad, S., Ho-Ngoc, N., Nguyen-Anh, T., Pham-Van, D., Nguyen-Thi-Viet, H., Do-Hoang, P., Do-Kim, C., & To-The, N. (2022). Crop farming and technical efficiency of tea production nexus: An analysis of environmental impacts. Journal of the Saudi Society of Agricultural Sciences, xxxx. https://doi.org/10.1016/j.jssas.2022.09.001

Nina, Tarumun, S., & Rifai, A. (2017). Analisis kebijakan pengembangan daya saing industri kelapa sawit Riau. Indonesian Journal of Agricultural Economics (IJAE). 8(2), 231–245. http://dx.doi.org/10.31258/ijae.8.2.231-245

Paramitha, P., Wibowo, R., & Fajar, A. (2014). Studi efisiensi teknis dan ekonomis usahatani tebu sendiri dan tebu rakyat di Pabrik Gula Padjarakan. Berkala Ilmiah Pertanian, 1(1), 1–13.

Paulraj, A., Chandrasekaran, M., & Easwaran, N. (2015). Policy analysis matrix approach: Applications, strengths and weaknesses. Agricultural Research Journal, 52, 11. https://doi.org/10.5958/2395-146X.2015.00029.0

Perwitasari, H., Mulyo, J., Sugiyarto, S., Widada, A. W., Siregar, A., & Fadhliani, Z. (2021). Economic impact of sugarcane in Indonesia: An input-output approach. Agro Ekonomi, 32. https://doi.org/10.22146/ae.61051

Poernomo, A. (2018). Analysis of the protection of input subsidies policy (fertilizer and seed) and production output in rice plant agriculture in Indonesia. Eko-Regional Jurnal Pengembangan Ekonomi Wilayah, 12(1), 49–55. https://doi.org/10.20884/1.erjpe.2017.12.1.1069

Pratiwi, T. D., Wibowo, E. P., & Wibowo, H. (2021). Daya saing usahatani tebu terhadap komoditas eksisting di wilayah kerja pabrik gula Wonolangan Kabupaten Probolinggo Tahun 2018. Caraka Tani: Journal of Sustainable Agriculture, 33(1), 57. https://doi.org/10.20961/carakatani.v33i1.19562

Purbaningsih, Y., Bafadal, A., & Sutariati, G. A. K. (2019). An analysis of the comparative and competitive advantage of sago processing business. IOP Conference Series: Earth and Environmental Science, 382(1). https://doi.org/10.1088/1755-1315/382/1/012036

Raushan, K., Ahern, C., & Norton, B. (2022). Determining realistic U-values to substitute default U-values in EPC database to make more representative; a case-study in Ireland. Energy and Buildings, 274, 112358. https://doi.org/10.1016/j.enbuild.2022.112358

Riyanto, M. R. P. (2018). Perubahan budidaya tanaman tebu ke tanaman bawang merah Desa Kedung Dalem Kecamatan Dringu Kabupaten Probolinggo. Avatara, 6(1). Retrieved from https://jurnalmahasiswa.unesa.ac.id/index.php/avatara/article/view/22178

Robaey, Z., Asveld, L., Sinha, K. M., Wubben, E., & Osseweijer, P. (2022). Identifying practices of inclusive biobased value chains: Lessons from corn stover in Iowa, sugar cane in Jamaica, and sugar beet in the Netherlands. Cleaner and Circular Bioeconomy, 3(January), 100032. https://doi.org/10.1016/j.clcb.2022.100032

Salvago, M. R., Phiboon, K., Faysse, N., & Nguyen, T. P. L. (2019). Young people's willingness to farm under present and improved conditions in Thailand. Outlook on Agriculture, 48(4), 282–291. https://doi.org/10.1177/0030727019880189

Santosa, R. (2020). Analisis daya saing kacang hijau di Kecamatan Saronggi Kabupaten Sumenep. Jurnal Pertanian Cemara, 17(2), 35-49. https://doi.org/10.24929/fp.v17i2.1146

Saputri, N. K., & Respatiadi, H. (2018). Policy Reform to Lower Sugar Prices in Indonesia. 16. https://repository.cips-indonesia.org/pt/publications/270481/policy-reform-to-lower-sugar-prices-in-indonesia

Setiawan, K., & Sengadji, H. M. (2016). Analisis Dampak Kebijakan Pemerintah Terhadap Daya Saing. Agrica (Jurnal Agribisnis Sumatera Utara) 9(2), 80–89. https://doi.org/10.31289/agrica.v9i2.485

Setiawan, R. F., Widayanti, S., & Sudiyarto. (2018). Analisis daya saing usahatani tembakau kasturi di kabupaten Jember. Jurnal Ilmiah Sosio Agribis, 18(1), 12–26. http://dx.doi.org/10.30742/jisa1812018449

Shang, T., Liu, P., & Guo, J. (2019). How to allocate energy-saving bene fi t for guaranteed savings EPC projects ? A case of China. Energy, xxxx, 116499. https://doi.org/10.1016/j.energy.2019.116499

Sinaga, A. H. (2018). Analisis komoditi jagung (Zea mays L). Jurnal Darma Agung. 26(1), 318-325. http://dx.doi.org/10.46930/ojsuda.v26i1.6

Stellian, R., & Danna-Buitrago, J. P. (2022). Revealed comparative advantage and contribution-to-the-trade-balance indexes. International Economics,

170(October 2020), 129–155. https://doi.org/10.1016/j.inteco.2022.02.007

Sulaiman, A. A., Sulaeman, Y., Mustikasari, N., Nursyamsi, D., & Syakir, A. M. (2019). Increasing sugar production in Indonesia through land suitability analysis and sugar mill restructuring. Land, 8(4), 1–17. https://doi.org/10.3390/land8040061

Takeshima, H., & Nkonya, E. (2014). Government fertilizer subsidy and commercial sector fertilizer demand: Evidence from the Federal Market Stabilization Program (FMSP) in Nigeria. Food Policy, 47, 1–12. https://doi.org/10.1016/j.foodpol.2014.04.009

Tanjung, F., Azhari, R., & Erwin, E. (2023). Competitiveness and impact of government policies on the development of people's arabica coffee plantations partnership pattern in Solok Regency. Journal of Social Research, 2(2), 376–387. https://doi.org/10.55324/josr.v2i2.589

Thamrin, S. (2022). Kinerja pabrik gula di Provinsi Sulawesi Selatan. Agrokompleks, 22(2), 25–31. https://doi.org/10.51978/japp.v22i2.438

van Zyl, J., & Pearson, S. R. (1990). Review: The policy analysis matrix for agricultural development. Development Southern Africa, 7(1), 133–140. https://doi.org/10.1080/03768359008439507

Warr, P. (2014). Agricultural liberalization, poverty and inequality: Indonesia and Thailand. Journal of Asian Economics, 35, 92–106. https://doi.org/10.1016/j.asieco.2014.10.003

Widyatami, L. E., & Wiguna, A. A. (2019). Competitiveness and impact of government policies on rice farming with SRI Method in Rogojampi District, Banyuwangi Regency. Agraris, 5(2), 99–110. https://doi.org/DOI: http://dx.doi.org/10.18196/agr.5279

William, B., Kpenavoun, S., & Hervé, C. (2023). Analysis of the competitiveness of soybean production in Benin. Scientific African, 19, e01491. https://doi.org/10.1016/j.sciaf.2022.e01491

Yodfiatfinda. (2020). Effort to improve the interests of young generations in the agricultural sector to attain food security in Indonesia. 194(FANRes 2019), 291–296. https://doi.org/10.2991/aer.k.200325.058

Yunitasari, D. (2019). Achieving self-sufficiency through sugar supply and demand policies (Dynamics system approach). International Journal of Scientific and Technology Research, 8(3), 34–40.

Yusvianto, A. G., & Kuntadi, E. B. (2022). Persepsi petani tebu terhadap penerapan sistem pembelian tebu (SPT): Studi kasus di Kabupaten Situbondo. JSEP (Journal of Social and Agricultural Economics), 15(2), 229. https://doi.org/10.19184/jsep.v15i2.30397

Zhang, C., & Song, Y. (2022). Road to the city: Impact of land expropriation on farmers' urban settlement intention in China. Land Use Policy, 123, 106432. https://doi.org/10.1016/j.landusepol.2022.106432

Zhu, Z., Wu, D., & Jiang, Q. (2022). Chinese Freshwater aquaculture: A comparative analysis of the competitiveness on regional aquaculture industries. Aquaculture and Fisheries. https://doi.org/10.1016/j.aaf.2022.11.001

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Does human capital spillover affect labor productivity?

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ABSTRACT

As a developing country, in 2022 Indonesia is the 4th largest population in the world and predicted to experience a demographic bonus in 2020-2035. However, along with the increase in the population and workforce in Indonesia, it turns out that the productivity of the workforce in Indonesia is still low. This study aims to analyze and examine the effect human capital spillovers proxied by higher educated labor and lifetime in-migration on labor productivity in Indonesia along with other production factor variables. This study used panel data collected from 28 provinces in Indonesia in period of 2010 to 2019. Based on the results, the higher the level of education, the higher the productivity and the presence of higher educated labor can provide knowledge spillover for the environment. Meanwhile, human capital spillover from indicators in-migration has no impact on productivity. These results indicate that knowledge spillover support by quality of human capital, but the movement of labor has not provided positive externalities for the surrounding environment.

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INTRODUCTION

Labor productivity has become a crucial economic indicator due to its tight relevance to competitiveness, economic growth, and standard of living (International Labour Organization, 2020). Workers with high productivity can produce more outputs than workers with low productivity. Labor may encourage economic growth with the existence of improved productivity, while at the same time labor productivity can also attract investment indirectly (Arham, 2019).

Based on data released by International Labour Organization Statistics (2020), from 2010 to 2019, Indonesia was ranked fifth for its labor productivity out of 10 countries members of ASEAN, with average productivity of $8.110 per worker. This figure indicates that Indonesia is still unable to compete with other members of ASEAN countries, even with the fellow developing countries, such as Malaysia and Thailand. If the labor productivity in Indonesia stays in the lower state, it will be a future potential threat, in particular low competitiveness which leads to low productivity. Once a competitiveness level goes low, economic-related issues will arise. On the other hand, Indonesia's low quality of workers encourages less optimal economic competitiveness (Adam, 2017). At the same time, the economic competitiveness and economic development in an area might be improved with labor productivity as the primary indicator.

High labor productivity can be actualized when the output is improved through the quality of human capital. Becker (1964) and Schultz (1961) placed the fundamental theory that human capital improvement can be portrayed through proper education and health service, trough empirical analysis associated with the influence of human capital on economic growth and resulted in positive and significant. Human capital is

the characteristics that share contributions towards production, such as knowledge, talent, attitude, skills, and others (Adriani, 2019). Improving the quality of human capital can be achieved through increasing educational attainment (Puspasari & Handayani, 2020; Sugiharti, Islami, & Pramudiastuti, 2021). However, education alone is not enough to encourage labor productivity. Hendarmin & Kartika (2019) verified that the average length of schooling has an insignificant positive relationship to labor productivity, but a negative relationship between education and labor productivity might occur due to the heterogeneity of the research coverage area (Pritchett, 2001; Sugiharti, Sugiyanto, & Kurnia, 2017).

However, the need of education continues, not only at basic education level but higher education as well. On the one hand, Benos & Karagiannis (2016) indicated that workers graduating from higher education positively influence labor productivity. The importance of having a highly qualified human resource, in terms of his high level of education, can improve labor productivity (Arshad & Malik, 2015). On the other hand, research by Putri & Kusreni (2017) demonstrated that workers graduating from higher education have an insignificant negative influence on labor productivity. The insufficient contribution provided by higher education causes an improvement in the number of workers graduating from higher education, leading to a decrease in labor productivity (Baharin et al., 2020).

Humans originated with social characteristics, meaning that human needs interaction with others. The past interaction between economic agents may support productivity in present time (Fauziah, Khoirunurrofik, Isnaeni, & Khoirunurrofik, 2020). During socializing and interacting, knowledge exchange is common to happen. Human capital is formed from knowledge spillovers which is seen as a tool for continuous progress and development (Chang, Wang, & Liu, 2016). Spillovers are important when new knowledge is available, and correctly applying a certain level of experimentation is required (Parman, 2012).

The knowledge spillovers can improve labor productivity due to exchanging ideas that lead to more insights. Mahony & Riley (2012) stated that knowledge exchange between workers is believed to be an important driver of economic growth. Knowledge spillovers are defined as interchangeable knowledge as an effect of interactions among individuals, later can be called capital spillovers (Salam, & Prishardoyo, 2018). The interaction might be in the form of people's migration, investment flow, and goods and service flow traded over areas. It can also be in the form of well-educated workers (Susanto & Welly Udjianto, 2019).

Since the interaction is capable of escalating labor productivity, recently economists and policy makers have been paying attention to spillover and the effect of spillover on the growth of an economy (Rahmayani, Sugiyanto, & Kurnia, 2017). Zheng & Du (2020) stated that human capital spillovers became one of the most important inputs in the economy, because if skilled human resources are increasing and abundant, it will lead to a high level of entrepreneurship. The impact of spillovers not only increases human resources in local area, but also the surrounding area. The development of the economy in an area not only makes an increase in the prosperous population in the area, but also affects the welfare of the population in the surrounding area (Susanto & Welly Udjianto, 2019).

Moretti (2004) explained the basis of the formation human capital spillovers from the view of spatial balance, which assumed that firms in urban areas are dependent on the overall level of human capital in cities, by comparing workers with higher education degrees in firms and cities. When a company employs skilled workers, the productivity increases. Moretti's (2004) research also showed that along with the increase in the proportion of educated workers employed, the impact on productivity is not direct, but the effect of the proportion of college graduates in urban areas will make human capital spillovers have a positive effect on increasing, until finally the productivity of all companies also increases.

The movement of people from one place to another is also a driving factor for spillover, which has a positive and significant to economic growth (Purnomo et al., 2019). In-migration promotes economic growth due to population growth. Hence, people's growth leads to improved production of goods and services due to increased consumption. Dewi & Idris (2019) suggested that in-migration has an insignificant negative influence on economic growth. The increase of in-migration triggers a decrease in economic growth (Susanti et al., 2015). Support to relationship between migration and spillover also came from research by Zheng & Du

(2020) concluding that from mega-urban agglomerations of integrated cities strong spillover.

Many previous researches were done in analyzing human capital spillover, especially in how knowledge can be spread over the community trough empirical model (Benos & Karagiannis, 2016; Fauziah et al., 2020; Kaur & Singh, 2016; Rahmayani et al., 2017), including modelling spillover by using input- output table and geographic distance between regions to create the weight matrix in spatial econometric estimation (Kuswardana, Djalal Nachrowi, Aulia Falianty, & Damayanti, 2021). However, there is still few research focused on analyzing spillover from the perspective of high level of education and workers mobility. This research is focused on the human capital spillovers and the effect on labor productivity from 2010 to 2019 by employing the data panel regression. Overall, the research hypothesis tries to reveals that human capital spillovers positively influence labor productivity in Indonesia. It is expected that the research will be beneficial to the government in formulating policies related to improving labor productivity in Indonesia.

RESEARCH METHOD

This research employed the quantitative approach using purposive sampling. Due to data limitations and the needs of minimizing data heterogeneity, only 28 out of 34 provinces were included in the observations. The data were derived from the literature studies and sourced from Indonesia's Statistics Center (BPS) during 2010-2019. Panel data analysis was applied as the analysis technique with the support of Stata v16 to process the data.

This research followed the economic growth model proposed Hall & Jones (1998) which determined that the production function includes its constant return to scale at the time of t, therefore:

$$Y(t) = K(t)^{\alpha}[A(t)H(t)]^{1-\alpha} \quad (1)$$

In which K represents capital, A is the level of knowledge or insights representing workers' effectiveness, and H represents total labor productivity at every skill level. Later, both above equations were divided by Lt and written in the logarithm form to decipher the output difference per worker and reveal the capital contribution per worker while A is considered constant. Then the model was formulated as follows.

$$\dot{y} = \alpha\dot{k} + (1-\alpha)\dot{h} \quad (2)$$

Here, the human capital ($\dot{h}$) was proxied by two factors, which were health and human capital spillovers. Thus, $\dot{h}$ can be decomposed as follows:

$$\dot{y} = \beta_0 + \beta_1\dot{k} + \beta_2 \text{health} + \beta_3 \text{human capital spillovers} \quad (3)$$

Since the model was based on production function developed by Hall & Jones (1998), this research used capital-labor ratio as proxy of Stock Capital ($\dot{k}$) (Hendarmin, 2019; Todaro & Smith, 2011). Capital-labor ratio is defined as the proportion of utilization on physical investment and labor is calculated as the ratio of capital and labor utilization. Here, capital-labor ratio and technology are interrelated. More modern machines can be bought using available capital (Ismail, 2015). The capital-labor ratio can be applied to identify the physical capital in an area, which is essential for productivity improvement.

Not only in identifying proportion physical investment and labor, capital-labor ratio also play important roles in labor productivity. Related research from Yuniasih et al. (2013) explained that labor productivity can be escalated by physical capital stock for 0.05%. When capital and workers are acknowledged only as a replacement input for the economy overall, it can hinder labor productivity from improving to maximum (Arshad & Malik, 2015). Research from Ismail (2015) implied the positive and significant influence of the capital-labor ratio on labor productivity.

As proxy of health, life expectancy was used. Studies by Sudirman & Ahmadi (2014), Putri & Kusreni (2017), Hendarmin & Kartika (2019) and Puspasari & Handayani (2020) indicated the enhancement of labor productivity when life expectancy that measures the health level increases and the low access to health makes life expectancy unable to improve labor productivity significantly. Mehmood et al. (2022) stated that life expectancy shares a positive and significant influence on labor productivity.

To capture education and human capital spillover, this research used average years of schooling (Purnomo et al., 2019), the workers graduating from previous higher education (Benos & Karagiannis, 2016), and a lifetime in-migration (Purnomo et al., 2019).

With the panel data in the equation, the model was formulated as follows.

$$\ln PTK_{it} = \beta_0 + \beta_1 \ln CLR_{it} + \beta_2 \ln AHH_{it} + \beta_3 \ln RLS_t + \beta_4 \ln PPT_{it} + \beta_5 \ln MSU_{it} + \varepsilon_{it} \quad (4)$$

In which lnPTK is labor productivity, lnCLR is the capital-labor ratio, lnAHH is life expectancy, lnRLS is the average length of schooling, lnPPT is workers graduating from the higher education, lnMSU is lifetime in-migration, β_0 is a constant, β_1 is the coefficient of lnCLR, β_2 is the coefficient of lnAHH, β_3 is the coefficient of lnRLS, β_4 is the coefficient of lnPPT, β_5 is the coefficient of lnMSU, ε is the error term, *i* is the cross-section, and *t* is the time series. Meanwhile, β_1, β_2, β_3, β_4, $\beta_5 > 0$, was hypothesized to be positively related to labor productivity. This coefficient would show empirical evidence of human capital spillovers on labor productivity in Indonesia in 2010-2019.

RESULT AND DISCUSSION

Human Capital Quality in Indonesia

To capture the condition of human capital in Indonesia, the HDI value was utilized with the consideration that it is a measure of human development achievement based on a number of basic components of the quality of health indicators, education levels and economic indicators. This measurement used three basic dimensions: length of life, knowledge, and a decent standard of living.

From Table 1, it can be seen that every year the average HDI number in Indonesia had a small increase, from 69.75 in 2017, to 70.38 in 2018 and 71.04 in 2019. From Table 1, it can be seen that provinces in Western Indonesia (Bali, Banten and below) had higher HDI than provinces located in Eastern Indonesia, with an average HDI of 73.04 for provinces in Western Indonesia, and 96.03 for provinces in Eastern Indonesia (2019 data). The trend of inequality between the western and eastern regions of Indonesia cannot be denied, however, to overcome inequality.

Descriptive Analysis

This research included 280 people originating from 28 provinces in Indonesia. Data were taken from 10-year timespan, starting from 2010 to 2019. Table 2 shows that a total of 280 observations was used in this research with an average labor productivity in Indonesia of 3.999352, a minimum labor productivity (lnPTK) of 3.057298 and a maximum of 4.498364. Capital-labor ratio (lnCLR) had an average value of 2.836149, minimum value of 1.916923 and maximum of 3.560478. Health seen from life expectancy (lnAHH) shows an average value of 4.231753, where the minimum value was 4.135167 and the maximum value was 4.316421. The average length of schooling (lnRLS) had an average value of 2.050746, the minimum value of 1.720979 and the maximum value of 2.283402. The average value of workers who completed higher education (lnPPT) was 12.28370, with minimum score of 10.19973 and maximum score of 14.74547. The average population migrating for life (lnMSU) was 12.89262, with a minimum score of 10.96414 and a maximum value of 15.58892. It can be concluded that the value generated by mean is larger than the value generated by the standard of deviation.

Table 1. Indonesian Human Development Index by Province

Province	2017	2018	2019
Aceh	70.60	71.19	71.90
North Sumatera	70.57	71.18	71.74
West Sumatera	71.24	71.73	72.39
Riau	71.79	72.44	73.00
Jambi	69.99	70.65	71.26
South Sumatera	68.86	69.39	70.02
Bengkulu	69.95	70.64	71.21
Lampung	68.25	69.02	69.57
Bangka Belitung Islands	69.99	70.67	71.30
Riau Islands	74.45	74.84	75.48
DKI Jakarta	80.06	80.47	80.76
West Java	70.69	71.30	72.03
Central Java	70.52	71.12	71.73
DI Yogyakarta	78.89	79.53	79.99
East Java	70.27	70.77	71.50
Banten	71.42	71.95	72.44
Bali	74.30	74.77	75.38
West Nusa Tenggara	66.58	67.30	68.14
East Nusa Tenggara	63.73	64.39	65.23
West Kalimantan	66.26	66.98	67.65
Central Kalimantan	69.79	70.42	70.91
South Kalimantan	69.65	70.17	70.72
East Kalimantan	75.12	75.83	76.61
North Sulawesi	71.66	72.20	72.99
Central Sulawesi	68.11	68.88	69.50
South Sulawesi	70.34	70.90	71.66
Southeast Sulawesi	69.86	70.61	71.20
Gorontalo	67.01	67.71	68.49
West Sulawesi	64.30	65.10	65.73
Maluku	68.19	68.87	69.45
North Maluku	67.20	67.76	68.70
West Papua	62.99	63.74	64.70
Papua	59.09	60.06	60.84

Human Capital Spillover to Labor Productivity

Panel Regression was estimated using 2 methods: Fixed Effect Model (FEM) and Random Effect Model

(REM). In the preliminary test to select the appropriate model using the Hausman test, Fixed Effect Model (FEM) was considered a better model than others. However, after accomplishing the classic assumption test, it was revealed that the result showed an unsatisfying result. To solve this, the Fixed Effect Model (FEM) was corrected using the robust standard error and Random Effect Model was corrected using Maximum Likelihood Estimation (Wooldridge, 2016). The final estimation result from the Akaike Information Criterion (AIC) value showed that the Random Effect Model (REM) method improvement (Random_RSE) is the best model. The estimation results can be seen in Table 3.

Table 2. Descriptive Statistics Analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
lnPTK	280	3.999	0.29	3.057	4.498
lnCLR	280	2.836	0.327	1.917	3.56
lnAHH	280	4.232	0.037	4.135	4.316
lnRLS	280	2.051	0.11	1.721	2.283
lnPPT	280	12.284	0.99	10.2	14.745
lnMSU	280	12.893	0.965	10.964	15.589

LnPTK is labor productivity, lnCLR is the capital-labor ratio, lnAHH is life expectancy, lnRLS is the average length of schooling, lnPPT is workers graduating from the higher education, and lnMSU is lifetime in-migration.

Based on Table 3, the goodness of fit model has been fulfilled with a significant value of the probability goodness of fit test (F-test, Wald Chi2, LRChi2). The smallest AIC value is shown by the Random Robust model (-783.2) meaning that of the 4 estimated models, the Random-RSE model is the best model.

Overall, the estimation results in Table 2 show that capital-labor ratio (lnCLR), life expectancy, and average length of schooling (lnRLS), and workers who complete higher education (lnPPT) had a positive significant influence on labor productivity. However, lifetime in-migration (lnMSU) had no significant and negative influence on labor productivity. More in-depth discussion is presented in the next section.

Human capital spillover to Labor Productivity

This research focuses on the productive workforce. As defined by BPS in 2022, the productive age is ranged from 15 to 64 years old. The age range of 7 to 14 years old and above 65 are excluded from the productive workforce category and this research. Yet, it is possible that people in the latter age ranges perform economic activities that produce a certain output. Besides, the utilization of GRDP in calculating labor productivity was carried out by dividing the total GRDP by workers. Thus, it calculated the productivity of a single input, which is workers.

Table 3. Estimation Result

	(1) Fixed	(2) Random	(3) Fixed_RSE	(4) Random_ RSE
main				
lnclr	0.399***	0.462***	0.399***	0.450***
	(0.0370)	(0.0346)	(0.120)	(0.0362)
lnahh	5.111***	2.560***	5.111***	2.892***
	(1.160)	(0.811)	(1.834)	(0.919)
lnrls	0.197	0.373**	0.197	0.365**
	(0.214)	(0.151)	(0.362)	(0.156)
lnptt	0.0469*	0.0454**	0.0469	0.0455**
	(0.0273)	(0.0228)	(0.0448)	(0.0231)
lnmsu	-0.00303	-0.00134	-0.00303	-0.00436
	(0.0325)	(0.0248)	(0.0378)	(0.0255)
cons	-19.70***	-9.449***	-19.70**	-10.77***
	(4.644)	(3.179)	(7.147)	(3.620)
sigma_u cons				0.200***
sigma_e cons				(0.0299) 0.0445***
				(0.00201)
AIC	-970.6	.	-972.6	-783.2
F test	318.10***		110.72***	
Wald chi^2		1533.91***		
LR chi^2				516.97***

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

LnPTK is labor productivity, lnCLR is the capital-labor ratio, lnAHH is life expectancy, lnRLS is the average length of schooling, lnPPT is workers graduating from the higher education, and lnMSU is lifetime in-migration

The estimation result of the main production factor variable, namely capital, showed significant influence on labor productivity. From coefficient value it can be concluded that each 1% raise of the capital-labor ratio increased 0.4503865 % of labor productivity, ceteris paribus. The probability value was 0.0000, lower than the significance level of $\alpha = 0{,}05; 5\%$. This confirm that the more intensive a capital owned by a company, the more productive a company will be. This result is supported by Afrooz, (2011); Afrooz, Rahim, Noor, & Chin (2010); Ismail, (2015). The capital-labor ratio is connected to need of technology. Hence, a company requires technology to improve its production. It causes more expenses in accommodating the company with more new and advanced machines. Once a company is equipped with new and advanced machines, skilled workers are automatically required to operate those machines, and productivity will be leveled up.

This research result is aligned with Solow's growth theory. Solow in Hall & Jones (1999) and Mankiw, Romer, & Weil (1992) explained that in certain technology circumstances, if the utilization of the capital-labor ratio increases, the output per worker of labor productivity will improve. If the available funds can be used to increase the capital-labor ratio through an increase in the production process, it can be predicted that labor productivity will relatively grow faster (Markhaichuk, Panshin, & Chernov, 2022).

Table 4. The Average Workers Graduating from Higher Education for 28 provinces in Indonesia, 2010 to 2019

Year	The Average of Workers Graduating from Higher Education
2010	251,860
2011	268,223
2012	302,787
2013	319,163
2014	343,633
2015	383,389
2016	446,648
2017	452,034
2018	462,638
2019	487,146

Source: BPS (2022)

The quality of human capital as indicated by life expectancy shows that life expectancy had a positive influence on labor productivity. From the coefficient value, it can be concluded that each raise of 1% in the life expectancy increased 2.892287 % of labor productivity, ceteris paribus. The probability value was 0.002, lower than the significance level of $\alpha = 0{,}05; 5\%$. Therefore, it can be verified that life expectancy significantly influenced labor productivity.

The rate of life expectancy, which had a positive and significant influence on labor productivity, is aligned with the research conducted by Putri & Kusreni (2017) which demonstrated that life expectancy numbers have positive and significant effects on labor productivity in 33 provinces in Indonesia, in 2008-2012. The research explained that life expectancy is considerably high if an area is occupied with good health conditions. The health condition highly determines one's productivity. Since health is the crucial basic factor in improving productivity, self-development and life quality improvement will be highest if a person is healthy. A person will often present for work because he is in good condition. On the contrary, a person's productivity will be jeopardized once he has a bad health condition. Automatically, such condition impacts performance and disturbs the output production.

This research result is also supported by Arshad & Malik (2015) that health is the most influential human capital for labor productivity in Malaysia. When a person is in his best physical and spiritual condition, he becomes more productive, earns more payments, and is seldom absent from work. This condition can improve productivity significantly. This statement is also supported by Todaro & Smith (2003) who revealed that workers with good health quality lead to enhanced productivity since the outputs are also significantly improved.

Life expectancy for 28 provinces in Indonesia is still categorized as low, even though every year it keeps increasing. This condition demonstrates the improvements made by the government in terms of the health system and services in Indonesia.

The first human capital spillover indicator, which is average length of schooling, proved to significantly influence labor productivity with a coefficient of 0.3653544. It can be concluded that each raise of 1% in the average length of schooling increased 0.3653544 % for labor productivity, ceteris paribus. The probability value was 0.019, lower than the significance level of $\alpha = 0{,}05; 5\%$.

This positive and significant result for the average length of schooling is supported by Puspasari & Handayani (2020) who stated that the average length of schooling promoted the labor productivity in Central Java from 2010 to 2015 by 0,42%. From the research, it can be notified that human resource quality influences labor productivity, as reflected in health and education quality. A person with higher education can accomplish better productivity based on the assumption that higher education leads to better capability, skill, and insights. These elements could encourage labor productivity.

This result is also supported by Oktavia et al. (2017) who put forward that the average length of schooling positively and significantly influences labor productivity in Sumatera. In agriculture, the condition of the average length of schooling tends to be stagnant—all similarly accomplished 6 years of education, equal to elementary school graduates. The average length of schooling in the agriculture sector increases each year. In 2010, it recorded an average of 6.39 and increased to 6.59 years in 2014. Even though the average length of schooling is documented as low, productivity can be increased. It signifies that

the human resources potency is employed maximally. Therefore, productivity can be increased. According to human capital theory, education will impact economic growth through skill upgrading and productive workers (Hendarmin & Kartika, 2019).

Education in Indonesia demonstrates consistent improvement. The government has to continue accommodating various programs and aids for all people, so they can easily access education-related items to encourage an improved average length of schooling.

The second spillover indicator was the workers graduating from higher education. This variable significantly influenced labor productivity with a coefficient of 0.045478. Therefore, it can be concluded that each raise of 1% in the variable of workers graduating from the higher education increased 0.045478 % of labor productivity, ceteris paribus. The probability value was 0.049, lower than the significance level of α=0,05;5%. Hence, it can be verified that the average length of schooling insignificantly influences labor productivity. Education and training are the key factors. Knowledge, education, and training will be a valuable addition to skills while working, to escalate the labor productivity. The results in this study are also in line with research from Benos & Karagiannis (2016) which estimated the role of human capital towards productivity and showed that human capital has a strong positive association with labor productivity through upper secondary and tertiary education. Chang et al. (2016) also supported this research that higher-educated employees will increase the productivity, which gets higher under greater technology intensity. Meanwhile, research from Susanto & Welly Udjianto (2019) had a different result since they included spatial aspect in their model, that college-educated worker was proved to have no significant effect on human capital.

From the research of Arshad & Malik (2015), it is reported in Malaysia that workers who have accomplished higher education with improper skills occupy the available job opportunity. More than 40% of companies have reported such events. The study of Muhson et al. (2012) proves that the work assignment is totally different from the study major, which is an education major. Yet, the occupation is still related to the economy.

From Table 5, it can be concluded that the number of workers graduating from higher education tends to increase each year in 28 Indonesian provinces. It is important to know that spillovers require skilled workers or an exchange of knowledge to occur, where most of the causes of the spillover effect are skilled workers interacting with each other (Chang et al., 2016). This means that the existence of highly educated workers is able to provide knowledge spillover to the surrounding environment. However, as stated in Indonesia Development Forum (IDF) (2019), it is necessary to watch out for the tendency of the skills of workers who graduated from higher education to be similar to those of workers graduating from their senior high school. In this case, a competence certification is necessary for workers for acknowledgment of expertise.

Table 5. The Average of Lifetime In-migration for 28 provinces in Indonesia, 2010 to 2019

Year	The Average of Lifetime In-migration
2010	700,949
2011	637,887
2012	647,768
2013	619,125
2014	654,231
2015	645,073
2016	647,766
2017	721,666
2018	762,008
2019	758,161

Source: BPS (2022)

The third variable in capturing human capital spillover was lifetime in-migration. Lifetime in-migration did not influence labor productivity with a coefficient of -0.008587. Therefore, it can be concluded that each raise of 1% in the variable of lifetime in-migration increased 0.008587% of labor productivity, ceteris paribus. The probability value was 0.7066, which is bigger than the significance level of $\alpha = 0{,}05; 5\%$. Hence, it can be verified that lifetime in-migration insignificantly influences labor productivity.

Lifetime in-migration that influences labor productivity negatively and significantly is in line with the research by Dewi & Idris (2019). Based on the research, the negative impact of migration can influence economic growth, as referred to by the migration theory. Despite giving a positive impact, such as improving economic growth, it more often delivers bad effects. Every time migrants penetrate an area, they can take over the available job opportunities from local workers. The local inhabitants can lose their jobs, and human resources quality can be reduced. That occurrence may weaken economic

growth. Once it decreases, labor productivity will automatically decline. Both of them are theoretically connected. Therefore, if lifetime in-migration negatively influences economic growth, it applies similarly to labor productivity.

From the scatter plot graph in Table 6, it is confirmed that there is no unidirectional pattern between lifetime in-migration and labor productivity, indicating neither correlation nor regression.

Table 6. The Average of Lifetime In-migration in 5 Main Islands in Indonesia, 2010 to 2019

Island Name	The Average of In-migration
Sumatera Island	578,557
Java Island	2,007,750
Kalimantan Island	424,073
Sulawesi Island	281,382
Papua Island	114,779

Source: BPS (2022)

By referring to the condition of lifetime in-migration for 28 provinces in Indonesia, it can be described that the figure shows a trend of improvement. But along with that, it even decreases labor productivity insignificantly. That occurrence happened due to the difference in impact received by each region. According to Dewi & Idris (2019), urban areas will mostly suffer from migration. At the same time, other smaller areas receive an insignificant impact. This phenomenon is implied by the centralization of people who immigrates to Java and Sumatera Island.

Lifetime in-migration in Indonesia is still unevenly distributed and centralized in Java and Sumatera islands. This uneven distribution causes Indonesia difficulties in tackling the impacts due to the migration. When an area is unprepared to deal with this phenomenon, a negative impact will occur. As revealed in the research by Dewi & Idris (2019), their entries will cost the existing workers to lose their jobs. The workers become less productive, and the quality will decrease; they no longer earn the income and find it difficult to fulfill daily needs. Once labor productivity declines, the economy will be directly affected, leading to decreased economic growth. Therefore, a control towards lifetime migrants should be managed and centralized only in a certain area and should be evenly distributed to other regions.

Research Implication

Based on the results, there are implications given by this study. First, since the capital-labor ratio has a positive and significant effect on labor productivity, it is important to make policies that include increasing the capital used (Ismail, 2015). What can be done is to continue to make equal distribution of infrastructure development and investment, especially for those outside Java Island. With this equal distribution, it is hoped that there will be greater job opportunities because the more investment is done, the more the equipment or technology will increase and qualified workers will be needed to operate the technology, leading to a higher absorption of labor and production output. In addition, the government must continue to ensure that industry in Indonesia implements a labor-intensive system in order to minimize the risk of reducing workforce.

Moreover, life expectancy has a significant positive effect on labor productivity. Health will have an impact on the macroeconomy of a country, so a commitment is needed to overcome health problems. Investment in health needs to be increased so that health system can function properly (Mehmood et al., 2022). The government must continue to make improvements to the quality and quantity of health services, complete facilities and infrastructure that support health, carry out examinations for pregnant women and infants to prevent additional maternal and infant mortality, check child nutrition to prevent stunting, and monitor *Posyandu* (health monitoring facilities for mothers and children). In addition, existing government programs such as the National Health Insurance (JKN) in the form of BPJS and KIS are further optimized so that those who receive health assistance are more targeted. Improvements in the quality of health services can simplify the treatment process.

Meanwhile, in the field of education, the average length of schooling has a positive and significant effect on labor productivity. The government must continue to strive to make a policy that is able to improve the quality of education (Puspasari & Handayani, 2020). Programs that have been carried out by the government, such as the 12-year compulsory education program, need to be optimized. In addition, it is necessary to make equal distribution of educational facilities and infrastructure, especially for remote areas and reduce the development gap for private and public schools so that all people can access education easily and get the same facilities.

To maintain spillover from educated workforce, the government must continue to provide scholarship assistance to prospective students who excel but are hampered by economic conditions that makes it difficult for them to continue their studies. In addition, improvements to higher education facilities and infrastructure need to be carried out. It can be carried out by providing access for urban areas to make it easier for educated workers who want to continue their education (Zheng & Du, 2020). When a person takes higher education, the knowledge and insights are more developed than others who do not. By taking higher education, a mindset is formed to be more advanced, making it easier for one to handle a certain task, which leads to labor productivity improvement. There is a need for training and competency certification for workers so that their skills can be recognized, and later they can get a better job according to his skills. In order for this to be implemented, the government's role is urgently needed to build a cooperative relationship with related institutions to improve the competence of quality graduates (Puspasari & Handayani, 2020). This research focuses on workers graduating from higher education on overall labor productivity. For future research, the human capital spillovers variable that is proxied with the workers graduating from higher education can be separated as the level of education. Hence, the impact of human capital spillovers can be identified more comprehensively to recognize which level of higher education influences labor productivity the most.

Lastly, in-migration for life has no effect on labor productivity, so it is necessary to control and equalize the people who want to migrate. If in-migration in an area is not controlled, it will cause various negative impacts. This can be done by increasing the potential resources owned by each region in Indonesia so that migrants do not only choose certain areas such as Java Island and Sumatra Island. According to Purnomo et al. (2019), human resources must be balanced both in terms of quality and quantity. Therefore, it is necessary to put restrictions on unqualified migrants to enter an area to reduce population density. Lifelong in-migration can increase labor productivity because there will be an exchange of information or knowledge that increases the knowledge of the local community.

CONCLUSION AND SUGGESTION

The average length of school and higher education workers has a significant effect on labor productivity, while lifetime in-migration as one of human capital spillover indicator has no significant effect on labor productivity in Indonesia. It can be concluded that the effect of human capital spillovers in Indonesia is achieved by education channel. Migration alone is not enough to generate human capital spillover. It is related to poor quality of human resources and the centralization of the migrants only in Java and Sumatra Islands. When there are workers who migrate and settle from one area to another, there is no guarantee that those migrant workers have a good quality of human capital. In some cases, migration from rural to urban areas (urbanization) carries a high externality due to the low quality of labor from rural areas moving to cities. But, the level of education embodied in the workforce is proven to be able to generate human capital spillover. Therefore, the government needs to focus its efforts by making policies to improve the quality of education to support of human capital spillover. Further research is expected to be able to use the variable for workers who have graduated from higher education by separating the levels of higher education in order to know specifically which levels of higher education have an effect on labor productivity.

REFERENCES

Adam, L. (2017). Membangun daya saing tenaga kerja indonesia melalui peningkatan produktivitas. Jurnal Kependudukan Indonesia, 11(2), 71. https://doi.org/10.14203/jki.v11i2.205

Adriani, E. (2019). Pengukuran modal manusia (suatu studi literatur). J-MAS (Jurnal Manajemen Dan Sains), 4(1), 176. https://doi.org/10.33087/jmas.v4i1.86

Afrooz, A. (2011). Total factor productivity in food industries of Iran. International Journal of Economics and Finance, 3(1), 47–51. https://doi.org/10.5539/ijef.v3n1p84

Afrooz, A., Rahim, K. B. A., Noor, Z. B. M., & Chin, L. (2010). Human capital and labor productivity in food industries of Iran. International Journal of Economics and Finance, 2(4), 47–51. https://doi.org/10.5539/ijef.v2n4p47

Arham, M. A. (2019). Faktor-faktor Pendorong Produktivitas Tenaga Kerja dan Tantangannya di

Indonesia. In Bunga Rampai Rekomendasi Kebijakan Ekonom Kementerian Keuangan Tahun 2019 (1st ed., Vol. 1, pp. 43–69). Jakarta: Badan Kebijakan Fiskal Kementerian Keuangan. https://doi.org/10.24036/jkep.v1i4.7753

Arshad, M. N. M., & Malik, Z. A. (2015). Quality of human capital and labor productivity : A case of Malaysia. International Journal of Economics, Management and Accounting, 23(1), 37–55. Retrieved from https://journals.iium.edu.my/enmjournal/index.php/enmj/article/view/289

Baharin, R., Syah Aji, R. H., Yussof, I., & Saukani, N. M. (2020). Impact of human resource investment on labor productivity in Indonesia. Iranian Journal of Management Studies, 13(1), 139–164. https://doi.org/10.22059/IJMS.2019.280284.673616

Becker, G. S. (1964). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. New York: National Bureau of Economic Research, Columbia University Press.

Benos, N., & Karagiannis, S. (2016). Do education quality and spillovers matter? evidence on human capital and productivity in Greece. Economic Modelling, 54, 563–573. https://doi.org/10.1016/j.econmod.2016.01.015

BPS (Badan Pusat Statistik). (2022). Analisis Profil Penduduk Indonesia. BPS Pusat, Jakarta

Chang, C.-F. F., Wang, P., & Liu, J.-T. T. (2016). Knowledge spillovers, human capital and productivity. Journal of Macroeconomics, 47(B), 214–232. https://doi.org/10.1016/j.jmacro.2015.11.003

Dewi, E. P., & Idris, I. (2019). Pengaruh tenaga kerja, migrasi masuk dan pembangunan manusia terhadap pertumbuhan ekonomi di Indonesia. Jurnal Kajian Ekonomi dan Pembangunan, 1(2), 251. https://doi.org/10.24036/jkep.v1i2.6168

Fauziah, N., Khoirunurrofik, I., Isnaeni, N. F., & Khoirunurrofik, K. (2020). The effect of knowledge spillovers and human capital through technological intensity on employment growth in Indonesia. Asia-Pacific Journal of Regional Science, 5(0123456789), 21–39. https://doi.org/10.1007/s41685-020-00174-4

Hall, R. E., & Jones, C. I. (1998). Why Do Some COuntries Produce So Much More Output Per Worker That Others? In NBER Working Paper Series (No. 6564). Cambridge. https://doi.org/10.3386/w6564

Hall, R. E., & Jones, C. I. (1999). Why do some countries produce so much more output per worker than others ? Author (s): Robert E . Hall and Charles I . Jones Published by : Oxford University Press. Quarterly Journal of Economics, 114(1), 83–116.

Hendarmin, H. (2019). Menelusuri kembali peran investasi modal manusia dan modal fisik dalam meningkatkan pertumbuhan produktivitas. Jurnal Ekonomi Bisnis Dan Kewirausahaan, 8(3), 216. https://doi.org/10.26418/jebik.v8i3.29813

Hendarmin, H., & Kartika, M. (2019). The relationship between human capital and the regional economy productivity. Jejak, 12(1), 138–152. https://doi.org/10.15294/jejak.v12i1.18396

Indonesia Development Forum (IDF). (2019). Mission Possible: Memanfaatkan Peluang Pekerjaan Masa Depan untuk Mendorong Pertumbuhan Inklusif.

International Labour Organization. (2020). Statistics on Labour Productivity.

International Labour Organization Statistics. (2020). Output per Worker (GDP Constant 2010 US $) -- ILO Model Estimates, Nov. 2020 - Annual.

Ismail, R. (2015). Impact of foreign workers on labour productivity: Analysis of firm level data. International Journal of Productivity and Quality Management, 16(1), 36–53. https://doi.org/10.1504/IJPQM.2015.070191

Kaur, M., & Singh, L. (2016). Knowledge in the economic growth of developing economies. African Journal of Science, Technology, Innovation and Development, 8(2), 205–212. https://doi.org/10.1080/20421338.2016.1147207

Kuswardana, I., Djalal Nachrowi, N., Aulia Falianty, T., & Damayanti, A. (2021). The effect of knowledge spillover on productivity: Evidence from manufacturing industry in Indonesia. Cogent Economics and Finance, 9(1). https://doi.org/10.1080/23322039.2021.1923882

Mahony, M. O., & Riley, R. (2012). Human capital spillovers : The importance of training. INDICSER Discussion Paper, 2.4(December).

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. The Quarterly Journal of Economics, May, 408=437. https://doi.org/10.1016/j.jpolmod.2014.01.001

Markhaichuk, M. M., Panshin, I. V., & Chernov, V. G. (2022). Impact of budget investment on labor productivity in resource models of intellectual capital (on the Example of Russian Regions)*.

Montenegrin Journal of Economics, 18(2), 191–202. https://doi.org/10.14254/1800-5845/2022.18-2.16

Mehmood, A., Siddique, H. M. A., & Ali, A. (2022). Impact of health on worker productivity: evidence from South Asia. Bulletin of Business and Economics, 11(2), 1–8. https://doi.org/10.5281/zenodo.6584755

Moretti, E. (2004). Workers' education, spillovers, and productivity: evidence from plant-level production functions. The American Economic Review, 94(3), 656–690. https://doi.org/10.1257/0002828041464623

Muhson, A., Wahyuni, D., Supriyanto, & Mulyani, E. (2012). Analisis relevansi lulusan perguruan tinggi dengan dunia kerja. Jurnal Economia, 8(1), 42–52. https://doi.org/10.21831/economia.v8i1.800

Oktavia, A., Zulfanetti, & Yulmardi. (2017). Analisis produktivitas tenaga kerja sektor pertanian di Sumatera. Jurnal Paradigma Ekonomika, 12(2), 49–56. https://doi.org/10.22437/paradigma.v12i2.3940

Parman, J. (2012). Good schools make good neighbors: Human capital spillovers in early 20th century agriculture. Explorations in Economic History, 49(3), 316–334. https://doi.org/10.1016/j.eeh.2012.04.002

Pritchett, L. (2001). Where has all the education gone? The World Bank Economic Review, 15(3), 367–391. Retrieved from http://www.jstor.org/stable/3990107

Purnomo, S. D., Istiqomah, & Suharno. (2019). The Effect of human capital and human capital spillover on economic growth. International Conference on Rural Development and Enterpreneurship 2019: Enhancing Small Busniness and Rural Development Toward Industrial Revolution 4.0, 5(1), 518–524. Retrieved from http://jp.feb.unsoed.ac.id/index.php/Icore/article/viewFile/1512/1523

Puspasari, D. A., & Handayani, H. R. (2020). Analisis pengaruh pendidikan, kesehatan, dan upah terhadap produktivitas tenaga kerja di provinsi Jawa Tengah. Jurnal Dinamika Ekonomi Pembangunan, 3(1), 65–76. https://doi.org/10.14710/jdep.3.1.65-76

Putri, Y. A. K. D., & Kusreni, S. (2017). Analisis pengaruh tingkat kesehatan, tingkat pendidikan, dan upah terhadap produktivitas tenaga kerja di Indonesia. Jiep, 17(2), 67–77. https://doi.org/10.20961/jiep.v17i2.14930

Rahmayani, D., Sugiyanto, F. X., & Kurnia, A. S. (2017). Does human capital spillovers promote economic growth in indonesia? (panel data analysis with gravity's approach). Advanced Science Letters, 23(8), 7114–7117. https://doi.org/10.1166/asl.2017.9304

Salam, S. A., & Prishardoyo, B. (2018). Pengaruh human capital spillover effects terhadap produktivitas industri pengolahan kawasan Kedungsepur. Economics Development Analysis Journal, 5(2), 226–234. https://doi.org/10.15294/edaj.v5i2.22036

Schultz, T. W. (1961). Investment in human capital. The American Economic Review, 51(1), 1–17. Retrieved from http://www.jstor.org/stable/1818907

Sudirman, & Ahmadi. (2014). Pengaruh pendidikan, upah, dan angka harapan hidup terhadap produktivitas tenaga kerja sektor ekonomi di Provinsi Jambi. Jurnal Ilmiah Universitas Batanghari Jambi, 14(4), 65–72. https://doi.org/10.33087/jiubj.v14i4

Sugiharti, R. R., Islami, F. S., & Pramudiastuti, O. L. (2021). Is educated labor really productive? Economics Development Analysis Journal, 10(1), 43–53. https://doi.org/10.15294/edaj.v10i1.42530

Sugiharti, R. R. R. R., Sugiyanto, F., & Kurnia, A. S. A. S. (2017). Does age economy affect productivity?—A survey on sub national of central Java Province. Advanced Science Letters, 23(8), 7146–7149. https://doi.org/10.1166/asl.2017.9312

Susanti, D. D., Komariyah, S., & Muslihatinningsih, F. (2015). Pengaruh migrasi dan tenaga kerja terhadap PDRB Kabupaten Jember Tahun 2003-2011. E-Journal Ekonomi Bisnis Dan Akuntansi, 2(1), 13–22. https://doi.org/10.19184/ejeba.v2i1.1401.

Susanto, J., & Welly Udjianto, D. (2019). Human capital spillovers and human development index in Yogyakarta Special Region and Central Java. International Journal of Innovation and Economic Development, 5(2), 57–64. https://doi.org/10.18775/ijied.1849-7551-7020.2015.52.2004

Todaro, M.P., & Smith, S. C. (2003). Pembangunan Ekonomi di Dunia Ketiga (8. Jilid 2). Jakarta: Erlangga.

Todaro, Michael P, & Smith, S. C. (2011). Pembangunan Ekonomi (11th ed.; A. Maulana, Ed.). Jakarta: Penerbit Erlangga.

Wooldridge, J. M. (2016). Introductory Econometrics: A Modern Approach. In Tolerance Analysis of Electronic Circuits Using MATHCAD. Boston: Cengage Learing. https://doi.org/10.1201/9781315215402-43

Yuniasih, A. F., Firdaus, M., & Fahmi, I. (2013). Disparitas, konvergensi, dan determinan produktivitas tenaga kerja regional di Indonesia. Jurnal Ekonomi Dan Pembangunan Indonesia, 14(1), 63–81. https://doi.org/10.21002/jepi.v14i1.447

Zheng, S., & Du, R. (2020). How does urban agglomeration integration promote entrepreneurship in China? Evidence from regional human capital spillovers and market integration. Cities, 97(October 2019), 1–16. https://doi.org/10.1016/j.cities.2019.102529

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Socioeconomic impacts of flooding in South-Eastern Nigeria: Causes, coping strategies, and flood control measures

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ABSTRACT

The occurrence of floods in Nigeria, particularly in the South-Eastern zones, has resulted in significant socioeconomic losses and continues to be a recurring hazard. This study aims to investigate the socioeconomic impacts of flooding in the region, identify causes and coping strategies, suggest measures for flood control, and evaluate the role of the government in flood management. The study collected data through a questionnaire distributed to 200 respondents and analyzed it using simple percentages, frequency distribution tables, and bar charts. The findings reveal that the incidence of flooding has a significant impact on the socioeconomic activity of the affected communities. To address this issue, proactive and reliable measures are necessary, such as reviewing urban plans and policies, establishing state response desks and relief centers in flood-prone areas, etc. These steps can provide long-term results and promote socio-economic growth in the region. Overall, the study highlights the need for effective flood management strategies to minimize the negative effects on communities and foster sustainable development in Nigeria.

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INTRODUCTION

Floods represent one of the most prevalent natural hazards-caused disasters in Nigeria. The occurrence of floods is typically associated with an excessive amount of rainfall or precipitation, combined with low absorption rates, which results in the overflow of river or sea banks beyond their normal bounds (Echendu, 2021). The increasing precipitation levels resulting from climate change have led to a rise in the frequency of yearly floods during Nigeria's rainy seasons, affecting the majority of the country's states (Agbonkhese et al., 2014). Unlike certain natural disasters, rainfall flooding can be effectively managed through appropriate planning and infrastructure development (Ebuzoeme, 2015). However, flooding in Nigeria is primarily attributed to anthropogenic causes, exacerbated by inadequate urban design practices and insufficient environmental infrastructure. Nigerian cities have undergone extensive physical development, including the construction, reconstruction, and modernization of roads, offices, markets, stores, manufacturing industries, and other industries, without adequate infrastructure, such as road drainage and canals to support them. As a result, floods have become a significant problem, particularly in several communities in the south-eastern part of the country (Nkwunonwo, 2016).

The primary cause of flooding in Nigeria is human-made, resulting from poor urban planning practices, inadequate drainage systems, and a lack of effective water channels/gutters, which exacerbate the problem (Arnell & Gosling, 2016). Most residential areas in Nigeria lack proper drainage systems and instead rely on natural drainage channels. Inadequate waste management systems and poor attitudes towards trash disposal also contribute to flooding (Ajiboye & Orebiyi, 2022). Nigeria's urban planning is inadequate, and the lack of proper planning is a significant contributor to floods, exacerbated by corruption and poor enforcement of planning legislation. The absence of a National Flood Risk Management (FRM) plan or comprehensive flood risk maps is indicative of Nigeria's neglect of the flood problem (Arnell & Gosling, 2016). Therefore, it is imperative to develop and implement adequate FRM plans that include proper spatial planning and infrastructure to manage floods, which have long-term detrimental effects on Nigeria's development (Nnadi et al., 2019). Previous studies suggest that communities need to be educated about disaster risk, State Response Desks and Relief Centers established in high-risk areas, disaster mapping conducted, and community coping mechanisms improved (Arnell & Gosling, 2016).

Flooding is excess water flowing onto the normally dry ground (Djimesah et al., 2018), for instance when rainfall exceeds the soil's capacity to absorb it. This results in serious effects on the environment (Nwachukwu et al., 2018). Floods in Nigeria are largely predictable, occurring as periodic flash floods throughout the rainy season, particularly along the coast, riverbanks, canals, and estuaries. Rainfall flooding, unlike certain natural disasters, may be managed with adequate planning and the installation of appropriate infrastructure (Satterthwaite, 2017). The primary natural source of floods triggered by climate change is excessive precipitation (MacLeod et al., 2021). Rather than maximum precipitation, (Tramblay et al., 2021) associate flood occurrence with the highest level of soil moisture. The saturation of the wetlands in riverine areas as well as the general global rise in sea level caused by global warming (Echendu, 2021). Floods are natural events, according to (Blöschl et al., 2015), and man does not cause them, however, his actions in deforestation and agricultural operations, particularly in flood-prone areas, have increased flood incidence over the world.

By fostering artificial conditions that might result in excessive run-off, which is the primary cause of flooding, humans seem to be exacerbating the issue. Human activities, such as the construction of impervious surfaces made of concrete and asphalt, have altered the natural landscape by replacing naturally occurring soils and rocks that are capable of absorbing water like sponges. These impervious surfaces prevent the percolation of water into the ground, resulting in an increased amount of surface runoff. This increase in surface runoff can lead to flash floods and other forms of flooding, which can cause significant damage to both human and natural systems. The replacement of natural surfaces with impervious surfaces is a form of land use change that can have far-reaching impacts on the hydrological cycle and other ecosystem processes warming (Ajiboye & Orebiyi, 2022). In addition, humans are also a big contributor to the issue in many watersheds since their usage of dams, canals, and irrigation systems occasionally worsens the circumstances that cause droughts and floods (Parsons, 2022). Flooding has immediate socioeconomic consequences since it affects day-to-day operations and activities (Arnell & Gosling, 2016). A previous study on the socioeconomic impacts of flooding in the metropolis of Port-Harcourt opined on the aggressive review of the state master plan and the implementation of development control (Ikechukwu, 2015).

This study represents a pioneering effort that comprehensively examines the phenomenon of flooding across the entire South-eastern region of Nigeria, which includes Abia, Anambra, Ebonyi, Enugu, and Imo. While a considerable body of research has been undertaken regarding flooding incidents in Nigeria, studies specifically examining the socioeconomic impacts of flooding across the South-eastern states are limited. The present study seeks to fill this critical gap by investigating the broad-ranging socioeconomic effects of flooding across the entire South-eastern region of Nigeria.

The objective of this study is to identify and analyze the causes and impacts of floods and to assess the coping strategies utilized by the communities affected by floods. Additionally, the study aims to suggest measures for flood control and to evaluate the role of the government in flood management in the study area.

RESEARCH METHOD

The study area is the States in the South-Eastern part of Nigeria (Figure 1). It includes Abia, Anambra, Ebonyi, Enugu, and Imo states. The Eastern region of Nigeria was geographically located in South-Eastern Nigeria. It is bordered by the river Niger in the West and has an administrative and cultural border with the Northern region of Nigeria to the north. The southern shore runs along the Gulf of Guinea, and the eastern boundary is located between the borders of Nigeria and Cameroon. The area's total surface area was about 76,145.65 square km (29,400 square mi).

In this region, humidity is high, ranging from 80 to 85% during the rainy season and 60% during the dry season (Nnadi et al., 2019). These events are responsible for the study area's high annual rainfall, which is concentrated in one season and ranges from 1,400 mm to 2,500 mm with only around four months of dryness, from November to February. Because of this, the study's natural vegetation is tropical dry or deciduous, which once consisted of large trees, dense undergrowth, and numerous climbers.

The South-eastern region of Nigeria is located within a belt of forest and grassland, a significant portion of which has been converted to agricultural land, mainly for the cultivation of oil palm trees. Agricultural practices in the region are heavily dependent on seasonal rainfall patterns, which are typically characterized by seven months of intense tropical rains from April to October, followed by five months of water scarcity from November to March. The region is also impacted by the Harmattan, a dry and dusty wind that typically arrives in late December or early January, resulting in reduced visibility and blocked sunlight.

Local inhabitants rely on crop farming, livestock rearing, fishing, and small-scale trading for their livelihoods, with both men and women typically engaged in multiple low-volume income-generating activities. The main food crops grown in the region include yam, cassava, rice, plantains, and vegetables, while the most significant cash crops are palm oil, rubber, coconuts, and cocoa.

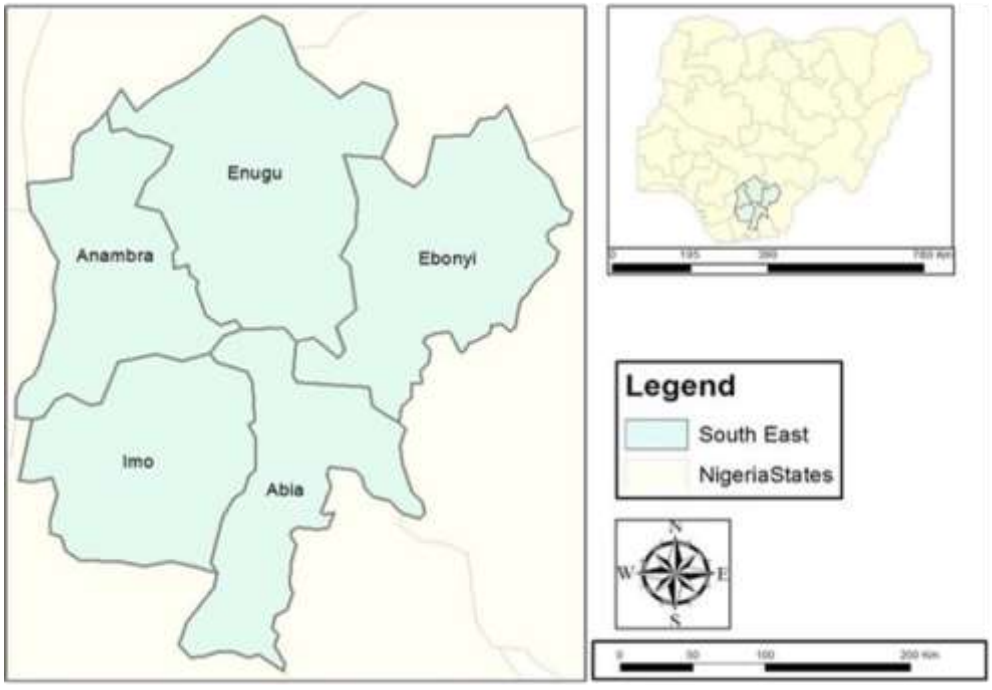

Figure 1. Map of the study area (NEMA, 2012)

The area is characterized by compound farms with semi-domesticated trees such as breadfruit, wild mango, African oil bean tree, and African pear. Livestock rearing includes chickens, goats, sheep, and miniature cattle, while commercial poultry farming is also significant. The extraction of mineral resources such as coal, limestone, zinc, lead, iron, and crude oil is an important economic activity, providing both skilled and unskilled labor opportunities. The region is also home to a thriving manufacturing industry, and petty trade is a common form of exchange for locally produced and imported goods. Urban areas provide employment opportunities in the public and private sectors of the health, financial, educational, and other industries (Danladi et al., 2015; Okpa, 2022).

Primary data were collected using a structured online questionnaire survey, which included demographic and socioeconomic information as well as flood occurrence data. The questionnaire was distributed to 200 respondents across the five states comprising the study area in southeast Nigeria, allowing for a broad range of perspectives. The data collection process was conducted electronically via email and WhatsApp, with respondent contact information retained for potential data clarification and validation. Additionally, secondary data sources were utilized, including previous research works, seminars, interviews, books, journals, newspapers, and the bureau of statistics. These sources provided a comprehensive understanding of the flood situation and its socio-economic impacts in the study area.

Table 1. Questionnaires Distribution

No	States	Number of samples	Percentage
			%
1	Abia	29	14.5
2	Anambra	62	31.0
3	Ebonyi	33	16.5
4	Enugu	42	21.0
5	Imo	34	17.0
	Total	200	100.0

Table 1 shows a breakdown of the 200 questionnaires distributed in the study area, where 14.5% of the questionnaires were distributed in Abia state, 31% in Anambra state, 16.5% in Ebonyi state, 21% in Enugu state, and 17% in Imo state were returned.

The data gathered from the respondents were combined and analyzed. To improve the strategy for disaster management approach in the research region, recommendations were given to stakeholders and the Government at various levels to take into consideration those effects in the study to be employed in their disaster risk reduction measures. The data collected were checked for errors, then inputted into Microsoft Excel and SPSS, then arranged and sorted using the selected variables to get cross-tabulation. Statistical analysis was carried out and interpreted to determine the significance of the variables.

RESULT AND DISCUSSION

Overview of Respondents' Demography

The majority of the respondent (38.5%) are within the age bracket of 20-29 years, and more than half of the respondents (58%) are graduates, while 67.5% of the respondents are civil servants (See Table 2).

Table 2. Respondents' Demography

No	Characteristic	Frequency	Percentage
			%
1	Educational		
	No Formal	4	2
	Primary	58	29
	Secondary	22	11
	Tertiary	116	58
2	Age		
	20-29	77	38.5
	30-39	70	35
	40-49	40	20
	Above 50	8	4
	Below 20	5	2.5
3	Marital Status		
	Divorce	1	0.5
	Married	119	59.5
	Single	78	39
	Widowed	2	1
4	Occupation		
	Artisan	33	16.5
	Civil Servant	135	67.5
	Entrepreneur	20	10
	Trader	12	6
5	Gender		
	Female	73	36.5
	Male	127	63.5

Level of Exposure to Flooding

The findings of the present analysis indicate that the surveyed participants reported the occurrence frequency of flood events in the studied region.

Specifically, a considerable proportion of respondents (68%) reported that floods take place intermittently, while 62% reported that they occur frequently. Moreover, a significant number of participants (60%) reported that floods always occur in the studied area. In contrast, only a minority of respondents (7% and 3%) reported that flood events are rare or have never occurred in their respective states.

Table 3 shows the causes of flood in the study area and its distribution among the respondents, 28.5% of the respondents attributed the cause of flood to haphazard dumping of solid waste, 28% of the respondents reported that encroachment of river valley, 19% reported the cause to be deforestation and inappropriate agricultural use, while 24% of the respondents linked it to lack of stormwater drainage system.

Table 3. Causes of Flood

No	Cause of Flooding	Frequency	Percentage %
1	Deforestation and inappropriate agricultural use'	38	19.0
2	Encroachment of river valley	56	28.0
3	Haphazard dumping of solid waste	33	28.5
4	Lack of stormwater drainage system	48	24.0

The results of this study reveal important insights into the causes and impacts of floods in the study area, as well as the coping strategies and flood control measures adopted by the communities. This study found that a significant proportion of respondents attributed the cause of flood to haphazard dumping of solid waste and encroachment of river valley. Deforestation and inappropriate agricultural use were also reported as contributing factors, as well as the lack of a stormwater drainage system. Previous studies also stated various factors that contribute to floods, such as land use changes, deforestation, urbanization, and climate change. They also suggest different approaches to flood management, including structural measures such as drainage systems, dams, and embankments, and non-structural measures such as flood forecasting and warning systems, land-use planning, and community-based approaches (Waghwala & Agnihotri, 2019; Yildirim & Demir, 2021).

Socio-economic Effects of Flooding

Flooding has both immediate and long-term socioeconomic consequences that significantly impact day-to-day activities. The immediate effects of flood disasters include the destruction of homes and properties, leading to the displacement of hundreds of individuals in the study area. The flood disaster also results in significant damage to livelihoods such as farming, poultry, and animal husbandry. The medium to long-term consequences of floods include food shortages, high food costs, and the high cost of rebuilding destroyed infrastructure. Moreover, flood incidents in the region often result in the deterioration of health conditions due to water-borne diseases. It is essential to consider the immediate and long-term effects of flooding to develop effective flood management and prevention strategies that can mitigate the adverse socioeconomic impacts of flooding.

Table 4 demonstrates the significant socioeconomic impact of floods in the communities. For all of the items evaluated, exceptionally high mean response values more than a threshold of 3 served as evidence for this. The responses were skewed towards "a very strong effect" for all the items due to the low standard deviations that were very near to the mean and little variability of responses. Even though there is variation in the levels of replies for each item category, the table shows that the majority of respondents express some level of displeasure with how flooding has affected their states.

The socioeconomic impact of floods was found to be significant, with respondents expressing some level of displeasure with how flooding has affected their states. The coping strategies adopted by the communities included raising doorsteps and pit latrines, constructing protective walls, and elevating house foundations, among others. The results of this study are also in line with previous studies showing that floods can have significant socio-economic impacts on affected communities, and that communities often adopt various coping strategies to reduce these impacts, including building houses and latrines, constructing protective infrastructure, and diversify livelihoods (Mensah & Ahadzie, 2020; Mai et al., 2020; Abubakari & Twum, 2019; Munyai et al., 2019; Echendu, 2020; Khan et al., 2021; Yushanthi & Nianthi, 2021).

Table 4. The Respondents' Answers on the Effects of Flood Incidence on Socio-Economic Activities.

No	Item	High	Very High	Mean	SD
		n (%)	n (%)		
1	Farmland	74 (37)	40 (20)	33	2.456.058
2	Crops Output	70 (35)	68 (34)	22	2.616.519
3	Plants Growth	81 (40,5)	59 (29,5)	28	2.894.259
4	Economic trees	34 (17)	119 (59,5)	50	4.025.543
5	Storage Facilities	21 (10,5)	112 (56)	50	3.778.227
6	Crops Species	19 (9,5)	121 (60,5)	33	4.112.042
7	Quality of Crop	20 (10)	108 (54)	50	3.458.323
8	Untimely Harvest	20 (10)	99 (49)	33	3.584.535
9	Death of Livestock	24 (12)	99 (49,5)	50	4.788.006
10	Animal Epidemics e.g; flu	25 (12,5)	114 (57)	40	3.911.521
11	Animal Ranching	25 (12,5)	110 (55)	40	371.322
12	Fishpond	32 (16)	109 (54,5)	33	3.716.031
13	Loss of Varieties of fish Species	11 (5,5)	109 (54,5)	50	4.616.817
14	Increased in the Price of Food	17 (8,5)	116 (58)	40	4.106.093
15	Affordability	25 (12,5)	104 (52)	50	3.592.353
16	Food Scarcity	22 (11)	115 (57,5)	50	3.970.516
17	Loss of Business Partne2 1	19 (9,5)	112 (56)	40	3.916.631
18	Loss of Business Partner 2	22 (11)	115 (57,5)	50	4.067.555
19	Laying off of Sales Persons	27 (13,5)	110 (55)	50	3.597.916
20	Epidemics e.g Cholera	25 (12,5)	110 (55)	40	371.322
21	Loss of Lives	31 (15,5)	119 (59,5)	50	4.021.816
22	Migration	28 (14)	102 (51)	50	3.045.488
23	Residential Houses	13 (6,5)	126 (63)	50	4.546.977
24	Household Properties	78 (39)	69 (34,5)	40	2.931.211
25	Markets	11 (5,5)	122 (61)	25	3.911.521
26	Schools	78 (39)	68 (34)	40	2.897.585
27	Roads	88 (44)	42 (21)	50	2.267.157
28	Electricity	86 (43)	55 (27,5)	50	2.540.669

According to the data analysis, majority of the respondents (44%) always raise their doorsteps and pit latrines, 36% construct protective walls and elevation of the house foundation, 9% use sandbags and tree logs, while 11% of the respondents use pipe outlets as their coping strategy. The major coping strategy utilized by the communities for flood adaptation is the construction of drainages and the building of dams/embankments (47%), and control of housing development (36%), while 17% initiate solid waste management practice. This study reveals measures for flood control in the study area. The respondents agreed that the roles played by the government include the use of community leaders (7%), government involvement (14%), and the use of media such as tv (19%), while the majority (60%) of the flood control measures is through the use of sensitization by government agencies.

The government's involvement in flood control has been low as reported by the respondents. Most of the respondents (30%) agreed that the government's commitment has been mainly to public awareness/education. In their opinion, indiscriminating dumping regulations (31%), and cleaning of drainage basins (23%) from the government are too poor, while 16% stated that they don't know about the government's efforts. Most of the respondents (11%) agreed that the government's absence plays a significant effort in terms of halting the flood menace. In their opinion, corruption (39%) and political issues (28%) are responsible for the lack of success in halting the flood menace through community efforts.

Some respondents (30%) agree that flood incidents sometimes occur in their state, 28% agreed that it often occurs, 30% of the respondents believe that there is always a flood incidence, while 8% said that it rarely occurs.

The major flood control measures identified by the respondents included the construction of drainages and the building of dams/embankments, as well as the control of housing development. However, the study found that the government's involvement in flood control has been low, with most respondents agreeing

that the government's commitment has been mainly to public awareness/education. Indiscriminating dumping regulations and cleaning of drainage basins were also reported as being too poor. Other studies also showed that while there were effective flood control measures in place, government involvement in flood management may be insufficient in some areas, with more resources needed for the actual construction and maintenance of infrastructure, and better regulations to deal with haphazard disposal and cleaning of drainage canals (Shrestha & Kawasaki, 2020; Qi et al., 2021; Rubinato et al., 2019; Mohanty et al., 2020; Campbell et al., 2019; Poku-Boansi et al., 2020; Sarma & Rajkhowa, 2021).

Overall, this study highlights the need for greater government involvement and support in flood control efforts in the study area. This may involve improving regulations and enforcement related to waste management and housing development, as well as investing in stormwater drainage systems and other flood control infrastructure. Additionally, there may be a need for increased public education and awareness campaigns to promote better flood preparedness and response among the communities.

Research Implication

This research has identified several significant consequences for local communities and economies. Floods can cause several physical losses, including damage to houses, infrastructure and public facilities. This condition certainly has a negative impact on people's daily lives, including one that makes it difficult for the community to access basic services such as clean water, electricity, and transportation. Floods also have a significant impact on the agricultural sector. The increasing frequency of floods can cause damage to crops and agricultural land. This condition contributes to decreased production and ultimately harms farmers. If this condition is not treated immediately, it will have an impact on food security and economic stability in the area.

The findings of this study have important implications for policy and practice aimed at reducing the occurrence and impact of flooding events in the studied region. Specifically, the identified causes of flooding highlight the need for targeted interventions, such as effective waste management, river valley preservation, sustainable agricultural practices, and improved infrastructure. Effective waste management has been demonstrated in previous studies to lower the danger of floods. Several studies emphasize the value of effective sewage treatment facilities and the need to reduce water pollution to ease the burden on rivers and drainage systems (Karamouz et al., 2018; Mishra et al., 2017; Woodward et al., 2021). Reduced flooding is largely a result of regulations that carefully control waste management and robust law enforcement (Adekola et al., 2020). Additionally, protecting river valleys has shown to be a successful method of lowering the frequency of flooding (van Der Meulen et al., 2021). According to studies, actions including installing riparian vegetation, constructing dams, and changing the drainage system can assist in decreasing excessive water run-off during heavy downpours. This plan not only lessens the chance of floods but also contributes to preserving a healthy river ecology (Rideout et al., 2022).

According to previous research, sustainable agriculture methods can also significantly contribute to lessening flooding. Crop rotation, upkeep of ground cover plants, and effective irrigation management are examples of sustainable agricultural practices that can decrease soil erosion and improve water retention. As a result, the chance of flooding brought on by runoff can be significantly diminished (Basche & DeLonge, 2019; Tian et al., 2021). A major factor in lowering floods is infrastructure improvement. Ample drainage channels, sturdy river embankments, and effective rainwater collection systems are only a few examples of the infrastructure that can withstand significant water flows highlighted in previous research (Chia et al., 2020; Shah et al., 2020).

Moreover, the severe and persistent impact of flooding events on affected communities underscores the need for emergency relief and financial assistance to support affected individuals and communities. Several studies show that flooding disrupts daily activities, such as loss of shelter, disruption of access to essential services (clean water, sanitation, and electricity), and physical and mental health losses. Floods that significantly and continuously impact the community emphasize the need for emergency assistance, including financial aid. This assistance can reduce community losses and help post-flood recovery if provided quickly and effectively—some assistance including food stocks, clean water supplies, temporary shelter, and health care services. In addition to these aids, financial assistance is also important to help individuals and communities overcome the economic losses caused by floods. Research has shown that

financial assistance can help replace property losses, restore economic activity, and support post-flood reconstruction efforts. Financial aid can also strengthen community resilience to future flooding through investments in flood-resilient infrastructure, insurance protection programs, and training in disaster risk management (Laurien et al., 2020; Dinh et al., 2021).

Despite the valuable insights provided by this study, there are several limitations that should be considered when interpreting the results. Firstly, the study utilized a relatively small sample size, limiting the generalizability of the findings. Additionally, the study relied solely on self-reported data, which may be subject to response bias and measurement error. Furthermore, the study did not account for potential confounding variables, such as climate change, which could have influenced the occurrence and impact of flooding events.

Further research could build on the present study by utilizing a larger and more representative sample size, and incorporating additional data sources and methods to triangulate the findings. Future studies could also incorporate objective measures of flood events, such as remote sensing and GIS data, to supplement self-reported data. Additionally, further research could explore the role of climate change and other potential confounding variables in the occurrence and impact of flooding events. Finally, research could explore the effectiveness of various strategies and policies aimed at mitigating the causes and adverse socioeconomic impact of flooding events in the studied region, and identify best practices for improving the resilience of affected communities.

The findings of this study have important implications for policy and practice aimed at reducing the occurrence and impact of flooding events in the studied region. Specifically, the identified causes of flooding highlight the need for targeted interventions, such as effective waste management, river valley preservation, sustainable agricultural practices, and improved infrastructure. Moreover, the severe and persistent impact of flooding events on affected communities underscores the need for emergency relief and financial assistance to support affected individuals and communities. However, the limitations of this study suggest that further research is necessary to confirm and extend these findings. Future research should aim to utilize larger and more representative samples, objective measures of flood events, and consideration of confounding variables, such as climate change. Additionally, research could explore the effectiveness of various strategies and policies to mitigate the causes and impact of flooding events, and identify best practices for improving community resilience. Overall, this study provides a crucial foundation for future research and policy aimed at addressing the complex challenges associated with flooding events in the studied region.

CONCLUSION AND SUGGESTION

The study's findings suggest that floods in the study area are caused by haphazard dumping of solid waste (28.5%), encroachment of river valleys (28%), lack of stormwater drainage systems (24%) and deforestation and inappropriate agricultural use (19%). The study also found that floods occur frequently in the area, causing significant socioeconomic impacts on the communities. The coping strategies utilized by the communities include raising doorsteps and pit latrines (44%), constructing protective walls and elevation of the house foundation (36%), using pipe outlets (11%), and using sandbags and tree logs (9%). The major coping strategies for flood adaptation are the construction of drainages and the building of dams/embankments and control of housing development, while solid waste management practices are less utilized.

According to the findings, there needs to be more government engagement in flood mitigation and issues with unfair disposal rules and poor drainage canal upkeep. This emphasizes the requirement for better flood control practices and supervision of current infrastructure, particularly for stricter laws and vigorous law enforcement, ensuring responsible waste disposal and maintaining suitable drainage channels. In addition, problems with politics and corruption were noted as obstacles to the viability of community-based flood management initiatives. Therefore, there is a need for enhanced openness in the use of resources for flood control and changes to governance. Corruption and political difficulties, which might obstruct the implementation of practical flood remedies, should be addressed more. The results of this study's consequences highlight the significance of robust government involvement and significant commitment to flood management. Specific corrective actions are required to enhance governance, infrastructure upkeep, and regulation. Communities

may lessen the adverse social and economic effects of floods and become more resilient to these disasters by improving the effectiveness and efficiency of their flood response.

Practically, the study's findings could be utilized to inform policy decisions on flood management in the study area. The government could increase its involvement in flood control, with particular emphasis on enforcing indiscriminating dumping regulations and cleaning of drainage basins. There could also be more investment in the construction of drainages and the building of dams/embankments, as these were identified as major coping strategies for flood adaptation. Additionally, sensitization and education campaigns could be intensified to increase public awareness on flood management and prevention.

REFERENCES

Abubakari, M., & Twum, K. O. (2019). Cities and floods: A pragmatic insight into the determinants of households' coping strategies to floods in informal Accra, Ghana. Jàmbá: Journal of Disaster Risk Studies, 11(1), 1-14. https://doi.org/10.4102/jamba.v11i1.608

Adekola, O., Lamond, J., Adelekan, I., & Eze, E. B. (2020). Evaluating flood adaptation governance in the city of Calabar, Nigeria. Climate and Development, 12(9), 840-853. https://doi.org/10.1080/17565529.2019.1700771

Agbonkhese, O., Agbonkhese, E. G., Aka, E. O., Joe-Abaya, J., Ocholi, M., & Adekunle, A. (2014). Flood menace in Nigeria: impacts, remedial and management strategies. Civil and Environmental Research, 6(4), 32-40.

Ajiboye, O., & Orebiyi, E. (2022). Assessment of socio-economic effects of flooding on selected communities of Anambra West Local Government Area, Southeast, Nigeria. GeoJournal, 87(5), 3575-3590. https://doi.org/10.1007/s10708-021-10400-x

Arnell, N. W., & Gosling, S. N. (2016). The impacts of climate change on river flood risk at the global scale. Climatic Change, 134, 387-401. https://doi.org/10.1007/s10584-014-1084-5

Basche, A. D., & DeLonge, M. S. (2019). Comparing infiltration rates in soils managed with conventional and alternative farming methods: A meta-analysis. PLoS One, 14(9), e0215702. https://doi.org/10.1371/journal.pone.0215702

Blöschl, G., Gaál, L., Hall, J., Kiss, A., Komma, J., Nester, T., ... & Viglione, A. (2015). Increasing river floods: fiction or reality?. Wiley Interdisciplinary Reviews: Water, 2(4), 329-344.

Campbell, K. A., Laurien, F., Czajkowski, J., Keating, A., Hochrainer-Stigler, S., & Montgomery, M. (2019). First insights from the Flood Resilience Measurement Tool: A large-scale community flood resilience analysis. International Journal of Disaster Risk Reduction, 40, 101257. https://doi.org/10.1016/j.ijdrr.2019.101257

Chia, B., Wang, Y., & Chen, Y. (2020). Flood resilience of urban river restoration projects: Case studies in Hong Kong. Journal of Management in Engineering, 36(5), 05020009. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000809

Danladi, J. D., Akomolafe, K. J., Babalola, O., & Oladipupo, A. R. (2015). Globalization and the Nigerian manufacturing sector. JL Pol'y & Globalization, 41, 202.

Dinh, N. C., Ubukata, F., Tan, N. Q., & Ha, V. H. (2021). How do social connections accelerate post-flood recovery? Insights from a survey of rural households in central Vietnam. International Journal of Disaster Risk Reduction, 61, 102342. https://doi.org/10.1016/j.ijdrr.2021.102342

Djimesah, I. E., Okine, A. N. D., & Mireku, K. K. (2018). Influential factors in creating warning systems towards flood disaster management in Ghana: An analysis of 2007 Northern flood. International journal of disaster risk reduction, 28, 318-326. https://doi.org/10.1016/j.ijdrr.2018.03.012

Ebuzoeme, O. D. (2015). Evaluating the effects of flooding in six communities in Awka anambra state of Nigeria. Journal of Environment and Earth Science, 5(4), 26-38.

Echendu, A. J. (2020). The impact of flooding on Nigeria's sustainable development goals (SDGs). Ecosystem Health and Sustainability, 6(1), 1791735. https://doi.org/10.1080/20964129.2020.1791735

Echendu, A. J. (2021). Relationship between urban planning and flooding in Port Harcourt city, Nigeria; insights from planning professionals. Journal of Flood Risk Management, 14(2), e12693. https://doi.org/10.1111/jfr3.12693

Ikechukwu, E. E. (2015). Socio-economic impacts of flooding on the residents of Port Harcourt Metropolis in Rivers state, Nigeria. Natural resources, 6(01), 1. https://doi.org/10.4236/nr.2015.61001

Karamouz, M., Rasoulnia, E., Olyaei, M. A., & Zahmatkesh, Z. (2018). Prioritizing investments in improving flood resilience and reliability of wastewater treatment infrastructure. Journal of Infrastructure Systems, 24(4), 04018021. https://doi.org/10.1061/(ASCE)IS.1943-555X.0000434

Khan, I., Lei, H., Shah, A. A., Khan, I., & Muhammad, I. (2021). Climate change impact assessment, flood management, and mitigation strategies in Pakistan for sustainable future. Environmental Science and Pollution Research, 28, 29720-29731. https://doi.org/10.1007/s11356-021-12801-4

Laurien, F., Hochrainer-Stigler, S., Keating, A., Campbell, K., Mechler, R., & Czajkowski, J. (2020). A typology of community flood resilience. Regional Environmental Change, 20, 1-14. https://doi.org/10.1007/s10113-020-01593-x

MacLeod, D. A., Dankers, R., Graham, R., Guigma, K., Jenkins, L., Todd, M. C., ... & Mwangi, E. (2021). Drivers and subseasonal predictability of heavy rainfall in equatorial East Africa and relationship with flood risk. Journal of Hydrometeorology, 22(4), 887-903. https://doi.org/10.1175/JHM-D-20-0211.1

Mai, T., Mushtaq, S., Reardon-Smith, K., Webb, P., Stone, R., Kath, J., & An-Vo, D. A. (2020). Defining flood risk management strategies: A systems approach. International journal of disaster risk reduction, 47, 101550. https://doi.org/10.1016/j.ijdrr.2020.101550

Mensah, H., & Ahadzie, D. K. (2020). Causes, impacts and coping strategies of floods in Ghana: A systematic review. SN Applied Sciences, 2, 1-13. https://doi.org/10.1007/s42452-020-2548-z

Mishra, B. K., Regmi, R. K., Masago, Y., Fukushi, K., Kumar, P., & Saraswat, C. (2017). Assessment of Bagmati river pollution in Kathmandu Valley: Scenario-based modeling and analysis for sustainable urban development. Sustainability of Water Quality and Ecology, 9, 67-77. https://doi.org/10.1016/j.swaqe.2017.06.001

Mohanty, M. P., Mudgil, S., & Karmakar, S. (2020). Flood management in India: a focussed review on the current status and future challenges. International Journal of Disaster Risk Reduction, 49, 101660. https://doi.org/10.1016/j.ijdrr.2020.101660

Munyai, R. B., Nethengwe, N. S., & Musyoki, A. (2019). An assessment of flood vulnerability and adaptation: A case study of Hamutsha-Muungamunwe village, Makhado municipality. Jàmbá: Journal of Disaster Risk Studies, 11(2), 1-8. https://doi.org/10.4102/jamba.v11i2.692

National Emergency Management Agency (NEMA) Report on 2012 Flood Disaster in Nigeria.

Nkwunonwo, U. C. (2016). A review of flooding and flood risk reduction in Nigeria. Global Journal of Human-Social Science B: Geography, Geo-Sciences, Environmental Science and Disaster Management, 16(2), 22-42.

Nnadi, O. I., Liwenga, E. T., Lyimo, J. G., & Madukwe, M. C. (2019). Impacts of variability and change in rainfall on gender of farmers in Anambra, Southeast Nigeria. Heliyon, 5(7), e02085. https://doi.org/10.1016/j.heliyon.2019.e02085

Nwachukwu, M. A., Alozie, C. P., & Alozie, G. A. (2018). Environmental and rainfall intensity analysis to solve the problem of flooding in Owerri urban. Journal of Environmental Hazards, 1, 107.

Okpa, J. T. (2022). Exploring the relationship between infrastructural development and socioeconomic well-being in rural areas: Evidence from Bakassi, Cross River State, Nigeria. Journal of Socioeconomics and Development, 5(2), 153-161. https://doi.org/10.31328/jsed.v5i2.3618

Parsons, L. (2022). Strategic environmental ignorance: Antipolitical knowledge gaps from drought measurement to adaptation in Cambodia. Environmental Science & Policy, 136, 261-269. https://doi.org/10.1016/j.envsci.2022.06.011

Poku-Boansi, M., Amoako, C., Owusu-Ansah, J. K., & Cobbinah, P. B. (2020). What the state does but fails: Exploring smart options for urban flood risk management in informal Accra, Ghana. City and Environment Interactions, 5, 100038. https://doi.org/10.1016/j.cacint.2020.100038

Qi, W., Ma, C., Xu, H., Chen, Z., Zhao, K., & Han, H. (2021). A review on applications of urban flood models in flood mitigation strategies. Natural Hazards, 108, 31-62. https://doi.org/10.1007/s11069-021-04715-8

Rideout, N. K., Lapen, D. R., Peters, D. L., & Baird, D. J. (2022). Ditch the low flow: Agricultural impacts on flow regimes and consequences for aquatic ecosystem functions. Ecohydrology, 15(5), e2364. https://doi.org/10.1002/eco.2364

Rubinato, M., Nichols, A., Peng, Y., Zhang, J. M., Lashford, C., Cai, Y. P., ... & Tait, S. (2019). Urban and river flooding: Comparison of flood risk management approaches in the UK and China and an assessment of future knowledge needs. Water science and engineering, 12(4), 274-283. https://doi.org/10.1016/j.wse.2019.12.004

Sarma, J., & Rajkhowa, S. (2021). Urban floods and mitigation by applying ecological and ecosystem engineering. Handbook of Ecological and Ecosystem Engineering, 201-218.

Satterthwaite, D. (2017). The impact of urban development on risk in sub-Saharan Africa's cities with a focus on small and intermediate urban centres. International journal of disaster risk reduction, 26, 16-23. https://doi.org/10.1016/j.ijdrr.2017.09.025

Shah, S. M. H., Mustaffa, Z., Teo, F. Y., Imam, M. A. H., Yusof, K. W., & Al-Qadami, E. H. H. (2020). A review of the flood hazard and risk management in the South Asian Region, particularly Pakistan. Scientific African, 10, e00651. https://doi.org/10.1016/j.sciaf.2020.e00651

Shrestha, B. B., & Kawasaki, A. (2020). Quantitative assessment of flood risk with evaluation of the effectiveness of dam operation for flood control: A case of the Bago River Basin of Myanmar. International Journal of Disaster Risk Reduction, 50, 101707. https://doi.org/10.1016/j.ijdrr.2020.101707

Tian, Z., Wang, J. W., Li, J., & Han, B. (2021). Designing future crops: challenges and strategies for sustainable agriculture. The Plant Journal, 105(5), 1165-1178. https://doi.org/10.1111/tpj.15107

Tramblay, Y., Villarini, G., El Khalki, E. M., Gründemann, G., & Hughes, D. (2021). Evaluation of the drivers responsible for flooding in Africa. Water Resources Research, 57(6), e2021WR029595. https://doi.org/10.1029/2021WR029595

van Der Meulen, B., Bomers, A., Cohen, K. M., & Middelkoop, H. (2021). Late Holocene flood magnitudes in the Lower Rhine river valley and upper delta resolved by a two-dimensional hydraulic modelling approach. Earth surface processes and landforms, 46(4), 853-868. https://doi.org/10.1002/esp.5071

Waghwala, R. K., & Agnihotri, P. G. (2019). Flood risk assessment and resilience strategies for flood risk management: A case study of Surat City. International Journal of Disaster Risk Reduction, 40, 101155. https://doi.org/10.1016/j.ijdrr.2019.101155

Woodward, J., Li, J., Rothwell, J., & Hurley, R. (2021). Acute riverine microplastic contamination due to avoidable releases of untreated wastewater. Nature Sustainability, 4(9), 793-802. https://doi.org/10.1038/s41893-021-00718-2

Yildirim, E., & Demir, I. (2021). An integrated flood risk assessment and mitigation framework: A case study for middle Cedar River Basin, Iowa, US. International Journal of Disaster Risk Reduction, 56, 102113. https://doi.org/10.1016/j.ijdrr.2021.102113

Yushanthi, Y., & Nianthi, K. R. (2021). Human Response to Flood Disaster in Kandawalai: Kilinochchi District in Sri Lanka. International Journal of Disaster Management, 4(2), 51-60.

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How much parking space is needed for park and ride facilities to support sustainable infrastructure

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ABSTRACT

Park and ride (P&R) is the right strategy to overcome transportation problems in metropolitan cities with high mobility levels to realize smart mobility. The three main goals of P&R are to reduce congestion levels, increase public transportation use, and improve urban space quality. The provision of parking capacity is one of the success factors in the planning of the P&R facility. Therefore it is necessary to calculate the parking space requirement in P&R. The research was conducted at Sidoarjo Station, the most significant origin station in Sidoarjo Regency, and a recommended P&R location. This study aims to calculate parking space requirements and facilities for the existing conditions and projections when P&R operates. Data were collected through primary surveys in the form of observations on parking characteristics at Sidoarjo Station and secondary surveys in literature studies. The results of the study indicate that the existing condition of the parking facility at Sidoarjo Station has exceeded the parking capacity, so to accommodate the need for parking space, it is necessary to increase the parking area of 96 m^2 in the existing condition up to 413 m^2 or 5,923 m^2 for the next ten years.

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INTRODUCTION

In the last five years, the increasing population density and the rapid development of business districts in metropolitan cities have prompted the emergence of new suburbs and satellite cities around the city. These cities are developing rapidly along with the increasing population (Zhou et al., 2019). Surabaya, as the capital of East Java Province as well as the second largest metropolitan city in Indonesia, has become a destination city for workers from outside the largest area in the Gerbangkertasusila Region (Irawati et al., 2021), reaching 170 thousand commuters every day in 2018 (BPS, 2018). Sidoarjo Regency is the area with the most commuters to Surabaya, 40% or 109 thousand commuters. The number of commuters continues to increase annually by 0.5% (Irawati et al., 2021; Nurkhariza & Nurlaela, 2019) in line with the increase of the population in Sidoarjo Regency, which has grown by 7% over the last five years (BPS, 2021).

The increasing number of commuters from suburban areas to the city center triggers various transportation problems, both at the place of origin and destination (Memon et al., 2021), such as traffic congestion and environmental degradation (Mills & White, 2018), which will impact on economic, social

and ecological conditions. Based on BPS (2021), the loss experienced by the city of Surabaya due to traffic jams reaches 12 billion per year. Meanwhile, in the environmental aspect, the transportation sector accounts for 14% of total global GHG emissions, 72.8% of which comes from land transportation activities (Obaid et al., 2021). This condition is then exacerbated by the low interest of the public in using public transportation (Handayeni & Ariyani, 2018). Traffic congestion and high air emissions in the city center are the main challenges to sustainable transportation development (Widayanti & Pattisinai, 2021).

Park and ride (P&R) is a form of Transport Demand Management (TDM) that is very popular in several developed and densely populated countries (Agustin et al., 2019). P&R is the right strategy to overcome transportation problems in metropolitan cities with high mobility levels to realize sustainable urban transportation development (Ortega et al., 2021; Widayanti & Pattisinai, 2021). P&R is in the form of parking facilities used by travelers to leave private vehicles (cars and motorcycles) to switch to public transportation modes (trains and buses) to go to activity locations in the city center (Macioszek & Kurek, 2020). P&R can effectively reduce commuters' use of private vehicles (Chen & Kim, 2018). The existence of P&R as a supporting facility for commuter movement provides an alternative mode of transportation that is more environmentally friendly while encouraging the use of public transport, especially in suburban areas with a high level of commuter mobility but not yet served by public transportation networks (Dirgahayani & Sutanto, 2020; Ortega et al., 2021).

Sidoarjo Station is the largest origin station in Sidoarjo Regency, with an average number of 1,200 passengers per day (Nurkhariza & Nurlaela, 2019), and is one of the recommended locations for the development of P&R facilities (Irawati et al., 2021). The existence of the P&R is expected to support improving the quality of the downtown environment, reduce traffic congestion, and increase the use of public transportation (Ibrahim et al., 2020; Macioszek & Kurek, 2020) for commuters in Sidoarjo – Surabaya. Based on Irawati et al. (2021), the implementation of P&R can reduce the number of the private vehicle used by commuters by up to 82.91%, accompanied by improvements in the transportation system and transportation policies in the Gerbangkertasusila Metropolitan Area.

One of the challenges in implementing P&R at Sidoarjo Station is providing parking spaces that accommodate the parking needs of commuters in Sidoarjo–Surabaya. The provision of adequate parking space is one factor that influences the success and effectiveness of using P&R (Handayeni & Ariyani, 2018). In existing conditions, research that examines the calculation of parking needs for P&R facilities in Indonesia and other developing countries in Southeast Asia is still limited. Several studies that were found only explain the estimation of P&R demand in general without calculating the parking space requirement of the total demands. Calculating parking space requirements needs to be done to minimize idle capacity, i.e. the unused capacity of a facility in planning activities for supporting public transportation facilities, which in this context is P&R planning.

In their findings, Ortega et al. (2021) and Shen et al. (2017) mentioned that one of the causes of the low utilization of M&R facilities is the physical condition of parking and the provision of parking capacity that is not following the needs of commuters. Therefore, this study aims to analyze the need for parking spaces at the P&R facility at Sidoarjo Station based on the projected results of P&R demand for the next 10 years using the calculation of parking accumulation and private vehicle ownership for Sidoarjo–Surabaya commuters. The results of this study can be used as a reference in determining the number of parking spaces needed by commuters effectively and efficiently to optimize the use of P&R.

RESEARCH METHOD

The research was conducted at Sidoarjo Station, a class 1 train station in Sidoarjo Regency, located in Lemahputro Village, Sidoarjo District. Sidoarjo Station operates under the management of PT. KAI Operation Area VIII Surabaya (Figure 1). In this study, the P&R service radius is assumed to have an ideal service radius of 4 km (Cornejo et al., 2014; Ortega et al., 2021; Spillar, 1997). Regarding the radius, the areas included in the P&R service radius at Sidoarjo Station are Sidoarjo District, Candi District, and Buduran District. The study area was determined based on several points of consideration, including:

1. Sidoarjo Regency is the area of origin of commuters with the largest percentage, namely 40% of the total commuters in Surabaya City (BPS, 2018)

2. The construction of the Surabaya Regional Railway Line is planned to connect Surabaya – Sidoarjo and become an alternative mode of commuter transportation (Surabaya City Development Planning Agency, 2021)
3. Sidoarjo Station is the largest station of origin and has the highest number of passengers in Sidoarjo Regency with an average number of passengers per day of 1,200 passengers (PT. KAI DAOP VIII, 2019)
4. Sidoarjo Station is one of the locations recommended by the Sidoarjo Regency Transportation Service for P&R development (Sidoarjo Regency Transportation Service, 2020)
5. There are plans for the construction of P&R facilities for the Sidoarjo Station in several planning documents, including the 2019 National Railway Master Plan document, the 2009-2029 Sidoarjo Regency RTRW, and the 2019 Sidoarjo Regency Local Transportation System.

The research is a quantitative research that is used to produce a finding, where the findings can be obtained through statistical procedures or other measurement-based methods. This is because this study used statistical procedures and other measurements to identify and examine the variables that have been determined. In addition, this study included research instruments (data collection techniques and samples) prior to the field survey. The primary survey in the form of observations was carried out for two days (weekdays and weekends) to collect data on parking characteristics, such as parking space ownership, capacity, number of vehicles entrance and exit, and parking duration. Meanwhile, the secondary survey was carried out through literature studies on the probability of P&R users at Sidoarjo Station (Irawati et al., 2021).

Furthermore, the data were analyzed using an analysis of parking characteristics, including parking accumulation, parking capacity, and parking index (Parmar et al., 2020), as well as an analysis of parking needs based on parking accumulation (Putrato et al., 2021; Winayati et al., 2019) and private vehicle ownership (Hasibuan, 2019). Calculating parking needs based on parking accumulation was used to calculate parking needs in existing conditions. In contrast, vehicle ownership predicted future parking needs based on the projected probability of P&R users at Sidoarjo Station. The 5 steps that needed to be taken to calculate parking space requirements are as follows.

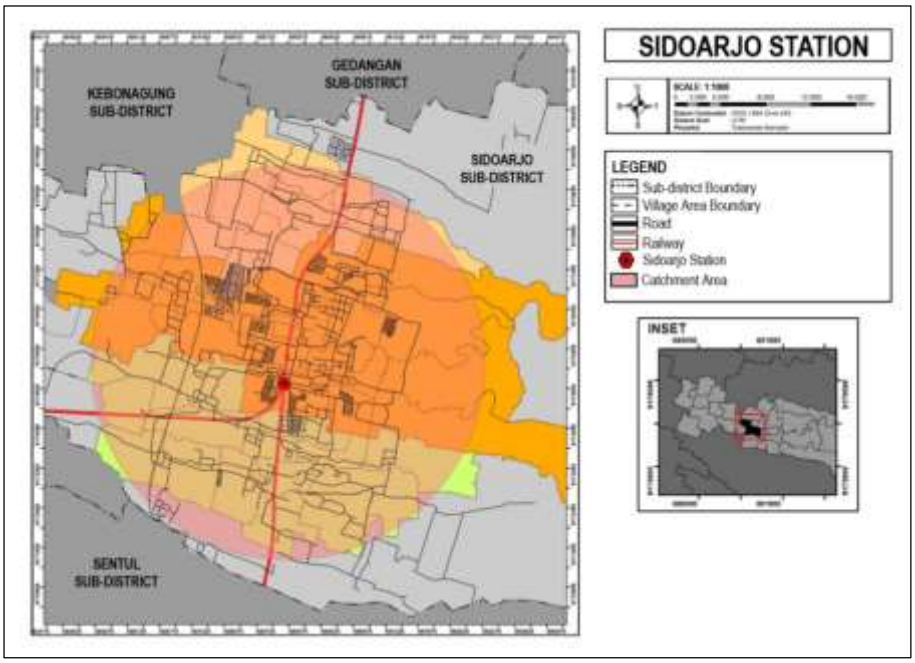

Figure 1. Study area

Table 1. Park and Ride Planning Standards at Sidoarjo Station

No	Component	Standard	Total	Units	References
Park and Ride Building					
1	Parking Area	Passenger Car Gol 1 Passenger Car Gol 2 Passenger Car Gol 3 Motorcycle	2,3 x 5 2,5 x 5 3 x 5 0,75 x 2	m^2	(Directorate General of Transportation, 1998; U.S. Department of Veterans Affairs, 2016)
2	Parking Pattern	Angle 30° Angle 45° Angle 60° Angle 90°	-	(°)	
3	Ramp	Single Threaded Design Double Threaded Design	-	-	
4	Circulation	One way Two ways	3,5 6,5	m	
5	Entrance and Exit	One track Two tracks Minimum Distance In/Out of Corner Intersection	b=3-3,5; d=0,8-1; R_1=6-6,5; R_2=3,5-4 b=6; d=0,8-1; R_1=3,5-5; R_2=1-2,5 22 – 30	m m	
Park and Ride Support Facilities					
1	Lighting	Illumination Lamp (LED) with Color Temperature Cool-White Atau Daylight Light sensor	≥ 60 -	lux -	(U.S. Department of Veterans Affairs, 2016; Metrolinx, 2021; Walker, 2008)
2	Information	Entrance Exit Information Parking Location Information Information on Parking Space Availability Parking Counter Information	-	-	(Spillar, 1997; VDOT, 2018; Victoria, 2020)
3	Safety	Camera CCTV Security Posts Security Fence Panic-Alarm Fire-Protection Assembly and Evacuation Points	1-2 1-2 - - - -	Units/Corner Units - - - -	(American Association of State Highway and Transportation Officials & Task Force on Public Transportation Facilities Design, 2004; Spillar, 1997; Vincentius et al., 2017)
4	Energy	Use of the Light Control System Green Roof/Green Building	- -	- -	(U.S. Department of Veterans Affairs, 2016; Metrolinx, 2021; Walker, 2008)
5	Environment	Vegetation Around the Parking Location	-	-	(VDOT, 2018; Vincentius et al., 2017)
6	Counter	Digital and Non Digital Ticket Counters	-	-	(Metrolinx, 2021)
7	Additional Facilities	Toilet Non-Motorized Parking Kiss and Ride Customer Service Center Waiting Room	-	-	(Spillar, 1997; Suryandari et al., 2015; Vincentius et al., 2017)

Step 1. Collecting data regarding parking characteristics at Sidoarjo Station, including parking area ownership, parking volume, parking duration, and parking capacity. In this study, the data were obtained through a secondary survey in accordance with the policy of limiting activities during the COVID-19 pandemic.

Step 2. Calculating the existing parking space requirements using the formula:

$$Ap = Parking\ Accumulation\ x\ SRP \quad (1)$$

In wihich Ap is parking needs based on parking accumulation, SRP is parking space unit in indonesia based on the regulation of the Directorate General of Transportation in 1998 (SRP Motorcycles: 0.75 x 2 m; SRP Cars: 2.5 x 5 m)

$$Vo = Vehicle\ Ownership\ x\ SRP \quad (2)$$

Vo denotes parking needs based on vehicle ownership, SRP is parking space unit in Indonesia based on the Regulation of the Directorate General of

Transportation in 1998 (SRP Motorcycles: 0.75 x 2 m; SRP Cars: 2.5 x 5 m)

Step 3. Calculating the projection of P&R users based on the probability of P&R users (Irawati et al., 2021) using the formula:

$$Pn = Po\,(1 + r.n) \quad (3)$$

Pn states number of commuters in the n year, Po is number of base year commuters, r indicates growth rate of commuters at Gerbangkertasusila, 0.5%, and n is year. In this study the n started from 5, 10, and 15.

Step 4. Calculating the projected need for parking space when the P&R facility at Sidoarjo Station operates based on the results from step 3, which are assumed to be the number of motorized vehicle owners in the next 5 years to 15 years using the formula:

$$Parking\ Space\ Requirement = Vehicle\ Ownership\ x\ SRP \quad (4)$$

Vp indicates accumulated parking during peak hours, SRP is parking space unit in Indonesia based on the Regulation of the Directorate General of Transportation in 1998 (SRP Motorcycles: 0.75 x 2 m; SRP Cars: 2.5 x 5 m)

Step 5. Knowing the total area needed for parking space at Sidoarjo Station to be used as one of the basis for planning the layout and design of P&R at Sidoarjo Station.

Parking requirements in existing conditions were calculated based on parking accumulation. The assumption used in this study is that the need for parking space is based on parking requests expressed by parking accumulation at Sidoarjo Station (Table 1).

RESULT AND DISCUSSION

Parking Characteristics

Sidoarjo Station has parking facilities covering an area of 450 m^2 divided into two parts: car parking area of 337.5 m^2 and motorcycle parking area of 112.5 m^2. Parking facilities at Sidoarjo Station have been operated using the e-Reska parking system and it is under the management of PT. Reska Multi Usaha, which is a subsidiary of PT. KAI engaging in parking services. Based on PT. Reska Multi Usaha (2021), the average number of parking users at Sidoarjo Station was 500 vehicles per day. Figure 2 and Figure 3 shows a plan of parking facilities at Sidoarjo Station and the location of Sidoarjo Station.

In this study, parking characteristics were identified based on parking accumulation, parking capacity, and parking index. Parking accumulation shows how many vehicles are in a parking lot at a specific time. Table 2 and Figure 4 explain about parking accumulation at Sidoarjo Station for motorcycles and cars, the highest parking accumulation occurred on weekdays from 13.00 to 14.00, namely 114 vehicles for motorcycle category and 30 vehicles for car category.

Figure 2. The location of Sidoarjo station

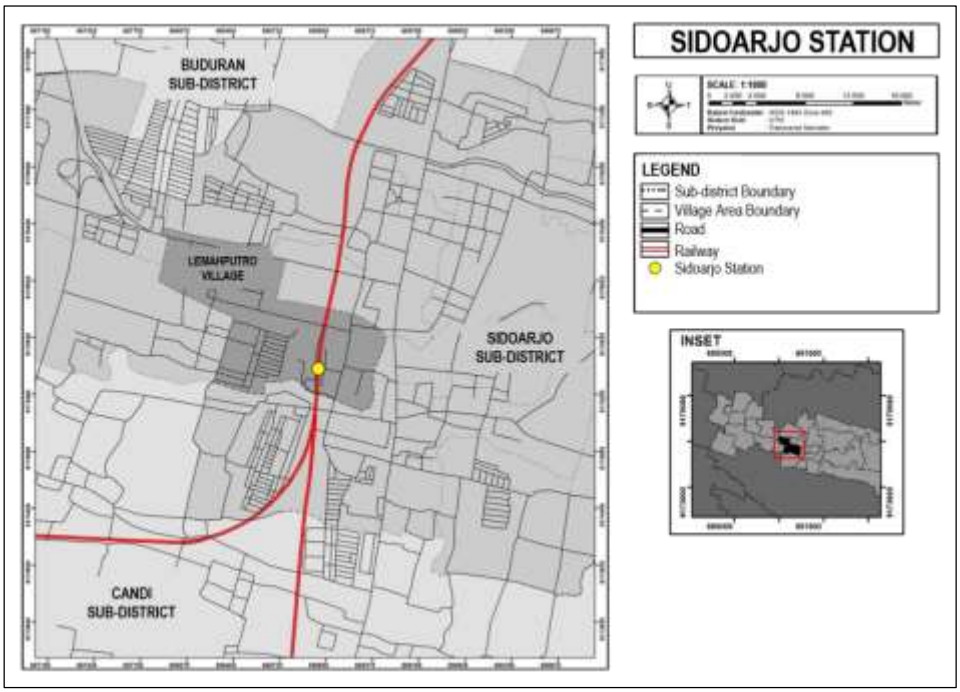

Figure 3. The location of Sidoarjo station

Table 2. Parking Accumulation at Sidoarjo Station

Type of Vehicle/ Workday		Peak Hour	Entry	Exit	Parking	Parking Accumulation
			..... Unit			
Car						
Weekday	Morning	05.00 - 06.00	11	1	7	17
		06.00 - 07.00	14	3	17	28
	Afternoon	12.00 - 13.00	12	3	20	29
		13.00 - 14.00	10	5	25	30
	Evening	17.00 - 18.00	7	8	15	14
		18.00 - 19.00	5	3	14	16
Weekend	Morning	05.00 - 06.00	7	1	7	13
		06.00 - 07.00	9	4	13	18
	Afternoon	12.00 - 13.00	8	7	14	15
		13.00 - 14.00	17	9	15	23
	Evening	17.00 - 18.00	4	3	11	12
		18.00 - 19.00	7	5	12	14
Motorcycle						
Weekday	Morning	05.00 - 06.00	65	12	18	71
		06.00 - 07.00	53	24	71	100
	Afternoon	12.00 - 13.00	41	24	75	92
		13.00 - 14.00	43	21	92	114
	Evening	17.00 - 18.00	20	29	44	35
		18.00 - 19.00	48	61	35	22
Weekend	Morning	05.00 - 06.00	48	7	21	62
		06.00 - 07.00	24	18	60	66
	Afternoon	12.00 - 13.00	41	18	61	84
		13.00 - 14.00	35	10	72	97
	Evening	17.00 - 18.00	17	21	57	53
		18.00 - 19.00	21	48	53	26

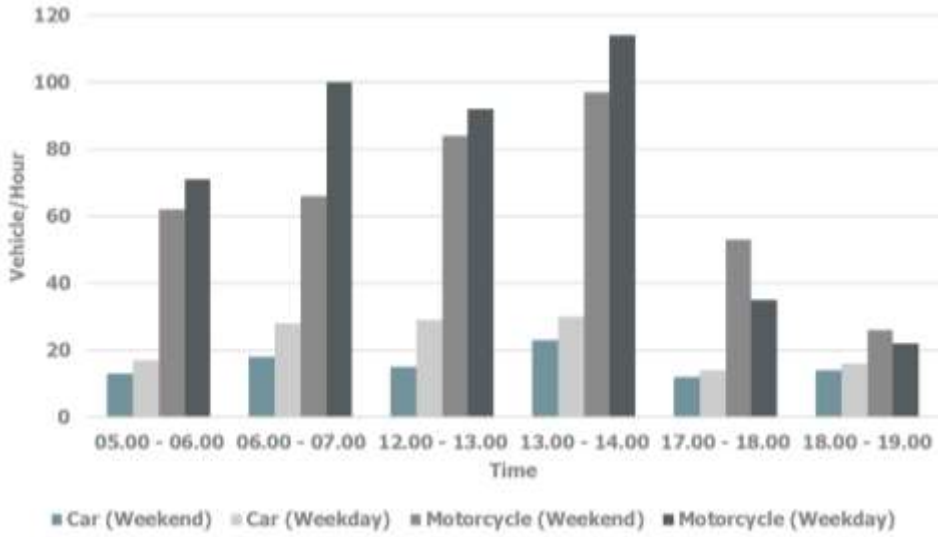

Figure 4. Parking accumulation at Sidoarjo station

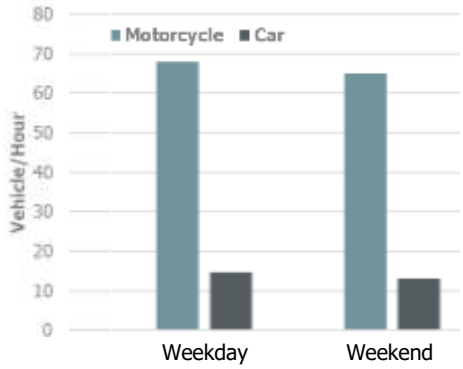

Figure 5. Parking capacity at Sidoarjo station

Furthermore, the parking capacity at Sidoarjo Station shows the maximum number of vehicles that can be accommodated by a parking facility in a certain time. Table 3 and Figure 5 explain the parking capacity at Sidoarjo Station, which shows that the maximum number of vehicles on weekdays could be adjusted to 65 motorcycles and 13 cars per hour. Meanwhile, on weekends, there were three additional units in the motorcycle parking area and two in the motorcycle parking area. This is because the average duration of vehicle parking on weekends is more extended than on weekdays.

The parking index at Sidoarjo Station shows the ability of parking facilities to accommodate vehicles based on parking accumulation and capacity. The results of the parking index calculation are displayed in percentage form, where if the parking index value is more than 100%, it can be interpreted that the parking demand is greater than the parking capacity (Table 4).

Table 3. Parking Capacity at Sidoarjo Station

Type of Vehicle/ Day	Parking Area	Parking Lots	Average of Parking Duration	Parking Capacity
	m^2	vehicle	hour	vehicle/ hour
Car				
Weekday	337.5	30	2.31	13
Weekend			2.40	15
Motorcycle				
Weekday	112.5	100	1.54	65
Weekend			1.47	68

Figure 6 shows that the parking index calculation results show that at certain times, especially during peak hours, the parking index value at Sidoarjo Station had a value of more than 100%, which means that the available parking spaces at Sidoarjo Station cannot accommodate vehicle parking needs. Based on this, it is necessary to expand or add parking areas at Sidoarjo Station to accommodate the increasing parking demand and the operation of P&R facilities at Sidoarjo Station.

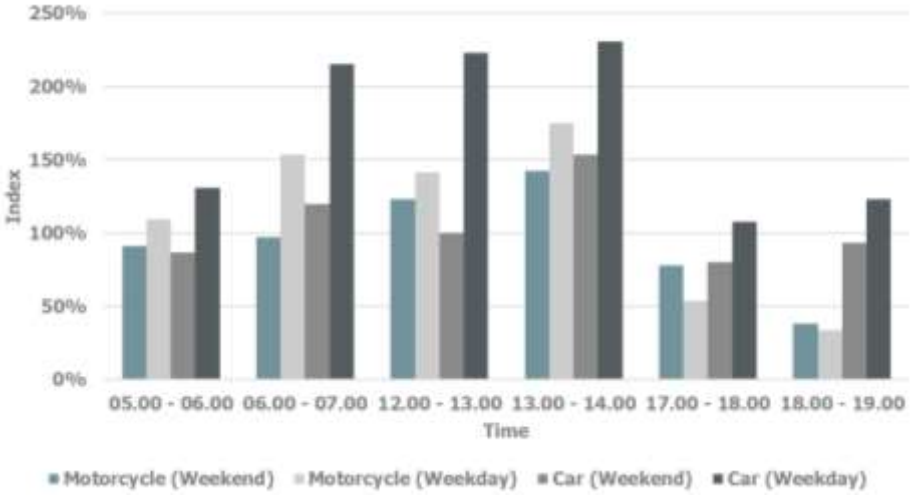

Figure 6. Parking index at Sidoarjo station

Table 4. Parking Index at Sidoarjo Station

Type of Vehicle/ Workday	Peak Hour	Parking Accumulation	Parking Capacity	Parking Index
		unit	Unit/hour	%
Motorcycle				
Weekday	05.00 - 06.00	71	65	109
	06.00 - 07.00	100	65	154
	12.00 - 13.00	92	65	142
	13.00 - 14.00	114	65	175
	17.00 - 18.00	35	65	54
	18.00 - 19.00	22	65	34
Weekend	05.00 - 06.00	62	68	91
	06.00 - 07.00	66	68	97
	12.00 - 13.00	84	68	123
	13.00 - 14.00	97	68	143
	17.00 - 18.00	53	68	78
	18.00 - 19.00	26	68	38
Car				
Weekday	05.00 - 06.00	17	13	131
	06.00 - 07.00	28	13	215
	12.00 - 13.00	29	13	223
	13.00 - 14.00	30	13	231
	17.00 - 18.00	14	13	108
	18.00 - 19.00	16	13	123
Weekend	05.00 - 06.00	13	15	87
	06.00 - 07.00	18	15	120
	12.00 - 13.00	15	15	100
	13.00 - 14.00	23	15	153
	17.00 - 18.00	12	15	80
	18.00 - 19.00	14	15	93

Probability of Park and Ride Users

Sidoarjo Regency is one of the districts/cities in the Gerbangkertasusila Metropolitan Area, with the City of Surabaya as the center of its activities. One of the impacts of this condition is the high number of commuters in the Sidoarjo Regency, along with the increasing number of jobs available in Surabaya. A commuter is a type of worker who moves back and forth from the place of origin to the destination in another district/city in a day, both for work and education purposes (Irjayanti et al., 2021; Setyodhono, 2017). In this study, the commuters in question were workers who lived in Sidoarjo Regency and worked in Surabaya City using private vehicles (cars and motorcycles).

Table 5 shows that the commuters from Sidoarjo to Surabaya were dominated by males, and the age range was 20-30 years. The average level of final education of the commuters was undergraduate, and they worked as private employees. Most commuters from Sidoarjo to Surabaya used motorcycles as their primary mode of transportation.

The probability of P&R users at Sidoarjo Station was obtained through the assumption that 90% of the probability of commuters from Sidoarjo to Surabaya who want to move by train is a user of P&R, so the potential for P&R users at Sidoarjo Station was obtained through modeling the choice of train mode using multinomial logit analysis. These assumptions were determined by considering the location of the respondent's residence or commuters from Sidoarjo to Surabaya. Based on these calculations, it was found that the probability of commuters from Sidoarjo to Surabaya using cars and motorcycles who moved by train was 49.2%. Therefore, the probability of using P&R facilities was based on the assumption that 90% of the total opportunities for choosing the train will use parking facilities, which is 44.3% (Irawati et al., 2021).

Table 5. Characteristics of Sidoarjo – Surabaya Commuters

Characteristic	Description
Gender	73% male; 27% female
Age	4% less than 20 years old; 37% 20 – 30 years old; 31% 30 – 40 years old; 20% 40 – 50 years old; and 8% more than 50 years old
Education	5% junior high school; 31% senior high school; 19% diploma; 34% bachelor degree; and 11% master degree
Occupation	7% student; 15% government employees; 2% tni/polri; 34% private sector employees; 12% teacher and lecturer; 10% seller; 14% enterpreneur; and 5% others
Modes of transportation	28% car users; 72% motorcycle users
Distance from residence to station	10% less than 1 km; 17% 1 – 2 km; 42% 3 – 4 km; and 31% more than 4 km
Distance from station to destination	5% less than 1 km; 19% 1 – 2 km; 44% 3 – 4 km; and 32% more than 4 km

Sources: Irawati et al. (2021)

Park and Ride Parking Needs

In existing conditions, especially during weekdays and peak hours, the parking facilities at Sidoarjo Station have exceeded the available parking capacity, thus triggering new parking areas that are not following their placement. This can be seen through the parking index at Sidoarjo Station, which has exceeded 100%. The imbalance between the availability of parking spaces and the increasing need for parking at Sidoarjo Station often causes problems between vehicle users and station visitors.

On the other hand, when viewed from the probability of P&R users at Sidoarjo Station based on Irawati et al. (2021) of 44.3%, it can be seen that there will be an increase in parking needs along with the rise in the number of parking users at Sidoarjo Station. So, in planning parking facilities, especially in this case, the P&R at Sidoarjo Station requires additional parking areas for motorcycles and cars. Based on this, it is necessary to calculate parking needs at Sidoarjo Station for the existing and projected conditions when P&R operates.

1. Existing parking space needs

Parking needs in existing conditions will be calculated based on parking accumulation (Putrato et al., 2021; Winayati et al., 2019). The assumption used in this research is the need for parking space based on parking demand expressed by parking accumulation at Sidoarjo Station. The parking area at Sidoarjo Station is 450 m2, comprising 112.5 m2 of motorcycle parking and 337.5 m2 of car parking. The average number of vehicles per day is 444 motorcycles and 156 cars (Table 6).

Based on the results of the calculation of parking needs at Sidoarjo Station in existing conditions, it can be seen that parking facilities at Sidoarjo Station required the addition or expansion of parking areas to accommodate parking needs. The shortage of parking space required was 96 m^2 consisting of 58.5 m^2 for motorcycles and 37.5 m^2 for cars. In addition, from Table 5, it is known that the area of parking lots at Sidoarjo Station still did not follow the Parking Space Unit (SRP). The size of the existing parking lot is 0.5 x 1.9 m for motorcycle parking and 2.2 x 4.5 m for car parking. Therefore, it is necessary to increase the area of the parking lot to match the SRP and facilitate parking activities for station visitors.

Table 6. Existing Parking Space Needs

Aspect	Car	Motorcycle
Maximum parking accumulation	30	114
Parking area	337.5 m^2	112.5 m^2
Existing parking lots	30	100
Ideal parking lots*	25	75
Parking space needs	375 m^2	171 m^2
Lack of Parking Space	37.5 m^2	58.5 m^2

*) = Parking Space Unit in Indonesia based on the Regulation of the Directorate General of Transportation in 1998 (SRP Motorcycles: 0.75 x 2 m; SRP Cars: 2.5 x 5 m)

2. Projected parking space needs

The projection of parking space needs at Sidoarjo Station when P&R operates was calculated based on vehicle ownership (Hasibuan, 2019). The assumption used in this study is that there is a relationship between vehicle ownership and the required parking area. Vehicle ownership was identified through the number of commuters from Sidoarjo to Surabaya. Thus, as the number of commuters from Sidoarjo to Surabaya increases, the number of parking spaces required will also increase. The projection of parking space needs is carried out for the next 10 years.

Table 7. Number of Commuters from Sidoarjo to Surabaya based on the Mode of Transportation Used

Category	Percentage	Total
	%	people
Motorcycle Users	87	4,454
Car Users	9	461
Public Transport Users	4	204

In this study, the P&R service radius used an ideal service radius of 4 km (Cornejo et al., 2014; Ortega et al., 2021; Spillar, 1997). So, when referring to the radius, the areas included in the P&R service radius at Sidoarjo Station were Sidoarjo District, Candi District, and Buduran District. The number of commuters from Sidoarjo to Surabaya who lived in Sidoarjo District, Candi District, and Buduran District was 5,119. Furthermore, it was calculated using the probability percentage of P&R users at Sidoarjo Station (Irawati et al., 2021). In that case, the probability of P&R users in the three sub-districts was 2.268 people consisting of 1.973 motorcycle users and 204 car users.

Based on the calculation of the projected parking demand at Sidoarjo Station by considering the probability of P&R users in existing conditions of 44.3% and the growth rate of commuters in Sidoarjo to Surabaya of 0.5% per year, it was known that the need for parking space in 2022 was 5.510 m^2 consisting of 2.960 m^2 parking motorcycle and 2.550 m^2 car park. Meanwhile, the need for parking would increase by 413 m2 to 5,923 m2 in the next 10 years.

Furthermore, from the land ownership of Sidoarjo Station, it can be seen that the entire land is owned by PT. KAI. The land that can be developed as a P&R facility is only 80 x 30 m2 (Figure 5). This is because some part of the said land, in its existing condition, is used by the local community to build houses, parking lots, and roads. Any development plan requires a process of land acquisition and socialization among the community, local government, and PT. KAI. Therefore, to overcome obstacles regarding the fulfillment of parking needs at P&R Sidoarjo Station, efforts to provide and develop P&R at Sidoarjo Station can be made vertically. Based on Government Regulation of the Republic of Indonesia Number 16 of 2021 on the Implementing Regulations of Law Number 28 of 2022 concerning Buildings (Peraturan Pemerintah Republik Indonesia Nomor 16 Tahun 2021 tentang Peraturan Pelaksanaan Undang-Undang Nomor 28 Tahun 2022 tentang Bangunan Gedung), the maximum number of floors for a parking building is 8 floors.

Table 8. Projected Parking Space Needs

Year	Commuter		Parking Space Needs*	
	Car	Motorcycle	Car	Motorcycle
	..... People		..... m^2	
2017[1]	204	1,973	2,550	2,960
2022	209	2,022	2,614	3,033
2027	214	2,072	2,678	3,170
2032	219	2,121	2,741	3,181

[1]base year

*Parking Space Unit in Indonesia based on the Regulation of the Directorate General of Land Transportation 1998 (SRP Motorcycles: 0.75 x 2 m; SRP Cars: 2.5 x 5 m)

Park and Ride Implementation

From the results of the analysis based on the suitability of the existing conditions of parking facilities with standards referring to the Decree of the Director General of Land Transportation Number 272/hk.105/DRJD/96 on Technical Guidelines for the Implementation of Parking Facilities, as well as P&R Guidelines, in general, Sidoarjo Station has complied with 16 of the 25 existing indicators. While 9 other indicators are still not suitable, such as the width of the vehicle opening, the width of the parking space, the circulation path does not meet the minimum width, there are no CCTVs in parking facilities, there are no lighting lamps with sufficient lighting intensity, there is no parking space for non-vehicles motorized and persons with disabilities, there are no pedestrian paths yet, and there are still conflicts between vehicles and parking users and other station visitors.

Regarding the intention of Sidoarjo to Surabaya commuters to use P&R at Sidoarjo Station, it can be influenced by several factors. The results of the research show that policy influences subjective norms and can indirectly influence attitudes and behavior of commuters. Therefore, one of the solutions to increase the use of P&R based on the results of this research is to increase the level of public trust and acceptance of the government and the programs it arranges. A high level of public trust can affect the condition of the people in an area and accelerate changes in attitudes and behavior, in this context, attitudes and behavior that can encourage the use of P&R.

The research findings explain that the success of implementing P&R is determined by several factors including the availability of parking lots and complementary facilities. The better the quality of P&R services, including regarding security, safety and ease of obtaining information, the greater the public's trust and satisfaction with the implementation of P&R. In addition, the availability of public transportation modes encourages the formation of a certain behavior, namely using P&R.

Furthermore, a person's attitude and behavior in general is related to the policies that apply in a region. The existence of a policy will suppress and limit a person's actions, which influences his attitude and behavior. In addition, policies that are implemented evenly and fairly, accompanied by outreach to the public, can accelerate changes in attitudes and behavior. On the other hand, related to the condition of the COVID-19 pandemic that has occurred since the beginning of 2019, it has certainly had a lot of influence on people's behavior, as well as their perception of public transportation. The research findings show that the better the implementation of the policy on using public transportation during a pandemic and the application of health protocols, the higher the strictness of the policy and the public's trust so that it can encourage the intention of Sidoarjo - Surabaya commuters to use P&R. This is also supported by research results which show that the condition of public transportation around P&R during the COVID-19 pandemic made it easier for commuters to use P&R.

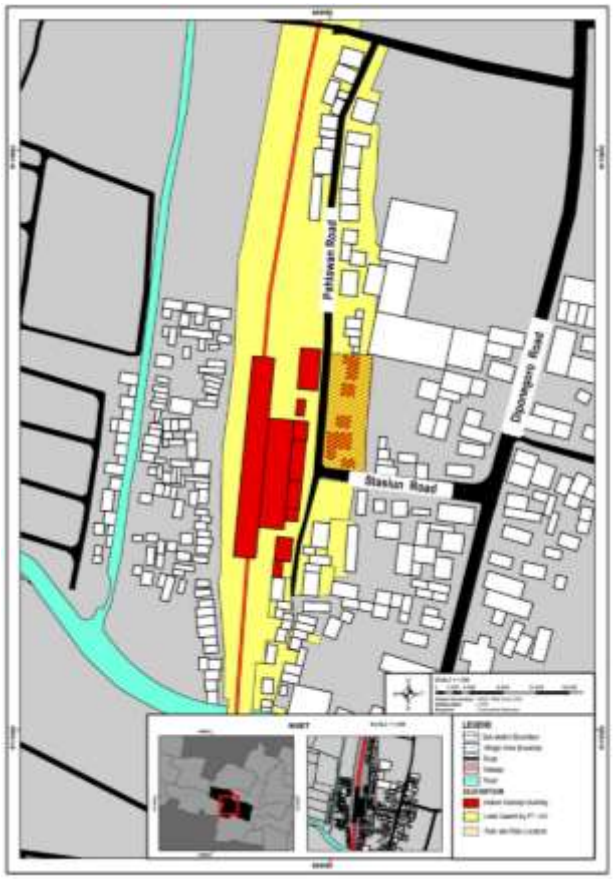

Figure 7. Land ownership of PT. KAI at Sidoarjo station

Research Implication

The growth in the number of private vehicle use that is increasing along with the improvement in the economic condition of the community intensively encourages the government to seek innovations in controlling transportation problems, such as traffic congestion, and so on (Ling et al., 2022). In recent years, sustainable transportation has become a hot issue discussed by urban designers (Porru et al., 2020). Various innovations regarding sustainable transportation planning to realize smart mobility have been raised in multiple forums, one of which is regarding traffic regulation in the city center through parking facilities (Rosenblum et al., 2020). The provision of parking facilities or P&R in sub-urban areas effectively reduces the number of the private vehicle used in the downtown area, thereby reducing traffic congestion levels and improving the quality of urban space.

In planning a P&R facility, two main challenges must be faced by the government or developers, namely determining the location of the P&R and the parking capacity that P&R can provide (Annisa et al., 2019; Ortega et al., 2021). These two things significantly influence the success rate of P&R (Handayeni & Ariyani, 2018). This study analyzes the number of parking spaces required by a P&R facility. The research findings indicate that the parking space needs in P&R can be calculated based on parking characteristics and the probability of commuters. In this case, commuters as the primary target for implementing P&R. The calculation of parking needs aims to minimize the emergence of idle capacity from P&R planning (Buana, 2019) and determine the direction of parking development in the area (Jog et al., 2015).

Meanwhile, the findings of this study can also complement the results of previous studies, where some research on P&R can only accommodate calculations regarding projected P&R demand without clearly stating the number of parking spaces required following the projections of P&R users (Asapa, 2014; Irawati et al., 2021; Nurkhariza & Nurlaela, 2019; Palupiningtyas, 2019). Irawati et al. (2021), in their research, state that the probability of P&R users at Sidoarjo Station is 44.3%. This figure is obtained by modeling private vehicle users who want to switch to using public transportation. Furthermore, the findings of this study can explain the area of parking space needed by P&R at Sidoarjo Station, which is obtained from the significant probability of P&R users, which is 5.923 m2 in the next 10 years.

On the other hand, in recent research on P&R, many efforts to plan and implement P&R have been carried out in developed countries (Macioszek & Kurek, 2020; Shen et al., 2017; Song et al., 2017), even some P&R locations have high levels of relatively high success. However, this is different from the implementation of P&R in developing countries. Apart from differences in regional, community, and socioeconomic characteristics, one of the obstacles to implementing P&R in developing countries is the limitation of studies that include planning activities, prediction of P&R demand, implementation, and evaluation of the effectiveness of these facilities (Hussain, 2020; Ibrahim et al., 2020). Therefore, this research is expected to be one of the references by governments and developers in developing countries in planning for the required parking space in a P&R facility effectively and efficiently.

CONCLUSION AND SUGGESTION

This study aims to analyze the need for parking spaces at the P&R facility at Sidoarjo Station based on the projected results of P&R demand for the next 10 years using the calculation of parking accumulation and private vehicle ownership for Sidoarjo – Surabaya commuters. From the results, it is known that the existing condition of the parking facility at Sidoarjo Station has exceeded the parking capacity, so to accommodate the parking needs, it is necessary to increase the parking area of 96 m^2 consisting of 58.5 m^2 to motorcycle parking and 37.5 m^2 of car. Meanwhile, the number of commuter parking needs when the P&R facility operates is 5,510 m^2 consisting of 2,960 m^2 for motorcycle parking and 2,550 m^2 for car parking. The need for parking will increase by 413 m^2 to 5,923 m^2 in the next 10 years.

On the other hand, the calculation of parking needs can also be influenced by other variables, such as land use and economic conditions. In this study, parking needs analysis is only calculated based on ideal conditions using parking accumulation and the probability of P&R users without any intervention from other variables. So that further research can add additional variables that have the potential to affect P&R parking needs. The research results on the need for parking spaces in P&R can be used as a reference in conducting a study of P&R planning in Indonesia

and other developing countries. The findings of this study can also complement the results of previous studies so that it is expected to maximize the ability of P&R facilities to meet parking needs.

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REFERENCES

Agustin, I. W., Adhianti, R. A. C., Fikriyah, Shakia, N. F., & Maulidiah, I. A. (2019). Exploring the role of Transportation Demand Omotenashi (TDO) in the city center plaza of Batu. IOP Conference Series: Earth and Environmental Science, 328(1). https://doi.org/10.1088/1755-1315/328/1/012024

American Association of State Highway and Transportation Officials, & Task Force on Public Transportation Facilities Design. (2004). Guide for Park-And-Ride Facilities. October, 137. Retrieved from https://store.transportation.org/Common/DownloadContentFiles?id=319

Annisa, Herman, & Wiradinata, I. (2019). A sustainable transportation: a literature study on park and ride in the Bandung metropolitan area. MATEC Web of Conferences, 276, 03008. Retrieved from https://doi.org/10.1051/matecconf/201927603008

Asapa, A. (2014). Park and ride sebagai bagian dari pelayanan kereta api perkotaan Bandung. Jurnal Perencanaan Wilayah Dan Kota, 25(2), 157–173. https://doi.org/10.5614/jpwk.2015.25.2.5

BPS Kabupaten Sidoarjo. (2018). Statistik Komuter GERBANGKERTASUSILA. Provinsi Jawa Timur: BPS. Retrieved from https://www.bps.go.id/publication/2017/12/25/2017000000000000102368/statistik-komuter-gerbangkertosusila-hasil-survei-komuter-gerbangkertosusila-2017.html

BPS Kabupaten Sidoarjo. (2021). Kabupaten Sidoarjo Dalam Angka. Retrieved from https://sidoarjokab.bps.go.id/

Buana S., M. (2019). Analisis kebutuhan ruang parkir stasiun lempunyangan Yogyakarta. In Universitas Atma Jaya Yogyakarta. Retrieved from http://e-journal.uajy.ac.id/7244/4/3TF03686.pdf

Chen, X., & Kim, I. (2018). Modelling rail-based park and ride with environmental constraints in a multimodal transport network. Journal of Advanced Transportation, 2018. https://doi.org/10.1155/2018/2310905

Cornejo, L., Perez, S., Cheu, R. L., & Hernandez, S. (2014). An approach to comprehensively evaluate potential park and ride facilities. International Journal of Transportation Science and Technology, 3(1), 1–18. https://doi.org/10.1260/2046-0430.3.1.1

Directorate General of Transportation. (1998). Pedoman Perencanaan dan Pengoperasian Fasilitas Parkir. Departemen Perhubungan Republik Indonesia: Jakarta

Dirgahayani, P., & Sutanto, H. (2020). The effect of transport demand management policy on the intention to use public transport: A case in Bandung, Indonesia. Case Studies on Transport Policy, 8(3), 1062–1072. https://doi.org/10.1016/j.cstp.2020.03.004

Handayeni, K. D. M. E., & Ariyani, B. S. P. (2018). Commuters' travel behaviour and willingness to use park and ride in Tangerang city. IOP Conference Series: Earth and Environmental Science, 202(1). https://doi.org/10.1088/1755-1315/202/1/012019

Hasibuan, M. C. (2019). Analisa Kebutuhan Parkir Pada Rumah Sakit Kelas B di Kota Medan. In Program Studi Teknik Sipil, Fakultas Teknik, Universitas Muhammadiyah Sumatera Utara Medan.

Hussain, H. D. (2020). Predicting the commuter's willingness to use LRT, utilising the theory of planned behaviour and structural equation. Journal of Applied Engineering Science, 18(3), 403–412. https://doi.org/10.5937/jaes18-27013

Ibrahim, A. N. H., Borhan, M. N., & Rahmat, R. A. O. K. (2020). Understanding users' intention to use park-and-ride facilities in malaysia: The role of trust as a novel construct in the theory of planned behaviour. Sustainability (Switzerland), 12(6). https://doi.org/10.3390/su12062484

Irawati, S., Agustin, I. W., Rini, I., & Ari, D. (2021). Potensi park and ride dalam mendukung penggunaan kereta api komuter di Stasiun Sidoarjo. Planning for Urban Region and Environment Volume, 10(3), 159–168. Retrieved from https://purejournal.ub.ac.id/index.php/pure/article/view/220/168

Irjayanti, A. D., Sari, D. W., & Rosida, I. (2021). Perilaku pemilihan moda transportasi pekerja komuter: Studi kasus Jabodetabek. Jurnal

Ekonomi dan Pembangunan Indonesia, 21(2), 125–147. https://doi.org/10.21002/jepi.v21i2.1340

Jog, Y., Sajeev, A., Vidwans, S., & Mallick, C. (2015). Understanding smart and automated parking technology. International Journal of U- and e-Service, Science and Technology, 8(2), 251–262. https://doi.org/10.14257/ijunesst.2015.8.2.25

Ling, S., Ma, S., & Jia, N. (2022). Sustainable urban transportation development in China: A behavioral perspective. Frontiers of Engineering Management, 9(1), 16–30. https://doi.org/10.1007/s42524-021-0162-4

Macioszek, E., & Kurek, A. (2020). The use of a park and ride system a case study based on the City of Cracow (Poland). Energies, 13(13). https://doi.org/10.3390/en13133473

Memon, I. A., Sahito, N., Kalwar, S., Hwang, J., Napiah, M., & Zaly Shah, M. (2021). Choice modelling of a car traveler towards park-and-ride services in putrajaya to create green development. Sustainability (Switzerland), 13(14), 1–25. https://doi.org/10.3390/su13147869

Metrolinx. (2021). Metrolinx Design Standards: GO Bus Park & Ride Design Standard (Issue March).

Mills, G., & White, P. (2018). Evaluating the long-term impacts of bus-based park and ride. Research in Transportation Economics, 69(November 2017), 536–543. https://doi.org/10.1016/j.retrec.2018.07.028

Nurkhariza, A. R., & Nurlaela, S. (2019). Faktor-faktor yang memengaruhi permintaan commuter line berdasarkan karakteristik fasilitas park and ride di Stasiun Sidoarjo. Jurnal Transportasi: Sistem, Material, Dan Infrastruktur, 1(2), 106. https://doi.org/10.12962/j26226847.v1i2.5035

Obaid, M., Torok, A., & Ortega, J. (2021). A comprehensive emissions model combining autonomous vehicles with park and ride and electric vehicle transportation policies. Sustainability (Switzerland), 13(9). https://doi.org/10.3390/su13094653

Ortega, J., Tóth, J., & Péter, T. (2021). Planning a park and ride system: A literature review. Future Transportation, 1(1), 82–98. https://doi.org/10.3390/futuretransp1010006

Palupiningtyas, S. E. (2019). Kriteria fasilitas park and ride sebagai pendukung angkutan umum massal berbasis jalan. Warta Penelitian Perhubungan, 27(2), 69. https://doi.org/10.25104/warlit.v27i2.768

Parmar, J., Das, P., & Dave, S. M. (2020). Study on demand and characteristics of parking system in urban areas: A review. Journal of Traffic and Transportation Engineering (English Edition), 7(1), 111–124. https://doi.org/10.1016/j.jtte.2019.09.003

Porru, S., Misso, F. E., Pani, F. E., & Repetto, C. (2020). Smart mobility and public transport: Opportunities and challenges in rural and urban areas. Journal of Traffic and Transportation Engineering (English Edition), 7(1), 88–97. https://doi.org/10.1016/j.jtte.2019.10.002

PT. KAI DAOP VIII. (2019). PT. Kereta Api Indonesia. (2018). Rencana Induk Perkeretaapian Nasional Tahun 2018. Jakarta: PT. KAI. Retrieved from https://ppid.kai.id/_daop8/?_it8tnz=T1RBeE1EQXdNREF3&_8dnts=YzNSaGRHbHpkR2xy

PT. Reska Multi Usaha. (2021). Resparking PT Reska Multi Usaha. Retrieved from https://www.reska.id/index.php/TentangKami/resparking,

Putrato, P. A., Laku Utami, S. R., & Setiawan, M. B. (2021). Analisis kebutuhan dan penataan lahan parkir di Pasar Pegandon, Kabupaten Kendal. Reviews in Civil Engineering, 5(1), 22–28. https://doi.org/10.31002/rice.v5i1.3770

Rosenblum, J., Hudson, A. W., & Ben-Joseph, E. (2020). Parking futures: An international review of trends and speculation. Land Use Policy, 91(June 2019), 104054. https://doi.org/10.1016/j.landusepol.2019.104054

Setyodhono, S. (2017). Faktor yang mempengaruhi pekerja komuter di jabodetabek menggunakan moda transportasi utama. Warta Penelitian Perhubungan, 29(1), 21. https://doi.org/10.25104/warlit.v29i1.326

Shen, X., Chen, F., Su, B., Chen, Q., & Yao, J. (2017). Optimization of park-and-ride system: A case study of Shunyi in Beijing. Advances in Mechanical Engineering, 9(8), 1–8. https://doi.org/10.1177/1687814017714987

Sidoarjo Regency Transportation Service. (2020). Tatanan Transportasi Lokal Kabupaten Sidoarjo Tahun 2019. Kabupaten Sidoarjo: Dinas Perhubungan. Retrieved from https://dishub.sidoarjokab.go.id/

Song, Z., He, Y., & Zhang, L. (2017). Integrated planning of park-and-ride facilities and transit service. Transportation Research Part C: Emerging Technologies, 74, 182–195. https://doi.org/10.1016/j.trc.2016.11.017

Spillar, R. J. (1997). Park-and-Ride Planning and Design Guidelines. First Printing, October, 192.

Surabaya City Development Planning Agency. (2021). RTRW Kabupaten Sidoarjo Tahun 2009 – 2029. Kabupaten Sidoarjo: BAPPEDA. Retrieved from https://bappedalitbang.surabaya.go.id/

Suryandari, M., Wisakcono, A., & Agustin, I. W. (2015). Penerapan park and ride di stasiun Bekasi. Tataloka, 17(3), 172. https://doi.org/10.14710/tataloka.17.3.172-185

U.S. Department of Veterans Affairs. (2016). Park and Ride Building. Muskoge Oklahoma.

VDOT. (2018). Park & Ride Design Guidelines. In Virginia Department of Transportation, Transportation and Mobility Planning Division

Victoria, S. (2020). Bulleen Park and Ride Urban Design and Landscape Plan Report. 1–189

Vincentius, T., Defiana, I., & Septiano, A. (2017). Concept for design of park & ride building in Surabaya. International Journal of Engineering Research & Technology (IJERT), 6(11), 133–142.

Walker, C. (2008). Parking Structure Design Guidelines. In Kimley Horn. https://doi.org/10.1162/leon_r_01372

Widayanti, F. R., & Pattisinai, A. R. (2021). Investigate Park and Ride performance assessment for the better sustainable urban transportation in Surabaya. IOP Conference Series: Materials Science and Engineering, 1098(2), 022019. https://doi.org/10.1088/1757-899x/1098/2/022019

Winayati, W., Lubis, F., & Haris, V. T. (2019). Analisis kebutuhan areal parkir Gedung Fakultas Teknik Universitas Lancang Kuning. SIKLUS: Jurnal Teknik Sipil, 5(1), 39–51. https://doi.org/10.31849/siklus.v5i1.2424

Zhou, Y., Li, Y., Hao, M., & Yamamoto, T. (2019). A system of shared autonomous vehicles combined with park-and-ride in residential areas. Sustainability (Switzerland), 11(11), 1–15. https://doi.org/10.3390/su11113113

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Determinants of crop diversification among smallholder farmers within marshes around Bukavu, Eastern DR Congo

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ABSTRACT

In the South Kivu province of the democratic republic of Congo, smallholder farmers have been draining marshlands for years to grow a variety of crops into a mixed cropping system. This study based on interviews with smallholder farmers examines the drivers of crop diversification and the challenges these farmers face in marshes where various crops are grown for food and income security. Results showed that in these marshy landscapes, crop diversification system is traditionally rooted in local farming practices (84%), and this is designed to meet farmers' self-consumption and market objectives (72%), and also withstand risks associated with the changing climate and pest outbreaks (91%). Further, results from the logistic regression showed that farming experience, farm size, and livestock ownership influence significantly farmers 'decisions to diversify crops. However, farmers claimed to face increasing prices of agricultural inputs (73%) and unusual crop theft (32%) during this ongoing COVID-19 pandemic whereas floods and pest attack as well as plant diseases are raising more concerns among farmers. Although farmers acknowledged the significant roles of livestock in easily acquiring manure and mulch to improve croplands, they still requested specific interventions in terms of priorities (*e.g* drainage equipment, pest management information) to strengthen the resilience and sustainability of agriculture within marshes.

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INTRODUCTION

In the South Kivu province of the Democratic Republic of Congo (DRC), agriculture is practiced in high and low lands into a traditional intercropped system, often mixed with livestock (Heri-Kazi & Bielders, 2020a; Civava et al., 2013; Cox, 2011). Farming in the South Kivu rural and periurban areas is meaningful for local communities because it helps farmers 'households produce self-food, generate income, and support children's education (Klapwijk et al., 2020; Maass et al., 2012; Cox, 2011).

In the territory of Kabare, we observe significant changes in crop production within marshlands. While before the 2000s, most of the wetlands in Kabare were still used for the production of beans, corn, sorghum into a mixed cropping system; many farmers have been changing their crop speculations over time. To date, many farmers are more inclined towards vegetable farming for its short production cycle, to

access permanent diversified food, and incomes (Balasha & Nkulu, 2021; Munyahali et al., 2020). Most of the crops observed in Kabare marshlands included head cabbage, tomato, beans, amaranth, eggplants, squash, and taro as well as sugarcane. However, farmers are facing many challenges that include climatic and socioecomic stressors. For example, while most of farmers are already portrayed as poor, the coronavirus-19 pandemic (COVID-19) has complicated their situation and limited their capacity to buying inputs and accessing needed information due to mobility and import restrictions.

A recent survey conducted in different marshlands around the town of Bukavu indicated that climate change is also a potential threat to agricultural food production (Balasha & Nkulu, 2021). The perceived climate change impacts include floods, increasing temperature, and pest infestation that have led to crop failure and harvest loss (Balasha & Nkulu, 2021; Mushagalusa et al., 2021). Also, heavy rains reported in Kabare are accompanied by intense erosion and this leads to cropland degradation and a decrease in soil fertility, thus compromising the sustainability of agriculture in high and low lands, such as marshes in this case (Heri-Kazi & Bielders, 2020a; 2020b). To adapt to these changes, farmers use, often in combination several strategies. Some of these are environment-friendly practices such as crop diversification. Dessie et al. (2019); Makate *et al.* (2016) and Krista et al. (2016) present crop diversification as a climate-smart technique, and one of the rational ways of reducing uncertainties in agriculture due to the fluctuation in the market and agro-climatic conditions.

Crop diversification is the practice of cultivating more than one variety of crops belonging to the same or different species in a given area in the form of rotations and or intercropping (Makate et al., 2016). This farming technique is easy to implement and acknowledged to have multiple benefits for most smallholder farmers because it is a sustainable approach for pest management, it improves soil fertility and reduces the need for fertilizers, especially if crop mix include leguminous crops that fix nitrogen (Mahmud et al., 2020; Jensen et al., 2020; Munyahali et al., 2020). It also provides the basis for food security and diverse diets and secure farmers 'incomes (Dessie et al., 2019; Krista et al., 2016).

However, despite these benefits, Balasha & Nkulu (2020) and Burchfield & de la Poterie (2018) identified limits (example: insecure land tenure, the high price of agricultural inputs such as seeds) that prevent farmers to implement long lasting crop diversification in the sites. In South Kivu, although crop diversification is recognized as the widespread farming system (Heri-Kazi & Bielders, 2020a; Civava et al., 2013; Cox, 2011), there is still limited knowledge of the drivers of and interests in crop diversification among farmers. We hypothesized that crop diversification depends on socioeconomic factors and farmers' perception of climate risks, and this farming system helps farmers to meet their food needs and market objectives in the context of changing climate and COVID-19 pandemic crisis. The objective of this study was to identify the drivers of crop diversification and challenges that farmers face in marshlands at this era of climate change and COVID-19. In this study, we combined field observations and farmers' interviews to address these 3 research questions: (i) Why are farmers interested in crop diversification in Kabare marshlands?, (ii) What factors do influence farmers' decisions to diversify crops?, (iii) How do climate change and COVID-19 affect marshland farmers?

The answers to these questions will help actors involved in agriculture development understand the factors that promote the use of sustainable practices among marshland farmers and formulate appropriate strategies based on farmers' needs and priorities.

RESEARCH METHOD

Description of the Study Area

The study was conducted from April to June 2020 in 4 marshy sites: Kabirundu, Kanosha, Kavule, Nakishangizi Kiko. These marshes are located between the villages of Buhozi, Nyantende, Chirhinja, Ihemba, Ihasi, Kabanda, and Mandwe in the territory of Kabare, around the town of Bukavu, in the province of South Kivu eastern DR Congo (Figure 1). The Provincial Inspectorate of Agriculture of the South Kivu province has identified 78 marshes in Kabare yet, no study, at the time of writing this article, has attempted to assess the farmers' motivations and challenges in these landscapes.

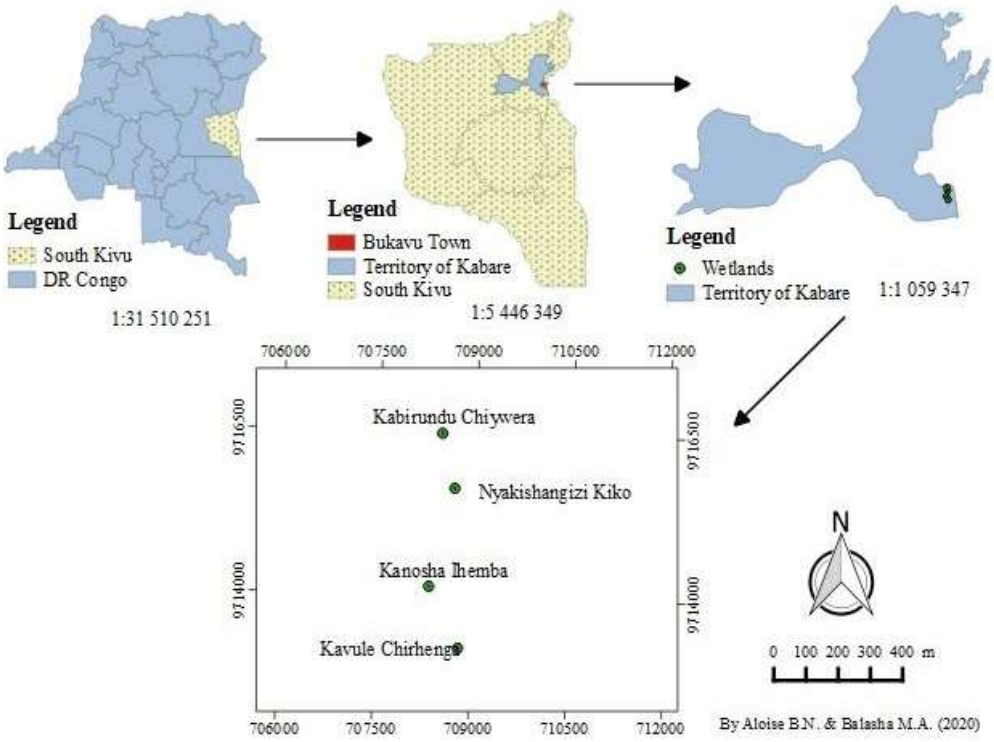

Figure 1. Map of South Kivu (eastern DR Congo) showing the marshes investigated in Kabare

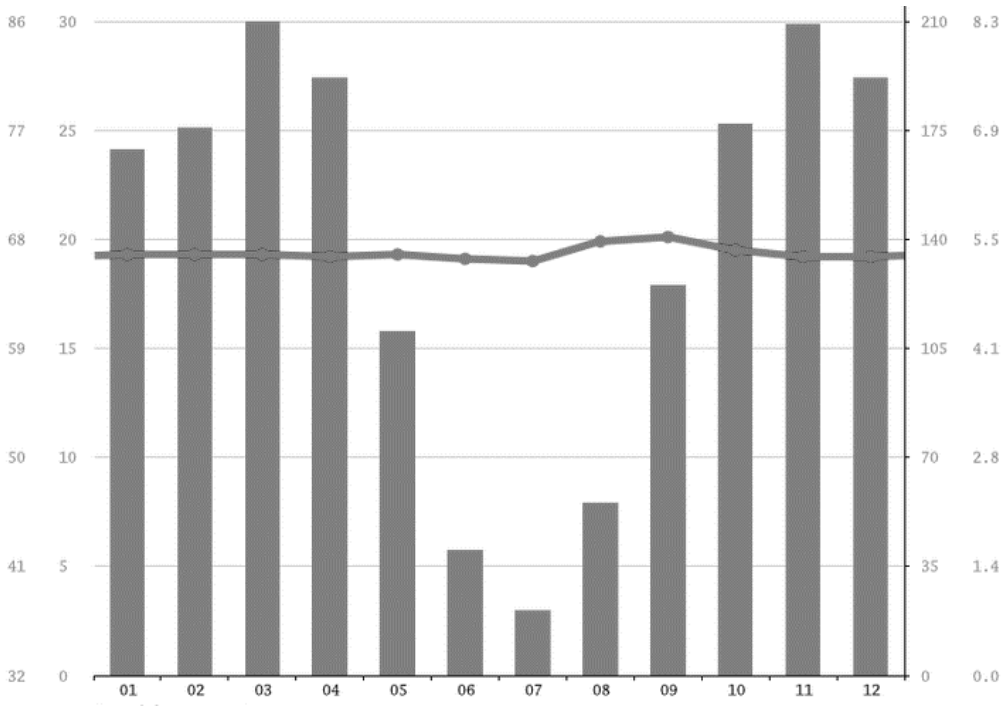

Figure 2. Ombrothermic diagram of the study area

Table 1. Description of The Variables Used in The Binary Logistic Regression

Variables	Description
Dependent variable	
Cropdiv	Crop diversification is specified by 1 if the farmer intercrops two or more crops in the same field, 0 otherwise
Explanatory variables	
Gender (x_1)	Gender (1 = male, 0 = female)
Household size(x_2)	1=Medium if household contains l-6 individuals, 0=large if ≥7
Experience (x_3)	Farming experience(1= short if ≤5 years, 0= long if ≥6 years
Land holding(x_4)	Way farmer holds land(1=owner, 0=tenants)
Farm size(x_5)	Size of arable land in m^2(1=≤ 299 m^2, 0= ≥300m^2
Labor (x_6)	Available labor during farming works (1 = yes, 0 = no)
Time (x_7)	Time spent in farm/ day (1 = if ≤ 4h, 0 if = ≥ 5h)
Objectives (x_8)	Farming objectives (1 =both food and income, 0= otherwise)
Livestock (x_9)	Farmer owns a livestock (1 = yes, 0 = no)
Climat -pest (x_{10})	Farmers perceived climate change and pest risks (1 = yes, 0= no)
Input price (x_{11})	Farmer noticed an increasing price of inputs (1 = yes, 0 = no)
Drainage (x_{12})	Drainage (1 = if done on time, 0 = otherwise)

The choice of these marshy sites was motivated by 3 reasons. First, the sites are large (± 10 hectares each) and exposed to climatic hazards such as floods. Second, many women and young people, including school dropouts work there for their financial autonomy. Finally, we conducted previously there a study on the perception of these farmers of climate change (Mushagalusa et al., 2021). The study area has a humid tropical climate characterized by a rainy season from September to May and a dry season from June to August. The variability of temperature and rainfall quantities for the last decades is presented in Figure 2. In that region, land degradation and landslides are a phenomenon execrated by the combination of intense rainfall, demographic pressure, and bad agricultural practices (Heri-Kazi & Bielders, 2020b; Nobile et al., 2018). Leeuwen et al. (2020); Mathys & Vlassenroot (2016) and Ansoms et al. (2012) have reported several cases of land disputes and land grabbing which increase violence among farming communities. In marshes, various vegetables (cabbage, amaranth, tomatoes; squash, eggplant, beans) and sugarcane, taro as well as potatoes are cultivated for cash and subsistence but farmers claimed to observe significant post-harvest losses (Mushagalusa et al., 2021; Chuma et al., 2022).

Data Collection and Analysis

A semi-structured questionnaire was used to collect information during field visits and interviews among 148 farmers chosen randomly within the four marshy sites (see Figure 1). These farmers were met on their fields during farming works from April to June 2020. A questionnaire was prepared in French and translated into *mashi*, a local language, and included this information: (i) farmers 'socio-economic characteristics (gender, age, access to land, owning livestock, contact with extension agents, sharing information among farmers, farm and households' size, time worked in the farm, farming objectives); (ii) farming system and practices (intercropping or pure cropping system), and (iii) perception of threats to agricultural production in this time of COVID-19 and climatic change. In addition, field observations helped understand the level of the damage associated with floods and pests whereas farmers' stories related to interests in crop diversification and perceived threats increased an understanding of farmers' motivations and challenges.

Data were encoded into Microsoft Excel and crosschecked to clean errors and analyzed using IBM SPSS Statistical Package Version 21.0. Data analysis was performed using descriptive statistics. A chi-square test (χ^2) was used to investigate if significant differences existed between socioeconomic variables and the farming objectives, as well the differences between marshes and perceived threats to crops. The binary logit model was performed to identify the drivers of crop diversification among farmers. The specification of the empirical model or reduced form that was estimated is as follows (see Table 1):

$$Y_i = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+ \beta_6X6+\beta_7X_7+\ldots\beta nX_n$$

Where Y_i is the dependent variable (crop diversification). It takes the value 1 if the farmer diversifies crops, 0 otherwise. X is the matrix of the variables likely to explain the variation of Y. β0 is the

Y intercept; whereas β_1- β_9 is a set of coefficients to be estimated and X_1-X_n are the explanatory variables hypothesized. This study considered α <0.05 as a criterion for statistical significance.

RESULT AND DISCUSSION

Socioeconomic Characteristics

Table 2 presents the relationship between the socioeconomic characteristics of farmers, their perception of climate risk, and crop diversification within marshlands. The total sample size of farmers surveyed was 148. We found that overall more than four-fifth (82%) of marshland farmers were crop diversifiers while 12% practiced pure cropping. There were statistically significant differences between the cropping system and the farming objectives among farmers (χ^2 = 4.474, p=0.034). Crop diversification was more observed among females (66%) and farmers living within large households (more than 7 individuals), having a farming experience of more than five years. Moreover, farmers who owned land (53%) and livestock (88%), and worked more than 5 hours per day in farms diversified their productions to meet household self-consumption as well as market objectives and also withstand risks associated with pests and climate change.

However, there were no statistically significant differences between males and females regarding the farming objectives (χ2 =0.712, p>0.05). These results are consistent with surveys conducted in Ethiopia and Zimbabwe where more than 80% of smallholder farmers diversified their agricultural productions and this depended on various demographic, land and livestock ownership, and environmental factors (Dessie et al., 2019; Makate et al., 2016). In this study, if the proportion of females was high among crop diversification farmers, it is because women tended to invest much of their resources in various mixed vegetable productions to expect collecting income in a short time. Also, in DR Congo, women are considered as a keystone of the agriculture sector and play a vital role in food production, food distribution, and food utilization – the three components of food security (African Development Bank, 2020; Habtezion, 2012; FAO, 2010).

Moreover, women know better than men what types of crops to grow according to the market demand trends since many of these women are involved in crop commercialization. For instance, Balasha & Nkulu (2020) found in Lubumbashi that female vegetable farmers were simultaneously vendors of harvests in order to reduce actors in the distribution chain. Discussing and exchanging information among fellow farmers were found to be significantly associated with crop diversification. This is because farmers learn in groups and imitate among themselves successful practices. This is confirmed by Balasha & Nkulu (2020) in a study conducted on the adoption of integrated production practices for sustainable urban agriculture in Lubumbashi. Also, in Nepal, Anjani et al. (2020) noticed that receiving seed information from fellow farmers helped to increase 12% the adoption of technologies or improved practices for most crops. The drainage of flooded lands was also significantly associated with crop diversification in the sites investigated. This is because drainage is the first operation farmers do to make marshes usable for agriculture. Verhoeven & Setter (2010) showed that marshes worldwide have been drained for long years to convert them into agricultural lands because they have fertile soils as a result of regular sediment deposition during flood events.

As the chi-square test did not highlight more significant differences to tell us enough about the factors associated with crop diversification, we were interested in performing a logistic regression to learn more about additional drivers of crop diversification among marshland farmers as shown in Table 3.

Drivers of Crop Diversification within Marshlands

In marshlands investigated, farmers grow various crops that meet their food needs and these crops generate income in a short time. Like this Farmer No11, many vegetable growers explained: `*'Before, when I used to grow cassava, I had to wait 12 or 15 months to harvest. With amaranth or squash, it is about 30 or 45 days. I can rotate these crops 3 times a year and mix them with other long-lasting crops such as taro".* Crops grown included in large part vegetables (95%), sugar cane (8%), taro (83%), corns and beans as well as cassava (Figure 3).

We observed that almost (4/5) of farmers maintained high levels of crop diversity: three up to five crops in the same field. Crops intercropped in most of the fields can be grouped as follows: (i) cabbage, amaranths, corn, eggplants and taro (ii) squash, eggplants and taro, sweet potato (iii) beans, corn, taro, and cassava, (iv) squash and sugarcane

and taro. Our results are in line with Bellon et al. (2020) who found high-level crop diversity in Ghana, ranging from two up to eight crops, with an average of 3crops per farmer. A recent study conducted in South Kivu by Ndjadi et al. (2020) shows that these crops, especially vegetables play an important role in rural and urban communities as both food and a business opportunity because they are fast-growing species, with high nutritional values and able to generate income in a relatively short period compared to other crops, example corn.

Table 2. Socioeconomic Characteristics of Diversifier Farmers within Marshlands

Variables	Category	Diversifiers	No diversifiers	Differences χ^2 sig.
		%	%	
Crop diversification	Overall	122(82)	26(18)	148***
Gender	Men	41(34)	11(42)	0.712ns
	Women	81(66)	15(58)	
Age (mean=43)	15-39	45(37)	9(35	0.048ns
	≥ 40	77(63)	12(65)	
Farmer 'household size	l-6(small)	43(35)	11(42)	0.461ns
Mean =8	≥7(large)	79(65)	15(58)	
Farming experience (years); Mean =11	≤ 5(short)	53(43)	14(54)	0.936ns
	≥6 (long)	69((57)	12(46)	
Land holding	Land owners	65(53)	15(58)	0.168ns
	Land tenants	57(47)	11(42)	
Farm size (m²); Mean =289	≤ 299(small)	76(62)	14(54)	0.0642
	≥ 300(large)	46(38)	12(46)	
Drainage	Yes	85(70)	24(92)	5.658*
	No	37(30)	2(8)	
Contact with NGO or agronomist	Yes	17(14)	4(15)	0.037ns
	No	105(86)	22(85)	
Worked time (hours); Mean = 6.25	≤ 4h	8(7)	1(4)	0.729ns
	≥5h	114(93)	25(98)	
Own a livestock	Yes	88(88)	16(89	0.012ns
	No	12(12)	2(11)	
Hired casual labor; Mean =2 persons	Yes	93(76)	21(81)	0.250ns
	No	29(24)	5(19)	
Perception of climatic and pest threats	Yes	108(88)	20(77)	2.468ns
	No	14(12)	6(23)	
Farming objectives	Food and income	91(75)	14(57)	4.474*
Sharing info with fellow	Yes	70(57)	9(35)	4 .462*
Farmers	No	52(43)	17(65)	
Increasing price of	Yes	88(72)	20(77)	0.250ns
agricultural inputs	No	34(28)	6(23)	

χ^2=Chi square test, sig = significance, *= significant at 10%, ns= no significant

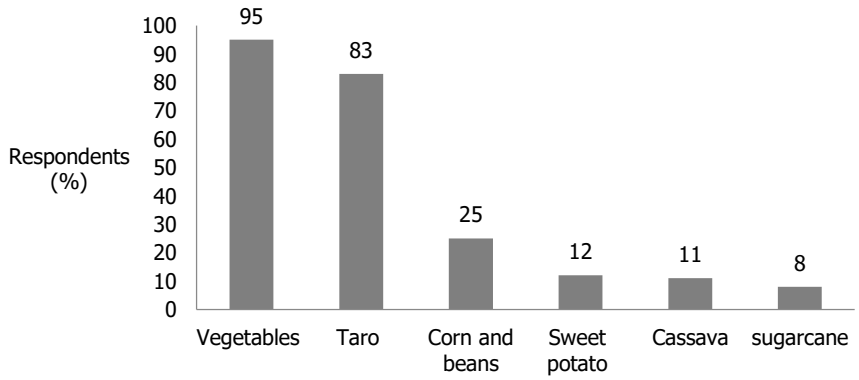

Figure 3. Crops produced by marshland farmers within investigated marshlands

Table 3. Factors Influencing Farmers' Decisions to Diversify Crops within Marshlands

Variables	Coefficient	Std. Error	Exp(B)
Gender	0.355	0.632	1.426
Household size	-0.304	0.570	0.738
Farming experience	-1.437*	0.636	0.238
Land holding	0.712	0.589	2.038
Farm 'size	1.104*	0.650	3.017
Permanant Labor	0.984	0.708	2.676
Time spent in farm	2.474	2.184	11.871
Farming objectives	0.514	0.720	1.672
Livestock ownship	1.942*	0.765	6.970
Perception of climatic and pest risks	1.143	0.814	3.136
Increasing price of agricultural inputs	-1.219	0.787	0.295
Drainage of water canals	0.153	0.658	1.165
Constant	-11.400	5.757	0.000

* denotes significant level at 10%, Overall percentage of correctly predicted model = 83.9%, Exp(B): exponentiation of the B coefficient, -2 Log likelihood = 86.926

Table 3 shows results from the binary logit model for the entire sample of farmers surveyed. Among the 12 variables examined, farming experience, farm size, and livestock ownership influenced significantly farmers 'decision to diversify crops. This implies that farmers' experience helps to manage diverse crops on a given piece of land and livestock provides manure to the system. Also, experienced farmers are assumed to have better knowledge of farming practices and agricultural challenges (Belay et al., 2017). Makate & Mango (2017) argued that farmers 'socioeconomic characteristics and practices are important factors in agricultural food production. In Zimbabwe, farming experience, household wealth, and land size holding were found to be the key determinants of crop diversification among farmers (Makate *et al.,* 2016). In South Kivu's rural areas, livestock influences positively agricultural production since soil fertility of most fields is maintained by available livestock manure, especially from cattle, guinea pigs, and rabbits (Klapwijk et al., 2020; Maass et al., 2012; Cox, 2011).

Results showed that livestock ownership increased 7 times farmers' chances to diversify crops compared to those who did not own livestock. Two reasons can explain this. First, livestock generates money, produces manure and trash for organic fertilization of crops and mulching, and in return, animals are fed with crop residues (Klapwijk et al., 2020; Zamukulu et al., 2019; Cox, 2011). Secondly, livestock (if some animals are sold) helps farmers acquire or adopt new agricultural technologies such as improved seeds which are expected to have a positive effect on agricultural productivity (Dontsop-Nguezet et al., 2016). In some cases, farmers trade their animals to access land, as said farmer No 24. *I cultivate this piece of land but does not belong to me. I give every year to the landowner a goat to use the land*. Farmers are encouraged to diversify crops to enhance crop productivity and resilience in rural smallholder farming systems threatened by changing climate (Hufnagel et al., 2020; Makate et al., 2016). Time worked on farms (6 hours /day on average) illustrates in large part that farming is an important activity for respondents. Time spent daily on farm increased by was positively correlated to farmers' decision to diversify crops. Our results are consistent with Balasha & Kesonga (2019) who found that vegetable growers in Lubumbashi worked daily about 5 hours and considered vegetable production as their main income-generating activity.

Farmers' Motivations for and Interests in Crop Diversification

Farmers 'interests and motivations for crop diversification in marshes are shown in figure 4. Farmers claimed to diversify crops because this practice is rooted in their farming traditions (84%) and helped to minimize climatic and pest risks (91%), meeting their farming objectives e.g. self-consumption and income-generating (72%), preventing food shortage (57%), stabilizing yield (65%) and maintaining soil fertility (54%). Like these respondents No 12 and 63, many farmers explained "*we intercrop amaranth, cabbage and eggplants, and taro because they grow fast. We start selling amaranth from the 30th day after sowing, and this first harvest helps to purchase inputs (example pesticide, manure) for the remaining crops. The diversification farming system is mainly designed to meet our food needs (diverse diets) and allows collecting progressively incomes from sequenced harvests. The most benefit of this system is that if one crop fails due to any hazard, at least one crop can survive and help us".*

Farmers 'motivations and interests in the intercropping system are in agreement with many studies on crop diversification. For example, Bellon et al. (2020) found that crop diversity is positively associated with self-consumption of food crops, and cash income from crops sold. Makate et al. (2016) and

Thimmegowda et al. (2016) stated that diversified cropping systems tend to be more agronomically stable and resilient to climate change. This resilience is explained by different advantages such as reduced weed and pest pressures, reduced need for chemical inputs like fertilizers, especially if the crop mix includes leguminous crops that fix nitrogen (Mahmud et al., 2020; Jensen et al., 2020; Munyahali et al., 2020). Also, FAO has been encouraging vegetable farmers to diversify crops to reduce pest incidence and excessive pesticide sprays in urban and periurban agriculture (Mushagalusa, 2019; Mutshail, 2008). Farmers 'interests in and motivations for diversified vegetable productions such as amaranth, squash, cabbage have been increasing because of the short cycle of growth of these crops and the income they provide (Ndjadi et al., 2020; Balasha & Kesonga, 2019). Additionally, the production of these vegetables is stimulated by the increase in demand for food in Bukavu town where the growing urban population has led to new food habits. In the context of the COVID-19 pandemic characterized by the disruption of food supply chains, lockdowns measures, and limited food imports (Clapp & Moseley, 2020; Workie et al., 2020; Béné, 2020), local smallholder farming systems based on crop diversification are resilient and accepted to adapt better to both climate change and ongoing pandemic because food is produced locally and disturbed straight among communities (Adhikari et al., 2021; Rattan, 2020).

Perceived Impacts of Climate Change and C0VID-19 among Marshland Farmers

Farmers reported various impacts linked to climate change and the COVID-19 pandemic (Table 4). The impacts related to COVID-19 were the increase in agricultural input prices (e.g pesticides, seeds) and crop theft cases whereas the propagation of pest and plant diseases, as well as floods, were due to climate change. There were significant differences between marshes and increases in the price of agricultural inputs as well as crop theft ($p< 0.05$). Overall, 32% of farmers were victims of crop theft, and this issue was more reported by 51% in Kabirundu. Moreover, more than 89% of farmers of the entire sample mentioned pest attacks and floods as potentials threats to agricultural production within marshes.

These threats jeopardize farmers' livelihoods on which farmers base their financial and food sources. Such a situation might be critical in the DRC, especially in the South Kivu province where agriculture is still a strategic livelihood and often the main source of income for about 70 and 80% of households (Dontsop-Nguezet et al., 2016). If the increases in agricultural input or food commodities prices are attributed to mobility restrictions, reduced good imports, and lockdowns due to COVID-19, the situation has been worsening with the volatility of the exchange rate that affects farming production cost (Murhula et al., 2020; Balasha et al., 2020; Balasha & Kesonga, 2019).

Meanwhile, the trend of crop theft rising among farming communities could be understood as an expression of severe poverty and increased insecurity as well as an incapacity for many people to afford food prices during this pandemic. Crop theft consists of stealing harvests including vegetables, fruits, or any agricultural produce belonging to another person. It may discourage farmers from investing their resources in agriculture. For example, Dyer (2020) found in Kenya that the risk of theft is perceived to be significantly stronger for farmers who just adopt and cultivate new valuable crops compared to those who grow traditional crops.

Figure 4. Farmers 'interests in and motivations for crop diversification within marshlands (%)

Table 4. Climate Change and COVID-19 Impacts on Agriculture within Marshes

Marshes	Input prices		Crop theft		Crop pest		Flood	
	Yes	No	Yes	No	Yes	No	Yes	No
	..... %							
Kabirundu	16(39)	25(61)	21(51)	20(49)	41(100)	0(0)	36(88)	5(12)
Kavule	29(91)	3(9)	9(28)	23(72)	25(78)	7(22)	25(78)	7(22)
Kanosha	33(92)	3(8)	10(28)	26(72)	32(89)	4(11)	28(77)	8(23)
Kiko	30(77)	9(23)	7(18)	32(82)	34(87)	5(13)	34(87)	5(13)
Overall	108(73)	40(27)	47(32)	101(68)	132(89)	16(11)	123(83)	25(17)
Test (χ^2)	35.702		11.055		11.429		3.860	
p-value	0.000		0.011		0.076		0.425	

Studies conducted in Kenya and South Africa show that crop theft can lead small-scale farmers to alter their production decisions resulting in crop type change or additional expenses for fencing to improve security (Dyer, 2020; Maluleke et al., 2016; Bunei et al., 2014). For instance, many farmers like this respondent N°41 explained, "*Before, we used to grow corn and tomato. Since last year, we have been switching to crops that we did not grow previously such as sweet potatoes and amaranth. We invest time and money in agriculture but thieves harvest for us. We now harvest prematurely to rescue some harvests".*

Research Implication

Smallholder farmers' motivations and interest in crop diversification as shown in Figure 4 illustrates how marshland agriculture plays a significant role in farming communities, and also how this farming system helps to reduce environmental risks in marshland agriculture. Basimine et al. (2022) have recently argued that wetlands are mainly converted into farmlands to ensure food and income security among rural populations. Based on the findings and other research across Africa, crop diversification is one strategy that smallholder farmers may employ to reduce their vulnerability in the face of global environmental change (Dessie et al., 2019; Makate et al., 2016; Krista et al., 2016).

However, being acknowledged as one of the most vulnerable ecosystems, marshlands should be exploited with a focus on sustainable practices. These practices include, for instance an integrated pest and fertility management, a permanent drainage of ditches or water canals to prevent floods that lead to crop failure and harvest loss (Balasha & Nkulu, 2021; Mushagalusa et al., 2021). Moreover, just like climate change whose response interventions need to target both men and women to strengthen their resilience capacities, a study by Basimine et al. (2021) also recommend that both local communities and decision-makers should be involved in designing sustainable utilizations and conservation options to durably improve livelihoods of populations depending of these marshy landscapes.

CONCLUSION AND SUGGESTION

This study examined the determinants of crop diversification and the challenges that farmers face in marshes where various crops are grown for farmers' livelihoods. Results show that farmers cultivate small-sized lands and produce crops that meet their food needs and market demand in Bukavu where food supply chains and imports are disrupted and restricted by the COVID-19 measures. The logistic regression model indicated that crop diversification in the South Kivu marshes was significantly influenced by farmers 'experience, the size of cultivated plot, and livestock ownership. Additionally, the comparison between crop diversifiers and not diversifiers revealed that the drainage of marshes, information exchange among farmers, time worked per day in the field and farming objectives were associated with crop diversification. Despite the perceived risks that threaten smallholder agriculture, marshes are still considered favorable lands where women and young school dropouts seek their financial autonomy and food for their families. In the face of climate change, crop diversification is a resilient approach and a sustainable way to reduce uncertainties in agriculture. Crop diversification also has the potential to improve farming households' livelihoods and contribute to key pillars of food security: food availability, food accessibility, food utilization, and stability. However, smallholder farmers need technical support to prepare for and

adapt to unexpected events such as pest and disease outbreaks, climatic hazards, and exogenous shocks.

REFERENCES

Adhikari, J., Jagadish, T., Sarba, R., Yamuna, G., & Hemant, O. (2021). COVID-19 impacts on agriculture and food systems in Nepal: Implications for SDGs. Agricultural Systems 186, 102990. https://doi.org/10.1016/j.agsy.2020.102990.

Anjani, K., Hiroyuki, T., Ganesh, T., Naveen, A., Saroja, S. Madhab, K., & Joshi, P. (2020). Adoption and diffusion of improved technologies and production practices in agriculture: Insights from a donor-led intervention in Nepal. Land Use Policy, 95,104621. https://doi.org/10.1016/j.landusepol.2020.104621

African Development Bank, 2020. From farm to fork: The women championing an agricultural transformation in Africa. Retrieved from http://www.ipsnews.net/2020/06/farm-fork-women-championing-agricultural-transformationafrica/

Ansoms, A., Claessens, K., & Mudinga, E. (2012). L'accaparement des terres par des élites en territoire de Kalehe, RDC. L'Afrique des Grands Lacs. Annuaire 2011-2012, pp. 206-226.

Balasha, M., Hwali M., Kesonga, N., Murhula, B., & Kitsali, K. (2020). Understanding the Roles of Street Vendors of Agricultural Commodities during the COVID-19 Outbreak in the Informal Economy. Open Journal of Social Sciences. 8, 115-129. https://doi.org/10.4236/jss.2020.89008.

Balasha, M., & Nkulu, J. (2020). Déterminants d'adoption des techniques de production et protection intégrées pour un maraîchage durable à Lubumbashi, République démocratique du Congo. Cahiers agricultures 29: 13. https://doi.org/10.1051/cagri/2020012.

Balasha, A. & Kesonga, N. (2019). Évaluation de la performance économique des exploitations de chou de Chine (Brassica chinensis L.) en maraîchage à Lubumbashi en République Démocratique du Congo. Rev. Afr. d'Envi. et d'Agriculture, 2(1), 11-19.

Balasha, A. & Nkulu, M. (2021). Potential threats to agricultural food production and farmers' coping strategies in the marshlands of Kabare in the Democratic Republic of Congo. Cogent Food & Agriculture 7:1, 1933747, https://doi.org/10.1080/23311932.2021.1933747.

Basimine, C., Mondo, M., Denis, S., Katcho, K. Nachigera, G. & Schmitz, S. (2022). Socio-economic determinants of land use and land cover change in South-Kivu wetlands, eastern D.R. Congo: Case study of Hogola and Chisheke wetlands. Environmental Development. 43, 100711. https://doi.org/10.1016/j.envdev.2022.100711.

Basimine, C., Mondo, M., Katcho, K., Nachigera, G., & Schmitz, S. (2021). Factors driving utilization patterns of marshlands in the vicinity of South-Kivu urban agglomerations based on Rapid Assessment of Wetland Ecosystem Services (RAWES). Environmental Challenges 5, 10029. https://doi.org/10.1016/j.envc.2021.100297

Belay, A., Recha, W., Teshale, W., & Morton, J. (2017). Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. Agric & Food Security. 6:24. https://doi.org/10.1186/s40066-017-0100-1

Bellon, M., Bekele H., Azzarri, C., & Francesco, C. (2020). To diversify or not to diversify, that is the question. Pursuing agricultural development for smallholder farmers in marginal areas of Ghana, World Development. 125, 104682; https://doi.org/10.1016/j.worlddev.2019.104682

Béné, C. (2020). Resilience of local food systems and links to food security – A review of some important concepts in the context of COVID-19 and other shocks. Food Security.12:805–822; https://doi.org/10.1007/s12571-020-01076-1

Bunei, E. K., Rono, J. K., & Chessa, S. R. (2014). Factors influencing farm crime in Kenya: opinions and experiences of farmers. International Journal of Rural Criminology, 2(1), 75–100. https://doi.org/10.18061/1811/58846

Burchfield E. K., & de la Poterie, A. (2018). Determinants of crop diversification in rice dominated Sri Lankan agricultural systems. J Journal of Rural Studies, 61, 206–215. https://doi.org/10.1016/j.jrurstud.2018.05.010

Civava, R., Malice, M. & Baudoin, J. P. (2013). Amélioration des agrosystèmes intégrant le haricot commun (Phaseolus vulgaris L.) au Sud-Kivu montagneux. Ed. Harmattan, pp.69-92.

Clapp, J., & Moseley, G. (2020). This food crisis is different: COVID-19 and the fragility of the neoliberal food security order. The Journal of Peasant Studies. 47(7), 1393-1417, https://doi.org/10.1080/03066150.2020.1823838.

Chuma, B. G., Ndeko, B. A., Mulalisi, B., Safina, B. F., Ndjadi, S. S., & Mushagalusa, N. G. (2022). Post-harvest Constraints of Solanaceae Species Produced in Kabare Wetlands, Eastern Democratic Republic of Congo. Agricultural Research, 11(3), 506–517. https://doi.org/10.1007/s40003-021-00586-4

Cox, T. P. (2011). Farming the battlefield: The meanings of war, cattle and soil in South Kivu, Democratic Republic of the Congo. Disasters, 36(2), 233–248. https://doi.org/10.1111/j.1467-7717.2011.01257.x

Dessie, A. B., Abate, T. M., Mekie, T. M., & Liyew, Y. M. (2019). Crop diversification analysis on red pepper dominated smallholder farming system: evidence from northwest Ethiopia. Ecological Processes, 8(1). https://doi.org/10.1186/s13717-019-0203-7

Dontsop-Nguezet, P. M., Njukwe, E., Amato, M., Nyakuni, A. G., Zozo, R., Okafor, C. & Akem, C. (2016). Non-farm activities and adoption of improved cassava and beans varieties in South-Kivu, DR Congo. Tropicultura. 34(3): 262-275.

FAO (2010). Growing greener cities in Democratic Republic of Congo, 00153 Rome, Italy, 35p.

Habtezion, S. (2012). Gender, agriculture and food security, in Gender and Climate Change Capacity development series, United Nations Development Programme, New York, NY USA, 30P.

Heri-Kazi, B., & Bielders, C. L. (2020a). Dégradation des terres cultivées au Sud-Kivu, R.D. Congo: perceptions paysannes et caractéristiques des exploitations agricoles. Biotechnol. Agron. Soc. Environ. 24(2), 99-116.

Heri-Kazi, B., & Bielders, C. L. (2020b). Erosion and soil and water conservation in South-Kivu (eastern DR Congo): The farmers' view. Land Degrad Dev. 1–15. https://doi.org/10.1002/ldr.3755

Hufnagel, J., Moritz, R., & Ewert, F. (2020). Diverse approaches to crop diversification in agricultural research. A review. Agronomy for Sustainable Development 40: 14. https://doi.org/10.1007/s13593-020-00617-4

Jensen, E., Carlsson G., & Hauggaard-Nielsen, H. (2020). Intercropping of grain legumes and cereals improves the use of soil N resources and reduces the requirement for synthetic fertilizer N: A global-scale analysis. Agronomy for Sustainable Development. 40, Article number: 5. https://doi.org/10.1007/s13593-020-0607-x

Dyer, J. (2020). The Fruits and Vegetables of Crime: Protection from Theft and Agricultural Development, Job Market Paper, University of Toronto, 83p.

Klapwijk, J., Schut, M., Piet, J., Vanlauwe, B., Giller, E. & Descheemaeke, K. 2020. Micro-livestock in smallholder farming systems: the role, challenges and opportunities for cavies in South Kivu, eastern DR Congo. Tropical Animal Health and Production, 52(3), 1167–1177. https://doi.org/10.1007/s11250-019-02112-9

Krista, B., Sieglinde, S., Kimberly, C., & Kurt, B. W. (2016). Assessing the value of diverse cropping systems under a new agricultural policy environment in Rwanda. Food Security, 8(3), 491–506. https://doi.org/10.1007/s12571-016-0582-x.

Leeuwen M., Mathys, G., de Vries, L., & Gemma, V. (2020). From resolving land disputes to agrarian justice -dealing with the structural crisis of plantation agriculture in eastern DR Congo. The ournal of Peasant Studies, 49(2), 309–334. https://doi.org/10.1080/03066150.2020.182417

Maass, L., Katunga, M., Wanjiku, L., Anja, G., & Peters, M. (2012). Challenges and opportunities for smallholder livestock production in post-conflict South Kivu, eastern DR Congo. Tropical Animal Health and Production, 44(6), 1221–1232. https://doi.org/10.1007/s11250-011-0061-5.

Mahmud, K., Makaju, S., Ibrahim, R., & Missaoui, A. (2020, January 1). Current progress in nitrogen fixing plants and microbiome research. Plants. 9, 97; https://doi.org/10.3390/plants 9010097.

Makate, C., & Mango, N. (2017). Diversity amongst farm households and achievements from multi stakeholder innovation platform approach: Lessons from Balaka Malawi. griculture and Food Security, 6(1). https://doi.org/10.1186/s40066-017-0115-7.

Makate, C., Wang, R., Makate, M., & Mango, N. (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: Adaptive management for environmental change. SpringerPlus, 5(1). https://doi.org/10.1186/s40064-016-2802-4.

Maluleke, W., Mokwena, R., & Motsepa, L. (2016). Farmers' perspectives on stock theft: police crime statistics. S. Afr. J. Agric. Ext. 44(2) 256-274. http://dx.doi.org/10.17159/2413-3221/2016/v44n2a393.

Mathys, G., & Vlassenroot, K. (2016). It's not all about the land': Land disputes and conflict in the eastern Congo, Rift valley institute PSRP briefing paper. 8p.

Munyahali, W., Kulemba, M., Chakirwa, P., Walangululu, J., Vanlauwe, B., & Nziguheba, G. (2020). Using the Legume CHOICE tool to support legume use on smallholder farms in South Kivu province in the Democratic Republic of Congo. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Murhula, B., Kitsali, K., & Mushagalusa, B. (2020). Pauvreté et Secteur Informel à Bukavu: Profil des détaillants des Produits Agricoles à l'Ere de la Pandémie COVID-19. Journal of Economics, Finance and Accounting Studies. 2(2), 1-10.

Mushagalusa, B. (2019). Drivers of adoption of integrated pest management among small-scale vegetable farmers in Lubumbashi, DR Congo. American Journal of Rural Development 7(2): 53–59. https://doi.org/10.12691/ajrd-7-2-2.

Mushagalusa, B., Kitsali, K., Murhula, B., Hwali, M., Ndele, B., Cirhuza, V., Assumani, B., Akili, I., Nicanor C., & Benoît, B. (2021). Perception et stratégies d'adaptation aux incertitudes climatiques par les exploitants agricoles des zones marécageuses au Sud-Kivu. VertigO - la revue électronique en sciences de l'environnement. 21(1). https://doi.org/10.4000/vertigo.31673

Mutshail, M. (2008). Project for the Development of Urban and Peri-urban Horticulture (UPH) in Lubumbashi (DRC), SENAHUP/FAOUPH, Project, Lubumbashi, online. Retrieved from ftp://ftp.fao.org/docrep/fao/011/ak159f/ak159f20.pdf.

Ndjadi, S. S., Vumilia, R. K., Ahoton, L. E., Saidou, A., Orou, B. D., Mugumaarhahama, Y., … Mushagalusa, G. N (2020). Typology and Prospects for the Improvement of Market Gardening Systems in South-Kivu, Eastern DR Congo. Journal of Agricultural Science, 12(6), 136. https://doi.org/10.5539/jas.v12n6p136.

Nobile, A., Dille A., Monsieurs, E., Basimike, J., Bibentyo, T. M., d'Oreye, N., … Dewitte, O. (2018). Multi-temporal dinsar to characterise landslide ground deformations in a tropical urban environment: Focus on Bukavu (DR Congo). Remote Sensing, 10(4). https://doi.org/10.3390/rs10040626

Rattan, L. (2020). Home gardening and urban agriculture for advancing food and nutritional security in response to the COVID-19 pandemic. Food Security 12:871–876, https://doi.org/10.1007/s12571-020-01058-3.

Thimmegowda, M. N., Ramachandrappa, B. K., Devaraja, K.,… (2016). Climate resilient intercropping systems for rainfed red soils of Karnataka, Indian Journal of Dryland Agricultural Research and Development, 31(2), 39. https://doi.org/10.5958/2231-6701.2016.00023.3.

Verhoeven, J., & Setter, L. (2010). Agricultural use of wetlands: opportunities and limitations, Annals of Botany 105: 155-163. https://doi.org/10.1093/aob/mcp172.

Workie, E., Mackolil, J., Nyika, J., & Sendhil, R. (2020). Deciphering the impact of COVID-19 pandemic on food security, agriculture, and livelihoods: A review of the evidence from developing countries, Current Research in Environmental Sustainability. 2,100014, http://dx.doi.org/10.1016/j.crsust.2020.100014

Zamukulu, P., Ayagirwe, R., Ndeko, A., Bagula, E. ... (2019). Contraintes et opportunités de l'intégration agriculture-élevage à Mushinga dans l'Est de la RD Congo, Journal of Animal & Plant Sciences. 41 (3), 7000-7014. https://doi.org/10.35759/JAnmPlSci.v41-3.4.

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Determinant return to work program for work-injured employees in Indonesia

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ABSTRACT

Work accidents can determine the safety quality in the workplace, which contributes to national economic development. It is estimated that gross domestic product losses from work injuries are 3.94% annually. It is important to reactivate work-injured persons' productivity. The Return to Work (RTW) program was formed to accommodate employees who become disabled after a fatal injury. This study aims to estimate the RTW rate and the factors that influence the probability of success of the RTW program for work-injured persons. Data were obtained from the Social Security Organization (BPJS Ketenagakerjaan) for the 2020–2021 period. A total of 195 participants enrolled in this program because of fatal work injuries. The study was cross-sectional and used a logistic regression model. The results showed that 75.90% of participants could work after following the program. Factors positively influencing the success of the RTW program included lower and upper amputation (OR = 2.474), working in the secondary sector (OR = 2.409), enrolling in the RTW program in 2020 (OR = 2.184), and paying a lower insurance premium rate (OR = 3.260). The rate of RTW in Indonesia is relatively high, with more than three-quarters of participants being able to work. Risky groups need more attention by providing information about the work environment and road hazards. These findings can be used as a reference point for further developing the RTW program to increase assistance to high-risk patients who are not able to work after finishing the program.

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INTRODUCTION

Indonesia experiences positive economic growth every year, with the trend of gross domestic product (GDP) ranging from around 3.5% to 4.3% from 2013 to 2019 (Central Agency on Statistics, 2020). Economic activity implies that people are involved in business. However, there is a trade-off: accidents due to potential hazards in the workplace. A large number of employees in Indonesia work in the primary or extractive sectors, for instance, agriculture, construction, and mining. This sector creates a particular risk that stems from hazardous agents, such as radioactive and chemical substances (ILO, 2020a).

Globally, occupational accidents involve more than 374 million nonfatal cases and 2.78 million deaths per year (ILO, 2020b). A comparison between countries in Southeast Asia shows that Indonesia has the highest number of fatal accidents at 43%, followed by Thailand (19.2%) and Singapore (10.5%) (Takala,

1999). Additionally, in Indonesia, there are 15,973 accidents per 100,000 workers, with a 20.9 fatality rate for accidents caused by three days of absence (Hämäläinen et al., 2006).

The Indonesian government has taken action to reduce the number of work injuries. It has developed occupational accident prevention programs to increase productivity, health promotion programs to raise awareness of work hazards, programs to control the work environment, and the provision of occupational accidents (Irfani, 2015). Occupational accidents typically occur because of machines and electrical equipment, for example, steam, pounding, pressing, sewing, drilling, and weaving machines. Other sources of occupational accidents are transporters and lifters. These sources are mainly from the mining and manufacturing sectors (Ministry of Manpower Republic Indonesia, 2021).

People with serious accidents tend to have disabilities afterwards. Mild and severe injuries sometimes result in amputation. After amputation, some individuals develop psychological disorders, such as anxiety and depression. Research in Kenya showed that 47.4% of amputees develop depression. Furthermore, around 24.5% of participants develop postoperative depression. Individual and social factors exacerbate this condition: young age, single status, low education, trauma, absence of prostheses, and lack of social support (Mohamed et al., 2022).

Click or tap here to enter text.Sustained depression in individuals affects work productivity. Workers who are depressed tend to lose work hours and fully not work, which results in lost productive time. The decline in productivity affects costs incurred by the company significantly. It is estimated that the lost productivity cost among workers in Japan due to presenteeism is around $469,67 per capita (Yoshimoto et al., 2020). Additionally, health costs for compensation-related occupational accidents were $114,000 for 234,370 cases in 2021 (BPJS Ketenagakerjaan, 2021).

Economically, occupational accidents affect both companies and workers. It is estimated that state losses due to occupational accidents make up 4% of the gross national product (Somavia, 2005). An accident's direct and indirect costs include medical expenses, lost working days, reduced production, lost compensation for workers, time and money expenses from retraining workers, equipment breakdown and repair costs, negative publicity for the company, and loss of contracts due to occupational accidents (ILO, 2007).

Persons with disabilities (PWD) in Indonesia number around 7.9 million, out of which 96% are working and 4% are openly unemployed (Ministry of Manpower Republic Indonesia, 2021). PWD experience lower labor force participation rates than nondisabled people (Halimatussadiah et al., 2017). PWD regulations were issued to protect them from discrimination and guarantee them opportunities (Dewi, 2019). Nevertheless, PWD face burdens regarding joining the formal sector. Employees perceive PWDs as bringing higher cost and lower productivity (Suryahadi, 2022). The Return to Work (RTW) program was developed to protect employees who become unemployed because of occupational accidents and to prevent additional unemployed PWDs in Indonesia.

Occupational accidents that cause physical and functional disabilities increase the number of PWDs in Indonesia. The proportion of patients who can recover completely without experiencing disability is around 95%. Meanwhile, 5% of patients die or experience functional disability, permanent/partial disability, and total disability. Even though this percentage is small, workers with disabilities can affect various economic areas, specifically unemployment and low productivity. Moreover, there were a significant number of occupational accident cases in 2021. There was a 265% increase in total claimants from 2020 to 2021. Additionally, the number of fatality cases increased slightly from 2.91% to 3.48%.

The issuance of Ministry of Manpower regulation No. 10/2016 regarding procedures for administering the RTW program provide additional benefits to the Work Injured Benefit program. The program focuses on fatal injuries, which cause physical and functional disabilities. It aims to recover workers' productivity after an injury that affects them physically and mentally. The patient is enrolled in several programs, including medical treatment, rehabilitation, and vocational training.

The RTW program has been operated in Indonesia since 2015. The program focuses on workers with fatal injuries or potential disabilities. Workers with fatal injuries usually experience amputation or a decrease in the body's functions caused by injuries in several locations, such as fractures, burns and wounds. The program aims to make workers physically and

mentally productive again after a occupational accident.

Since it was established, the number of patients who participated in the RTW program has increased gradually. By 2021, 1106 participants had experienced occupational accidents following the RTW program in Indonesia. In the last three years, there has been an increase of 40.08% of participants enrolled in this program. Before a worker can join the RTW program, the employer should sign an agreement to reemploy the patient. If, after the program ends, the patient cannot work productively in their current company, they have the opportunity to perform another job at the company or work at a new company. The program also includes on-the-job training for amputees who need to readjust to their tasks.

Several countries have researched the RTW program, aiming to identify determinants that affect the probability of returning to work. In Malaysia, Awang et al. (2016) revealed the internal and external factors behind the success of the RTW program: year of injury, cause of injury, gender of injured person, age of injured person, industry type, duration of intervention, participant motivation, and company interest. Kang (2022) stated that, in South Korea, age, gender, marital status, education, household income, residential area, accident type, disability level, company size, industry group, and job stability influenced the determinants of the RTW program. In China, He et al. (2010) found that the RTW program's determinants are age, working years, monthly salary, gender, marital status, education level, technical job title, occupational group, and injury severity.

Kang (2022) researched Korea's industrial accident and insurance patients. Kang found that workers' awareness of health recovery and rehabilitation on the physician were positive factors that influenced RTW. Additionally, environmental aspects and individual characteristics (age, level of disability) significantly affected RTW.

Awang et al. (2016) aimed to examine the success of the RTW program in Malaysia among work injury patients. As many as 65% of patients were able to return to work. The male gender, age, motivation, employer interest, intervention duration, and injury type were the key success factors in reemployment.

He et al. (2010) studied RTW patients recovering from work injuries in China. The authors found that 92.9% of patients could return to work with an average of 43 days off. Factors that influenced the success of the RTW program were age, injury severity, injury locus, injury nature, pain in the injury locus, self-report health status, and preinjury monthly salary.

Cancelliere et al. (2016) analyzed various health injury conditions and their relationship to the RTW program. Factors that influenced the success of the RTW program were higher education, lower severity of the injury, multidisciplinary intervention, and RTW coordination. Negative associations with RTW were the female gender, older age, higher disability, and depression.

Van der Kemp et al. (2019) examined mild-to-moderate stroke patients in the RTW program. Factors predicting RTW were global cognitive function and depressive symptoms after two-month onset for one year RTW.

In Indonesia, research related to the RTW program is still limited. Expanding this field to develop a better program in Indonesia is important. The current research aims to estimate the RTW rate in Indonesia, analyze the internal and external factors affecting participants who are able to work after the RTW program, and examine the factors affecting the probability of success the RTW program.

RESEARCH METHOD

The data used in this study were secondary data. The main resource was BPJS Ketenagakerjaan, which is responsible for conducting the RTW program. Other literature sources were the Central Statistics Agency, the Indonesian Ministry of Manpower, the Indonesian National Police, and journal articles. The data were processed using Microsoft Excel and STATA.

The respondent pool for the 2020–2021 period was 226 participants throughout all provinces in Indonesia. Only 195 participants were eligible to be included in this study. Respondents were excluded for having incomplete data. Further, respondents who were still undergoing treatment were not included because the study's focus was on working and nonworking status of patients after the RTW program. The data consisted of participants' working status, participants' age, participants' gender, participants' injury type, participants' working experience, accident year, industry group, insurance rate, and accident location.

The research adopted a cross-sectional quantitative approach. Descriptive and quantitative analyses were conducted. The illustrative method was

used to answer the first research question, and quantitative analysis using a logistic regression model was conducted to answer the second research question.

The RTW rate was calculated based on the total number of participants in the RTW program who could work divided by the total number of patients after the RTW program. The RTW rate was used to estimate the success rate of the RTW program. This calculation was based on previous research by Vles et al. (2005) and Awang et al. (2016).

Descriptive statistics were used to describe the risk factors influencing the RTW program's success. A frequency distribution technique was adopted to determine the distribution of research data by calculating the frequency of the data, which were then presented in tables.

The logistic regression analysis model analyses the response variable (dependent variable) to the independent variable. Logit modeling transforms the probability prediction problem in the interval to log-odds prediction. Odds are defined as risk or possibility, the ratio of something happening to the opportunity for another alternative (Juanda, 2009).

This study used a logit model where productivity was defined as being able to work after a patient finished an RTW program. The model was based on previous research by Kang (2022) and Awang et al. (2016).

RESULT AND DISCUSSION

Return to Work in Indonesia

There were 195 participants enrolled in the RTW program between 2020 and 2021. They were spread throughout Indonesia. The highest number of cases were found in the islands of Java and Sumatra. Participants in the RTW program receive special attention from doctors, who assess participants' postinjury conditions, ability to perform daily activities, and ability to work. Table 1 shows the distribution of participants' final working status after the RTW program.

These results indicate that the proportion of patients who can work is higher than that of patients who cannot. The success rate of the RTW program for workers in Indonesia is thus relatively high. To specify, 75.90% of participants are able to be active again in the labor market after the program. Awang et al. (2016) found that in Malaysia, the success rate of the RTW program was 65%, and Vles et al. (2005) found that in the Netherlands, the success rate was 74%. RTW participants with reemployed status have a higher tendency to leave the job compared to returning to it. Participants' regular or daily work status increase their chances of doing the same job after returning to work (Bae et al., 2023).

Table 1. Working Status after the Return to Work Program in Indonesia (2020–2021)

Working Status	Frequency	Percentage
		%
Not Working	47	24.10
Working	148	75.90
Total	195	100.00

Source: BPJS Ketenagakerjaan (2021)

Internal Factor of the Return to Work Program

The internal factors analyzed in this research were related to individual characteristics, including employee age, working years, gender, and injury type. These demographic characteristics can be further explained based on the data this study obtained.

Among the workers who participated in the RTW program, the lowest age was 18 years and the highest age was 58 years. The average age of participants was 30. The distribution of RTW participants was mainly in the 20–29 years category (45.64%) (Table 2). This shows that younger workers tend to experience more work injuries compared to older workers. Older workers in the 40–49 years category formed the highest proportion of those who were not working (46.15%). This proportion was higher than the average proportion of those who were not working (24.10%).

Regarding the number of working years of employees who participated in the RTW program, the lowest number was one year and the highest was 27 years. The median number was three years. The working years variable pertained to participants' work duration based on the first time they paid social insurance in their current company. Participants' average work duration was five years. The results showed employees' working years proportion to be mainly in the 0–5 category. A total of 69.23% of employees had lower working years. Work injuries mainly occurred among employees with low working years. In this category, 52 participants worked less than 12 months or one year. Occupational accidents

mainly occurred in employees with work experience below five years.

Table 2. Distribution of Internal Factors in the Return to Work Program (2020–2021)

Variable	Frequency	Percentage %
Age		
18–29 year	89	45.64
30–39 year	53	27.18
40–49 year	39	20.00
51–59 year	14	7.18
Sub total	195	100.00
Working Duration		
0–5 year	135	69.23
6–10 year	36	18.46
11–15 year	10	5.13
>15 year	14	7.18
Sub total	195	100.00
Gender		
Male	168	86.15
Female	27	13.85
Sub total	195	100.00
Injury Type		
Upper limb amputation	108	55.38
Lower limb amputation	54	27.69
Multiple injury nonamputation	33	16.92
Sub total	195	100.00

Source: BPJS Ketenagakerjaan (2021)

The distribution of RTW program participants by gender showed that men had more occupational accidents than women. The proportion of women in the RTW program was only 13.85% compared to 86.15% for men. The higher proportion of male participants experiencing occupational accidents is in line with Ashuro et al. (2021). Seland et al. (2006) found that men outnumbered women three times in RTW programs. According to Shewiyo et al. (2021), men (83%) outnumbered women four times in RTW programs. These results indicate that men face a higher risk of occupational accidents than women.

Regarding the type of injury, there are three major types: the lower limb type, which consists of the lower body; and the upper limb type, which consists of the upper body and multiple injuries (i.e., injuries in several parts of the body, including the upper body, lower body, and head). Both upper and lower limb cases are amputation cases, whereas multiple injury cases are nonamputation cases with a functional disability.

Respondents in the upper limb category were the most common (55.38%) in the current study. These respondents experienced disabilities in the upper area, including amputation of hands, arms, palms, and fingers. Because the hands are the most active body compared to the feet, upper limb injuries pose the most risk at work related to this research. A total of 27.69% of participants had lower limb injuries that needed amputation, most commonly amputations of the knees, thighs, and soles of the feet.

Last, the percentage of multiple injury patients was 17.62%. Patients with multiple injuries have injuries in more than one location, such as burns, electrocution injuries, injuries from exposure to chemicals, or fractures of both legs and arms. In the current study, these patients mainly worked in the manufacturing and goods and services sectors. Awang et al (2016) found that lower limb and upper limb injuries formed the most significant proportion of work injury cases in Malaysia. A total of 59.6% of participants had these injuries. He et al. (2010) revealed that 66.67% of participants had lower and upper injuries.

External Factor of the Return to Work Program

The external factors analyzed in this research were workplace accident characteristics. They included industry group, accident year, insurance rate, and accident location. These characteristics can be further explained based on observations from the data obtained in this study.

An industry is grouped into three areas based on the type of business activity it performs: primary, secondary, and tertiary. The primary industry group includes industries that conduct their main activities by extracting resources from nature (land and sea). This study's primary industry categories were agriculture/forestry and mining. The percentage of RTW participants who work in this sector is 10.25% (Table 3).

The secondary industry includes activities that produce finished products and ready-to-use products. In this study, there were three categories: construction, electrical, and manufacturing. This industry had 62.08% RTW participants, the largest proportion from the manufacturing industry.

The tertiary industry has service, trading, transportation, public service, insurance, and tourism activities. In this study, the tertiary industry group performed three main activities: goods and services, public services, and transportation. The industry had 26.67% participants. Trade was this group's most common activity, including goods supply and delivery.

Table 3. Distribution of Internal Factors in Return to Work Program (2020–2021)

Variable	Frequency	Percentage
		%
Industry Group		
Primary	20	10.25
Secondary	123	62.08
Tertiary	52	26.67
Sub Total	195	100.00
Accident Year		
2020	92	47.18
2021	103	52.82
Sub Total	195	100.00
Insurance Rate		
0.24	54	27.59
0.54	16	8.21
0.89	101	51.79
1.27	11	5.64
1.74	13	6.67
Sub Total	195	100.00
Accident Location		
Inside	134	68.72
Outside	13	6.67
Road	48	24.62
Sub Total	195	100.00

Source: BPJS Ketenagakerjaan (2021)

Research in the European Union on business sectors that cause occupational accidents indicated that several sectors have a significantly greater risk of accidents, including agriculture, forestry, fishing, manufacturing, construction, and transport storage (Ivascu & Cioca, 2019). This result has a similar business sectors pattern of work activity that has an impact on work injury in Indonesia.

The number of patients in the RTW program was higher in 2021 than in 2020. The RTW rate in 2020 (82.60%) was higher than in 2021 (69.90%). This might be because of COVID-19 regulations restricting work activity to slow down the spread of the virus. In 2021, some activities were limited, but the regulations were not as tight in 2020 when the coronavirus first infected Indonesia. Additionally, vaccinations started in January 2021.

The JKK claimants increased 205% from 2020 to 2021. The lower percentage in 2020 was due to the restrictions on commercial activities. In the last semester of 2020, BPJS Ketenagakerjaan started a program to promote RTW during the COVID-19 pandemic. Using posters distributed to offices, companies, and vocational training institutes, this program aimed to clarify to participants that the RTW program was still running during the pandemic.

JKK has an insurance rate based on the risk level of a company's activities. The higher the risk, the higher the insurance rate percentage, which is categorized into five types. The proportion of work activity is higher in the moderate level of occupational risk, 51.79%. Only 12.31% participants in the RTW program worked in high-risk and very high-risk occupations. This shows that work injuries occur not only in high-risk companies but also in low-risk ones. In addition, damage caused by traffic accidents is covered by the insurance program. The insurance rate does not determine the occupational risk on the road. The employee has an equal chance of accident while in commute from home to the workplace or vice versa.

Occupational accidents can occur in the workplace, outside the workplace, or on the road. In this research, a significant number of studies showed that they occurred in the workplace. The highest number of accident cases were inside the workplace, with a proportion of 68.72%. Meanwhile, occupational accidents outside the workplace were relatively low (6.67%). Furthermore, occupational accidents on the road were high (24.62%). These findings are similar to those of Shewiyo et al. (2021) for work injury in Tanzania. A total of 65.72% of work injury insurance claims were due to an accident inside the workplace. A total of 34.27% of claims were due to an accident on the road. Regulations related to the implementation of work safety in the workplace already exist. Nevertheless, occupational accidents that take place inside the workplace indicate a lower commitment to implementing safety standards. The government's control and supervision methods need to be improved.

Factor Influence the Success of the Return to Work Program

Internal and external factors were used to estimate factors influencing RTW programs. The factors were age, working years, gender, injury type, industry group, accident year, and accident location. These factors were analyzed using the logit model, which is a part of logistic regression, to estimate the probability of success RTW participants returning to work. The results of the logistic regression test with a 95% confidence interval found a relationship between risk factors and working status variables (Table 4).

Table 4. Regression Analysis of Factors Influencing Return to Work in Indonesia (2020–2021)

Working Status(0: Not Working, 1: Working)	Coef.	Odds	p-value
Age (Year)	-0.014	0.985	0.500
Working Experience (Year)	0.065	1.060	0.160
Gender (0: Female, 1: Male)	0.718	2.050	0.158
Injury Type (0: Nonamputation, 1: Amputation)	0.906	2.474	0.039**
Industry Group_Primary (0: Others, 1: Primary)	-0.354	0.705	0.570
Industry Group_Secondary (0: Others, 1: Secondary)	0.879	2.409	0.036**
Accident Year (0: 2021, 1: 2020)	0.781	2.184	0.041**
Insurance Rate (0: High Risk, 1: Low Risk)	1.181	3.260	0.017**
Accident Location (0: Inside/Outside, 1: Road)	0.577	1.781	0.215

***, **, and * denote significant level at 0.01. 0.05, and 0.10

The injury type variable had a significant influence with a p-value of 0.024. Lower and upper limb injuries (amputation) had a higher probability in the RTW program. Patients with lower-upper limb injuries had a 2.6-times higher probability of returning to work than patients with multiple injuries.

Patients in the upper and lower limbs category were dominated by amputees. Patients in the lower-upper limb category had better physical conditions than those with multiple injuries. Meanwhile, the multiple injury group had common injuries: fractures; tendon ruptures; burns; and trauma such as eye and head trauma. Some patients experienced a significant decrease in their body function, which affected their mobility.

These results are in line with those of Kang (2022), who found that the higher the degree of disability, the lower the chances of returning to work. Severe occupational accident rates lead to lower RTW rates. Injuries to the head, lower limb, pain for more than three years, and stress disorders are the causes of failure to return to work (Pélissier et al., 2017).

The success rate of the RTW program is related to the severity of the injury the patient experiences. Awang et al. (2016) and Cancelliere et al. (2021) found that the level of injury determines the success of the RTW program.

The dummy industry group secondary had a significant relationship with the secondary sector with a p-value of 0.014. Patients in the secondary industry had a 2.8-fold higher probability of returning to work than those in the tertiary sector. In contrast, the dummy industry group primary had no significant relationship with the tertiary sector.

The primary sector involves agriculture/forestry and mining activity with a higher risk of occupational injury. The agriculture/forestry sector dominated this study's primary group. Ouattara et al. (2022) found that 12% of farmers had one or more work injuries per year. The prevalence of occupational accidents in the agriculture sector is relatively high. The work environment and safety on the road while driving influence the risk of work injuries.

The tertiary industry group experiences 58% of accidents in outside workplaces. Business activities such as trade and transportation also lead to accidents. Road accidents are unpredictable, such as slips or collisions involving multiple vehicles. Research conducted in Australia, New Zealand, and the United States found evidence that truck drivers have the highest risk of road accidents (Driscoll et al., 2005).

In Italy, Mucci et al (2020) found that agriculture is the most hazardous economic sector. Upper limb injury is common in this sector. The source of such an injury is hand tools and machinery such as tractors. Such an injury can cause body impairment, including open wounds, lacerations, fractures, and overexcretion lesions.

The secondary industry comprises manufacturing, electronics, and construction, all of which face a high risk of occupational accidents (Seland et al., 2006). Research from Turkey found the most severe occupational accidents in this industry. From 2010 to 2019, these accidents caused permanent disability. The top five work areas contributing to disability are construction, metal products manufacturing, civil engineering, specialized construction activity, and land transport. The most frequent accidents occur in the mining of coal and lignite (Ceylan et al., 2022).

The accident year variable showed significant results with a p-value of 0.031. Patients in 2020 had a higher probability (2.2 times) of returning to work than patients in 2021. Some casualties influenced patients in 2021 in the RTW program negatively. Awang et al (2016) found that the RTW program in

2010 was successful, creating a likelihood of the program enrolling more participants in 2011 and 2012.

Several factors, such as the COVID-19 pandemic, affected the higher RTW rate in 2020. In 2020, there were still relatively few cases, and hospitals could still serve many non-COVID-19 patients. In early and mid-2021, however, there was a first and second wave, which led to a higher demand for health services and a lack of services for common diseases. Geyman (2021) stated that the COVID-19 pandemic created problems for health care in the United States such as barrier to access, higher cost and price, bad quality, widespread disparities, and equality.

Moreover, COVID-19 reduced the public's motivation to visit the hospital because of their fear of contracting the virus. Moynihan et al. (2021) found that health-care utilization increased three-fold during the pandemic. Arsenault et al. (2022) conducted a literature review in 10 countries of health-care services during the COVID-19 pandemic. There was significantly lower utilization of health care in those countries, around 9–40%. Patients were discouraged from consultations because of the anxiety of COVID-19 infection.

The insurance rate variable had a significant result with a p-value of 0.025. Participants working at a lower-risk insurance rate had a higher probability of returning to work than participants working at a higher-risk insurance rate. The probability of RTW at a lower-risk insurance rate was three times higher than at a high-risk insurance rate. The insurance rate determines the level of hazards in the workplace. The higher the danger in the workplace, the higher the insurance rate the employer should pay.

The insurance rate is also correlated to occupational risk. The higher the insurance rate, the higher the probability of fatal injury in some industries. This finding shows that the high-risk sector has a higher probability of fatal injury that causes people who experience it to be unable to work.

Research in Sweden found a significant correlation between high-risk companies and insurance payments. Employees in risky sectors are more likely to have work injuries and claim benefits from public insurance. However, the redistribution effect of social insurance in a occupational accident is due to participant contribution of lower or higher premiums (Andersson et al., 2022). For example, in this study, more than half of the RTW participants paid moderate premiums. However, they received similar treatments or benefits compared to people who paid a higher premium.

The RTW rate in Indonesia is relatively high compared to other countries. This shows that participants with fatal occupational accidents can work and be paid premiums as regular employees. This has positively influenced BPJS Ketenagakerjaan to increase the RTW rate and maintain the sustainability of the social security fund. The higher the RTW rate, the higher the sustainability premium from work-injured employees.

Research Implication

Workers with disabilities are currently not in a favorable position in Indonesia. Various government regulations for this group require further development (Kusumastuti et al., 2014). The RTW program is designed to reactivate workers' ability after a fatal work injury. The high success rate of RTW in Indonesia indicates the program's ability to restore worker productivity. Its impact has reduced the potential for unemployment, poverty, and GDP loss caused by fatal injuries. The RTW rate can be improved by examining motivation to shortener time of rehabilitation until RTW (Vanovenberghe et al., 2021). At the same time, employers should increase their awareness of PWD and promote equality and equal opportunity in the workplace as a support and reduce likelihood of long-term RTW (Jansen et al., 2021).

Government regulations oblige companies to employ 2% of disabled employees. Labor unions should mediate the relationship between employers and employees who experience disability after a work injury. The labor union's function would be supervising, controlling, and accompanying the disabled worker for a sustainable RTW experience. Labor unions would also provide social support to ensure employee convenience in the workplace (Skivington et al., 2016).

The health-care system plays a major role in restoring work injury victims' physical and psychological aspects. A fast response during an emergency can ensure better medication is provided to the patient. The "golden hour," or the earliest time when an employee suffers an injury, calls for a fast response to prevent the injury's effects from becoming more severe . As this research showed, the injury type affects the probability of returning to work. Health care for handling work injury patients has a significant

impact on this probability. The health-care provider needs to ensure priority service for work injury patients (Shaw et al., 2018). Additionally, BPJS Ketenagakerjaan, as an insurance provider, needs to provide fast service to insurer health care costs. The relationship among the health-care provider, BPJS Ketenagakerjaan, and the patient can provide better opportunities for the patient to return to the labor market (Kosny et al., 2018).

Furthermore, the year of the accident can influence the probability of success the RTW program. COVID-19 might have affected the program in Indonesia. The program depends on the health-care facility for medical treatment and rehabilitation. The COVID-19 wave in 2021 possibly decreased service quality, led to high occupancy, and decreased patients' motivation to visit the hospital (Tuczyńska et al., 2022). Thus, health-care providers should be aware of the services they can provide for patients injured at work.

BPJS Ketenagakerjaan is responsible for conducting promotive and prevention programs. The programs can be designed and integrated by following the riskiest group in the RTW program to optimize results and reduce workplace accidents. The tertiary and primary sectors face a greater risk of occupational accidents resulting from working in the secondary sector. Controlling road accidents requires providing safe driving training and installing proper lights, signs, and lines. Risk factors for occupational accidents can be reduced by implementing work safety standards, monitoring health and safety compliance, and conducting occupational safety training to increase workers' knowledge of hazards in the workplace.

The diversity in the employer insurance rate following the RTW program shows the effect of the principle of redistribution. It means social risk can be distributed among low- and high-risk companies equally (Andersson et al., 2022). However, a high-risk insurance rate contributes a significant number of not returning to work, which means there is a potential chance of higher fatality compared to a lower insurance rate.

CONCLUSION AND SUGGESTION

Based on the results, it can be concluded that the rate of the RTW program in Indonesia is relatively high, with more than two-thirds of participants able to return to work. The RTW program in Indonesia has a significant influence on increasing patients' ability to be productive after a work injury. Younger age, lower experience, male gender, lower and upper limb amputation, work in the secondary sector, higher enrollments in 2021, insurance rate payments in the moderate category, and accidents inside the workplace dominate the distribution of RTW participants. This group needs more attention to obtain information about hazards in the work environment and on the road. The key factors of the RTW program are lower-upper limb amputation, working in the secondary sector, accidents in 2020, and a lower insurance rate. These findings can be used as a reference for further developing the RTW program to focus on high-risk patients who are not able to work after the program ends.

This study did not include the duration of rehabilitation and job training as variables to determine the effectiveness of intervention in the RTW program. Furthermore, changes in wage levels before and after becoming disabled are important to determine the impact of occupational accidents on workers' income levels. Evaluation should be conducted three months to 12 months after the RTW program to ensure the sustainability of productivity, successful reactivation, and successful job replacement. The spatial analysis can assist institutions in mapping work risks and formulating more targeted policies. The year duration can be longer to include more participants and achieve better analysis accuracy. Major variables can be included in future research, including education level and marital status.

REFERENCES

Andersson, L. F., Eriksson, L., & Nystedt, P. (2022). Workplace accidents and workers' solidarity: mutual health insurance in early twentieth-century Sweden†. Economic History Review, 75(1), 203–234. https://doi.org/10.1111/ehr.13088

Arsenault, C., Gage, A., Kim, M. K., Kapoor, N. R., Akweongo, P., Amponsah, F., Aryal, A., Asai, D., Awoonor-Williams, J. K., Ayele, W., Bedregal, P., Doubova, S. V., Dulal, M., Gadeka, D. D., Gordon-Strachan, G., Mariam, D. H., Hensman, D., Joseph, J. P., Kaewkamjornchai, P., … Kruk, M. E. (2022). COVID-19 and resilience of healthcare systems in ten countries. Nature Medicine, 28(6), 1314–1324. https://doi.org/10.1038/s41591-022-01750-1

Ashuro, Z., Zele, Y. T., Kabthymer, R. H., Diriba, K., Tesfaw, A., & Alamneh, A. A. (2021). Prevalence of work-related injury and its determinants among construction workers in Ethiopia: A systematic review and meta-analysis. Journal of Environmental and Public Health. https://doi.org/10.1155/2021/9954084

Awang, H., Shahabudin, S. M., & Mansor, N. (2016). Return-to-work program for injured workers: factors of successful return to employment. Asia-Pacific Journal of Public Health, 28(8), 694–702. https://doi.org/10.1177/1010539516640354

Bae, S. W., Won, J. U., & Park, W. M. (2023). Prediction model for job retention according to the type of return to work among industrially injured workers in Korea. Journal of Occupational and Environmental Medicine, 65(1), E16–E20. https://doi.org/10.1097/JOM.0000000000002737

BPJS Ketenagakerjaan. (2021). Laporan Tahunan. Retrieved from https://www.bpjsketenagakerjaan.go.id/laporan-tahunan.html

Cancelliere, C., Donovan, J., Stochkendahl, M. J., Biscardi, M., Ammendolia, C., Myburgh, C., & Cassidy, J. D. (2016). Factors affecting return to work after injury or illness: Best evidence synthesis of systematic reviews. Chiropractic and Manual Therapies, 24(1):32. https://doi.org/10.1186/s12998-016-0113-z

Central Agency on Statistics. (2020). Laju Pertumbuhan Produk Domestik Regional Bruto Per Kapita Atas Dasar Harga Konstan 2010. Retrieved from https://www.bps.go.id/indikator/indikator/view_data/0000/data/296/sdgs_8/4

Ceylan, H., Kaplan, A., & Bekar, M. (2022). High-risky sectors in terms of work accidents in Turkey. Uluslararası Muhendislik Arastirma ve Gelistirme Dergisi, 14(1), 45–57. https://doi.org/10.29137/umagd.937910

Dewi, I. I. (2019). Anti-discrimination in employment regulation for persons with disabilities in Indonesia. Yustisia. 8(1), 133-151. https://doi.org/10.20961/yustisia.v0ixx.28016

Driscoll, T., Marsh, S., McNoe, B., Langley, J., Stout, N., Feyer, A. M., & Williamson, A. (2005). Comparison of fatalities from work related motor vehicle traffic incidents in Australia, New Zealand, and the United States. Injury Prevention, 11(5), 294–299. https://doi.org/10.1136/ip.2004.008094

Geyman, J. (2021). COVID-19 has revealed america's broken health care system: What can we learn? International Journal of Health Services, 51(2), 188–194. https://doi.org/10.1177/0020731420985640

Halimatussadiah, A., Nuryakin, C., Muchtar, P. A., Bella, A., & Rizal, H. (2017). Mapping persons with disabilities (PWDS) in Indonesia labor market. Economics and Finance in Indonesia, 63(2), 126–149. https://doi.org/10.7454/efi.v63i2.572

Hämäläinen, P., Takala, J., & Saarela, K. L. (2006). Global estimates of occupational accidents. Safety Science, 44(2), 137–156. https://doi.org/10.1016/j.ssci.2005.08.017

He, Y., Hu, J., Yu, I. T. S., Gu, W., & Liang, Y. (2010). Determinants of return to work after occupational injury. Journal of Occupational Rehabilitation, 20(3), 378–386. https://doi.org/10.1007/s10926-010-9232-x

ILO. (2007). Reduce Risk, Cut Cost! Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_146414.pdf

ILO. (2020a). Safety and Health at Work. Retrieved from https://www.Ilo.Org/Global/Topics/Safety-and-Health-at-Work/Lang--En/Index.Htm.

ILO. (2020b). Safety and health at work in Indonesia and Timor-Leste. Retrieved from https://www.ilo.org/jakarta/areasofwork/safety-and-health-at-work/lang--en/index.htm#banner

Irfani, T. H. (2015). The Prevalence of occupational injuries and illness in ASEAN: Comparison between Indonesia and Thailand.Public Health of Indonesia,1(1),19–29https://doi.org/10.36685/phi.v1i1.1

Ivascu, L., & Cioca, L. I. (2019). Occupational accidents assessment by field of activity and investigation model for prevention and control. Safety, 5(1). https://doi.org/10.3390/safety5010012

Jansen, J., van Ooijen, R., Koning, P. W. C., Boot, C. R. L., & Brouwer, S. (2021). The role of the employer in supporting work participation of workers with disabilities: A systematic literature review using an interdisciplinary approach. Journal of Occupational Rehabilitation, 31(4), 916–949. https://doi.org/10.1007/s10926-021-09978-3

Juanda, B. (2009). Ekonometrika Permodelan dan Pendugaan. IPB Press.

Kang, D. (2022). Positive factors for return to work after accidents: health awareness, consultation with doctors, and personal characteristics of

workers. Safety and Health at Work, 13(1), 32–39. https://doi.org/10.1016/j.shaw.2021.10.001

Kosny, A., Lifshen, M., Yanar, B., Tonima, S., Maceachen, E., Furlan, A., Koehoorn, M., Beaton, D., Cooper, J., & Neis, B. (2018). The role of healthcare providers in return to work. International Journal of Disability Management, 13(E3). https://doi.org/10.1017/idm.2018.4

Kusumastuti, P., Pradanasari, R., & Ratnawati, A. (2014). The problems of people with disability in indonesia and what is being learned from the World Report on Disability. American Journal of Physical Medicine and Rehabilitation, 93(1 Suppl.1). https://doi.org/10.1097/PHM.0000000000000025

Ministry of Manpower Republic Indonesia. (2021). Type of Work Accident. Retrieved from Https://Satudata.Kemnaker.Go.Id/.

Mohamed, I., Mutavi, T., & Gitau, C. (2022). Prevalence of anxiety, depression, and post-traumatic stress disorder among amputees attending jaipur foot trust articial limb centre in Kenya.East African Journal of Health and Science, 5(1), https://doi.org/10.37284/eajhs.5.1.572

Moynihan, R., Sanders, S., Michaleff, Z. A., Scott, A. M., Clark, J., To, E. J., Jones, M., Kitchener, E., Fox, M., Johansson, M., Lang, E., Duggan, A., Scott, I., & Albarqouni, L. (2021). Impact of COVID-19 pandemic on utilisation of healthcare services: A systematic review. BMJ Open, 11(3). https://doi.org/10.1136/bmjopen-2020-045343

Mucci, N., Traversini, V., Lulli, L. G., Baldassarre, A., Galea, R. P., & Arcangeli, G. (2020). Upper limb's injuries in agriculture: A systematic review. International Journal of Environmental Research and Public Health 17(12), 1–18. MDPI AG. https://doi.org/10.3390/ijerph17124501

Ouattara, B. S., Beseler, C. L., & Rautiainen, R. H. (2022). Agricultural injuries: risk factors and severity by affected body part among US (Midwest) farmers. Journal of Agromedicine, 28(2): 214-223. https://doi.org/10.1080/1059924X.2022.2089421

Pélissier, C., Fort, E., Fontana, L., Charbotel, B., & Hours, M. (2017). Factors associated with non-return to work in the severely injured victims 3 years after a road accident: A prospective study. Accident Analysis and Prevention, 106, 411–419. https://doi.org/10.1016/j.aap.2017.06.020

Seland, K., Cherry, N., & Beach, J. (2006). A study of factors influencing return to work after wrist or ankle fracutres. American Journal of Industrial Medicine, 49(3), 197–203. https://doi.org/10.1002/ajim.20258

Shaw, W. S., Nelson, C. C., Woiszwillo, M. J., Gaines, B., & Peters, S. E. (2018). Early return to work has benefits for relief of back pain and functional recovery after controlling for multiple confounds. Journal of Occupational and Environmental Medicine, 60(10), 901–910. https://doi.org/10.1097/JOM.0000000000001380

Shewiyo, B. S., Mwanga, H. H., Mrema, E. J., & Mamuya, S. H. (2021). Work-related injuries reported to workers compensation fund in Tanzania from 2016 to 2019. International Journal of Environmental Research and Public Health, 18(17). https://doi.org/10.3390/ijerph18179152

Skivington, K., Lifshen, M., & Mustard, C. (2016). Implementing a collaborative return-to-work program: Lessons from a qualitative study in a large Canadian healthcare organization. Work, 55(3), 613–624. https://doi.org/10.3233/WOR-162437

Somavia, J. (2005). Fact on Safety at Work. www.ilo.org/safework

Suryahadi, A. (2022). Disability and labor market exclusion: Evidence from Indonesia. Sustainability Science and Resources, 2(1), 45–77. https://doi.org/10.55168/ssr2809-6029.2022.2004

Takala, J. (1999). Global Estimates of Fatal Occupational Accidents.Epidemiology, 10(5, Sep), 640-646. https://doi.org/10.1097/00001648-199909000-00034

Tuczyńska, M., Staszewski, R., Matthews-Kozanecka, M., Żok, A., & Baum, E. (2022). Quality of the healthcare services during COVID-19 pandemic in selected European countries. Frontiers in Public Health, 10. https://doi.org/10.3389/fpubh.2022.870314

van der Kemp, J., Kruithof, W. J., Nijboer, T. C. W., van Bennekom, C. A. M., van Heugten, C., & Visser-Meily, J. M. A. (2019). Return to work after mild-to-moderate stroke: work satisfaction and predictive factors. Neuropsychological Rehabilitation, 29(4), 638–653. https://doi.org/10.1080/09602011.2017.1313746

Vanovenberghe, C., Du Bois, M., Lauwerier, E., & Van den Broeck, A. (2021). Does motivation predict return to work? A longitudinal analysis. Journal of Occupational Health, 63(1). https://doi.org/10.1002/1348-9585.12284

Vles, W. J., Steyerberg, E. W., Essink-Bot, M. L., van Beeck, E. F., Meeuwis, J. D., & Leenen, L. P. H.

(2005). Prevalence and determinants of disabilities and return to work after major trauma. Journal of Trauma - Injury, Infection and Critical Care, 58(1), 126–135. https://doi.org/10.1097/01.TA.0000112342.40296.1F

Yoshimoto, T., Oka, H., Fujii, T., Nagata, T., & Matsudaira, K. (2020). The economic burden of lost productivity due to presenteeism caused by health conditions among workers in Japan. Journal of Occupational and Environmental Medicine, 62(10), 883–888. https://doi.org/10.1097/JOM.0000000000002001

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Why is technology adoption not optimised? E-commerce business investigation in Java Island, Indonesia

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ABSTRACT

Technology adoption is essential to increase business competitiveness and performance. Technology can be adopted regarding sales media, payment, and shipping methods. Statistics Indonesia reports that as of June 30, 2021, businesses in Indonesia are still dominated by conventional types of business, with only 25.92% of companies conducting e-commerce activities. However, even businesses already doing e-commerce still use simple technology through instant messaging and social media. Technologies with more relevant features to sales, such as marketplaces and websites, are not used optimally. The low technology adoption can also be seen from the payment method, which is still dominated by cash at 77%, and the delivery method by face-to-face at 85%. Therefore, this research investigates why e-commerce businesses in Java have not been optimal in adopting technology. This study used raw data from the 2021 e-commerce survey conducted by Statistics Indonesia. The population in this study was all e-commerce businesses on the island of Java, totaling 1,774,589 units, with a sample of 5,543 units. The results of this study indicate that the variables of education, training, age, gender, capital, and labor issues tend to be related to technology adoption. The variable delivery service limitations tend not to be related to technology adoption.

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INTRODUCTION

Technology has sparked a leading revolution in the emergence of internet-based businesses (Jiménez-Rodríguez et al., 2022; OECD, 2019), or what is commonly referred to as an e-commerce business. Many innovations have emerged in product advertising, sales media, payment, and delivery methods through technology. E-commerce can be defined as the process of buying and selling products or services electronically (Costa & Castro, 2021). Goods or services are ordered with these methods, but payment and final delivery of goods or services do not have to be done online. Not included in e-commerce transactions are orders placed by telephone or facsimile (BPS, 2021; OECD, 2013).

More than that, according to Tan & Li (2022), the internet has important implications for economic development and poverty alleviation in developing countries. The characteristics of developing countries dominated by micro and small businesses cause the performance of these businesses to impact welfare directly. Costa & Castro (2021) revealed that small and

medium enterprises dominate in nearly every job-generating industry. Most households in Indonesia depend on micro and small enterprises for income (Trinugroho et al., 2022). This can be seen from e-commerce businesses in the island of Java, which are dominated by micro-enterprises with a gain of fewer than 300 million rupiahs per year, amounting to 82.07% (BPS, 2021).

The opportunity to use online trading methods can be done for large companies and provides the same potential benefits for small and medium businesses (Costa & Castro, 2021). With technology, market reach becomes wider (Ha, 2020; Susanty et al., 2020) while bringing a business unit closer to its customers at a low cost and short time (Saridakis et al., 2019). Thus the use of internet media has the opportunity to increase business competitiveness and business scale.

Not only does internet technology have a positive impact on entrepreneurs, but it also benefits consumers. An online shop that can be accessed 24 hours a day allows customers to buy at any time (Ünver & Alkan, 2022). In fact, with such broad access, customers can gather information about a product, both in terms of quality and price, at no cost (Wirdiyanti et al., 2022). Accessibility, flexibility, and convenience make the internet the ideal platform for the modern-day consumer (Costa & Castro, 2021).

Behind these various advantages, digital technology brings risks for micro and small businesses (Roy et al., 2018; Skare et al., 2023). New technology changes how a company operates (Khurana et al., 2022) and eliminates business units that are still consistent with conventional methods. Meanwhile, for businesses that have adopted e-commerce, competition among companies is also getting more challenging. Often these e-commerce businesses have difficulty getting customers because many online stores sell the same or similar products. The side of trust from customers is also often a problem. Customers are still often unsure about buying products online for fear of being scammed or concern about payment security. Another obstacle is the delivery problem, where loss or damage can cause customer disappointment.

Despite these drawbacks, technology adoption is fresh air for entrepreneurs in increasing their competitiveness and business performance (Trinugroho et al., 2022). Bank Indonesia estimates that the value of Indonesian e-commerce transactions in 2021 or at the time of the Covid-19 pandemic would reach IDR 401.25 trillion, with total marketing of more than 1.73 billion transactions (Alfian, 2022). This tremendous business value results from government policies limiting movement and physical interaction during the Covid 19 pandemic.

E-commerce is one of the leading solutions during the Covid-19 pandemic adopted by consumers to access purchasing products and services, even consumers who have not previously used e-commerce (Higueras-Castillo et al., 2023; Kawasaki et al., 2022; Nicewicz & Bilska, 2021). Even Costa & Castro (2021) emphasized that SMEs must go online because electronic commerce is a way out for business resilience and survival. E-commerce businesses that have survived the shocks of a pandemic have illustrated that digital technology provides opportunities for businesses to adapt to unexpected disruptions. Caballero-Morales (2021) demonstrated that digital resources such as the internet and communication platforms (WhatsApp, ZOOM, Skype) are critical facilitators for SMEs to maintain networks and create innovative products, which ultimately help them survive during and after Covid-19.

Statistics Indonesia reported that from data collection on all businesses up to June 30, 2021, only 25.92% of companies conduct e-commerce activities. This shows that conventional types of businesses still dominate industries in Indonesia. Most businesses (73.07%) do not carry out e-commerce activities because they are more comfortable selling directly (offline). The next reasons of doing conventional business are not being interested in selling online and lacking knowledge or expertise (BPS, 2021).

The number of e-commerce businesses in Indonesia in 2020 reached 2,361,423 business units (BPS, 2021). The companies were concentrated in Java island , reaching 75.26% or as many as 1,774,589. E-commerce businesses in Java island are dominated by micro businesses with an income of fewer than 300 million rupiahs per year, accounting for 82.07% (BPS, 2021).

Another problem experienced by e-commerce businesses in Java island is that only 25% of companies have financial reports. This shows that there is low awareness of financial management. In fact, financial statements are crucial not only for large companies but also for small and medium businesses (BPS, 2021). Financial reports are helpful in assessing company performance financially, analyzing which products bring optimal benefits, and evaluating

operational costs, and are valuable as material for consideration in obtaining a business loan (Stuebs et al., 2022).

The Ministry of Communication and Informatics (Kominfo, 2022) launched Indonesia's digital society index score for 2022, reaching 37.8 out of a maximum score of 100. The Minister of Communication and Informatics highlighted Indonesia's low digital literacy rate, which is still below the average of ASEAN countries. This is in line with what happens to businesses in e-commerce in Java island, which totaled 1,774,589 units (BPS, 2021). Rapidly developing technology has not been optimally utilized by the business world in terms of sales media, payment methods, and shipping methods. For the sales media aspect, an illustration of low technology adoption is shown in Table 1.

Table 1. The Sales Media Used by E-commerce Businesses in Java Island in 2020

Sales media	Use	Not Use	Total
	.....	%	.....
Instant message	94	6	100
Social media	50	50	100
Marketplace	24	76	100
Email	11	89	100
Website	3	97	100

Source: BPS (2021), processed

Table 1 shows that e-commerce businesses in Java use relatively simple technology, instant messaging, and social media. This media is too simple to run a company because of limited features and customer reach. Adequate media for running a business are marketplaces and websites. The marketplace is a meeting place for sellers and buyers (Selvi Dass & Gapar Md Johar, 2022), with various features that can support the business. Given the profile of entrepreneurs and the business scale of e-commerce businesses in Java island, marketplaces are pretty much possible for entrepreneurs to run. Website media is the media that e-commerce entrepreneurs rarely use. Website media requires the availability of human resources with high ICT knowledge to build websites. This media is not usable considering that 78% of e-commerce entrepreneurs in Java island have a high school education and below, and only 8% attended training on technology for digital marketing.

The low adoption of technology can also be seen from the payment method, which is still dominated by cash, by 77%. The convenience offered by fintech cannot make it a mainstay in payments. Instead, cash is the most frequently used payment method. COD is done by paying for the order in cash at the purchase location using cash or paying when the order arrives at the destination. This happens despite the adoption of technology in the payment system especially in terms of convenience (Tut, 2023) that the use of a smartphone has. In addition, transactions can be done anywhere and anytime. A cashless system can also help speed up the payment process at restaurants, shops, or other places by simply scanning. In addition, cashless mechanism also facilitates financial management because transactions that have been made can be tracked in detail. In addition, it minimizes the risk of losing cash or theft.

The delivery method is not spared from the low adoption of technology, which can be seen from the majority of entrepreneurs making face-to-face deliveries by 85%. The examples are food, beverage, and food ingredients group, which were mostly delivered via the internet in 2020, at 40.86%. From Table 2, it can be seen that among entrepreneurs who sell food, only 11% of e-commerce entrepreneurs use online delivery services. As for entrepreneurs who do not sell food, only 18% use online delivery services. This is quite concerning, considering the e-commerce survey data collection describes business conditions during a pandemic, where technology adoption should be optimised more than before the pandemic (Wang et al., 2021), due to restrictions on shopping in physical stores and people working and studying from home.

Table 2. Adoption of Technology in The Delivery Aspect by Type of Food and Non-Food Commodities

Method/Commodity Type	Food	Non Food
	..... %	
Non face to face (Online)	11	18
Face to face	89	82
Total	100	100

Source: BPS (2021), processed

This study combines the Technology Acceptance Model (TAM) and barrier factors to examine technology adoption by entrepreneurs, which is still rarely done by other researchers (Doanh et al., 2022). TAM is often used in behavioral research about technology acceptance, such as in information systems (Belletier et al., 2018) or technology adoption (Caffaro et al., 2020; Doanh et al., 2022). TAM

includes two factors: perceived usefulness (PU) and perceived ease of use (PEU) (Davis, 1989). PU describes the extent to which entrepreneurs believe using the application will benefit their business (Doanh et al., 2022). PEU shows the importance that entrepreneurs feel they do not need to put great mental and physical effort into their business through technology (Alturki & Aldraiweesh, 2021).

The importance of technology adoption for micro, small, and medium enterprises has been confirmed by several previous studies, especially its benefits in increasing business performance and competitiveness. Trinugroho et al. (2022) examined the adoption of digital technology for micro and small businesses in Indonesia. Adoption measurement is done through 3 things: online marketing, point of sales availability, and online payments. Doanh et al. (2022) combined the Technology Acceptance Model (TAM) and barrier factors to examine the intention of tea farmers in Vietnam to participate in live stream sales in Vietnam. This study seeks to investigate why e-commerce businesses in Java have not been optimal in adopting technology. The discussion regarding technology adoption is not only analyzed in terms of sales media, but also reviews in terms of payment methods and shipping methods.

Achieving the research objectives, this study follows research by Trinugroho et al. (2022) to conduct a discussion from the perspective of the entrepreneur factor, which is the leading actor determining the success or failure of a business. In addition, this study also reviews how problems with capital, labor, and delivery service limitations are related to technology adoption. Concerning the Technology Acceptance Model (TAM), which includes perceived usefulness (PU) and perceived ease of use (PEU), this study seeks to analyze how business factors adopt technology in their business processes. The entrepreneur factor is analyzed regarding education, training, age, and gender, because entrepreneurs with low education and training (digital literacy) and old age cause them to be less aware of the benefits of information technology and its ease of use (Doanh et al., 2022). Moreover, the constraints experienced by entrepreneurs, be it the lack of capital, the unskilled labor force, and the constraints on limited delivery services, exacerbated the low adoption of technology. To adopt technology optimally, capital in the form of funds and a workforce that can operate technology properly is required. Online delivery services that are adequately available are also needed. By discussing the entrepreneur factor and the constraints they face, this research is expected to contribute to providing a comprehensive study of technology adoption by a business entity in developing countries, as well as being a reference for taking strategic steps to optimize the use of technology by the e-commerce business units so that performance increases.

RESEARCH METHOD

This study of technology adoption by e-commerce businesses in Java is quantitative with an empirical case approach. This study used secondary data obtained from the 2021 e-commerce raw data survey held by Statistics Indonesia. The population in this study included all e-commerce businesses in Java island in 2020 with a total of 1,774,589 units, with a research sample of 5,543 units.

E-commerce survey is an annual data collection that has been routinely carried out by BPS since 2019. In 2021, BPS conducted an e-commerce survey to get an overview of business conditions in 2020 by registering all businesses (listings) in 5,394 selected census blocks in 34 provinces throughout Indonesia which include 303 regencies/cities. Interviews were then conducted on 11,928 businesses that were the selected sample. This data collection involved 1,901 enumerators and 484 supervisors. The scope of the 2021 e-commerce survey was businesses that used the internet to receive orders or sell goods and services during 2020. This activity is part of the First National Priority Program, "Strengthening Economic Resilience for Quality and Equitable Growth."

This study examines the determinants of technology adoption in e-commerce businesses in Java island, therefore this study referred to research by Trinugroho et al. (2022). The dependent variable in this empirical study is the adoption of technology-based innovations. There were three models to measure the type and level of adoption of technology-based innovations by e-commerce businesses in Java. First, the sales media aspect, divided into five media: instant messenger, social media, marketplace, email, and website. Second, the aspect of the payment method, and lastly, the aspect of the delivery method.

Table 3. Variable Measurement

No	Variable	Definition	Size
	Dependent Variable :		
	Model 1: Sales Media Aspects		
1	Instan Messanger	Businessman sells his product via instant messaging	1 = yes, 0 = no
2	Social Media	Businessman selling his product via social media	1 = yes, 0 = no
3	Marketplace	Entrepreneurs sell their products through the marketplace	1 = yes, 0 = no
4	Email	Businessman selling his product by email	1 = yes, 0 = no
5	Website	Entrepreneurs sell their products through websites	1 = yes, 0 = no
	Model 2. Aspects of Payment Methods		
6	Payment Method	Payment methods used by employers	1 = fintech, 0 = non-fintech
	Model 3. Aspects of Delivery Methods		
7	Delivery Method	Shipping methods used by employers	1 = non-face to face (online) 0 = face to face
	Independent Variable		
1	Education	Business owner education	1 = college, 0 = high school and below
2	Training	Training related to the use of information technology for digital marketing	1 = yes, 0 = no
3	Age owner	Age of business owner	the age of the business owner
4	Gender	Gender of business owner	1 = male, 0 = female
5	Lack of Capital	Entrepreneurs experience a lack of capital	1 = yes, 0 = no
6	Lack Skilled Workforce	The workforce owned by the business unit is less skilled	1 = yes, 0 = no
7	Limited Delivery Services	Entrepreneurs face the constraints of limited delivery services	1 = yes, 0 = no

Sales media was measured as a dummy variable 1 if the entrepreneur sold his product via instant messenger, social media, marketplace, email and website, and 0 otherwise. This was done because online marketing, including social media, is now an important component of marketing strategy (Sharma et al., 2020; Trinugroho et al., 2022). The payment method was measured as a dummy variable 1 if the entrepreneur used cashless to receive payments, and 0 otherwise. The shipping method was measured as a dummy variable 1 if the entrepreneur used the online method in the process of sending goods, and 0 if it is manual.

As for the explanatory variables, this study seeks to investigate the entrepreneur factor which is the main actor in business. The entrepreneurial factor was proxied by four variables. First, the entrepreneur's education was measured using the dummy variable 1 if the entrepreneur had an education up to university level, and 0 if the entrepreneur has a high school education and below. Second, training was measured using a dummy variable 1 if entrepreneurs took part in training related to the use of information technology for digital marketing, and 0 otherwise. Third, the age of the entrepreneur. Fourth, the gender of the entrepreneur as measured by the dummy variable was 1 if the entrepreneur is male and 0 if the entrepreneur is female.

The independent variable then included the constraints that entrepreneurs faced in running their businesses, including constraints on lack of capital, unskilled labor, and limited delivery services. Detailed explanations of all variables can be seen in Table 3.

For more details, an overview of the framework in this study is presented in Figure 1.

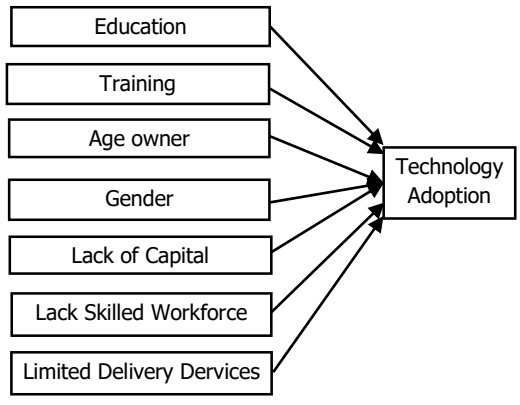

Figure 1. Research flow chart

This study used two methods of analysis. Descriptive analysis was used to obtain an overview of the description of e-commerce businesses in Java, consisting of business distribution, business categories, and entrepreneur profiles, as well as the obstacles entrepreneurs face in running their businesses. Furthermore, inferential analysis was used to find out how the independent variables influenced the dependent variable using binary logistic regression analysis with the help of SPSS 26 software.

Binary logistic regression is an analytical method with the dependent variable in the form of categorical and dichotomous data. To do so, Hosmer-Lemeshow goodness-of-fit test was done to ensure that the model in the study fit the data (Deng et al., 2022). Furthermore, data analysis was carried out using the odds ratio, a measure to see how big the tendency of the independent variable is toward the dependent variable. The odds ratio is the exponential of the coefficients. Odds ratios make interpretation easier and better (Wang et al., 2021). The equation in binary logistic regression can be formulated as follows:

$$technology\_adoption = \beta_0 + \beta_1 education + \beta_2 training + \beta_3 age\_owner + \beta_4 gender + \beta_5 lack\_of\_capital + \beta_6 lack\_skilled\_workforce + \beta_7 limited\_delivery\_services + \varepsilon$$

It should be noted that technology adoption was analyzed from the aspect of sales media in the form of instant messengers, social media, marketplaces, websites, and email, as well as the use of technology in payment and delivery methods.

RESULT AND DISCUSSION

Overview of E-commerce Businesses in Java

In 2020, e-commerce businesses in Indonesia would be concentrated in Java Island, with 1,774,589 units (75.26%), as presented in Table 4. The tendency to concentrate e-commerce businesses in economic centers such as Java Island can be due to the presence of complete infrastructure and a large market potential because a large population supports it. The existence of transportation infrastructure such as good roads will expedite the delivery of goods, thereby increasing consumer satisfaction. Meanwhile, the existence of fast internet infrastructure with wide coverage makes it easier for e-commerce players and consumers to conduct e-commerce transactions.

Table 4. Distribution of E-commerce Businesses in Java Island In 2020

Province	Number	Percentage
		%
31 DKI Jakarta	218,582	9,26
32 West Java	473,283	20.05
33 Central Java	406,911	17,23
34 DIY	147,781	6,26
35 East Java	467,996	19,82
36 Banten	60,036	2.64
Java Island	1,774,589	75,26

Source: BPS (2021)

When grouped according to business field category (KBLI), it can be seen that almost half of the e-commerce business sector in Java is in the trading business category (46.85%). The second and third positions, respectively, were occupied by businesses in the Processing Industry sector (15.73%) and the Provision of Accommodation and Provision of Food and Drink (15.30%). The proportion of e-commerce businesses by business category is presented in full in the following Table 5.

Based on Table 5, e-commerce businesses in Java island were dominated by companies engaged in trade wholesale and Retail, Repair, and Maintenance of Cars and Motorcycles by 46.85%. The second and third orders were businesses in the Manufacturing Industry sector at 15.73%, and Provision of Accommodation and Food and Drink by 15.30%.

Overview of Entrepreneurs and Constraints

Entrepreneurs determine the success of technology adoption in e-commerce businesses. Adaptive entrepreneurs will readily accept new technologies that will increase the chances of their business success. One effort to accelerate technology adoption is to attend training. Based on Table 6, only 8.3% of e-commerce entrepreneurs in Java received training. In contrast, the rest never received training. Entrepreneurs who received training were dominated by entrepreneurs with a high school education and below 67.5%, while only 32.5% came from tertiary institutions.

Table 5. Categories of E-Commerce Businesses in Java island

Business Category	Proportion
	%
A -- Agriculture, Forestry, and Fisheries	3.32
C -- Processing Industry	15.73
G -- Wholesale and Retail Trade, Car and Motorcycle Repair and Maintenance	46.85
H -- Transportation and Warehousing	5.48
I -- Provision of Accommodation and Provision of Food and Drink	15.30
J -- Information and Communication	3.59
M -- Professional, Scientific and Technical Activities	0.45
N -- Leasing and Leasing Activities Without Option Rights, Employment, Travel Agents, and Other Business Support	1.10
P -- Education (except those with formal status)	0.69
Q -- Community Health Activities and Social Activities	0.36
R -- Arts, Entertainment and Recreation	0.40
S -- Other Service Activities	6.73
Total	100.00

Source: BPS (2021), processed

Table 6. Percentage of E-commerce Entrepreneurs by Education and Training in Java island in 2020

Education	Get Training	Not Get Training
	..... %	
College	2.7	19.6
High school and below	5.6	72.1
Total	8.3	91.7

Source: BPS (2021), processed

Table 7. Percentage of E-commerce Businesses by Gender and Age of Entrepreneurs in Java island in 2020

Gender/Age	Productive	Non Productive	Total
	..... %		
Men	96	4	100
Women	97	3	100

Source: BPS (2021), processed

According to the demographic structure, productive age entrepreneurs (15 to 64 years) dominated the ownership of e-commerce businesses in Java island. When viewed by gender, male entrepreneurs were more dominant than women, both at productive and non-productive ages (see Table 7). The business profile, which influential age entrepreneurs dominated, is a potential for developing e-commerce businesses because effective age entrepreneurs are more receptive to innovations, including technology adoption (Trinugroho et al., 2022).

In running their business, entrepreneurs face different main obstacles. As many as 37% of e-commerce entrepreneurs in Java island admitted that they experienced the main block in the form of a lack of capital. In comparison, only 6% of entrepreneurs faced a shortage of skilled workers, and entrepreneurs who shared the main obstacle of limited delivery services were only 3%.

Research Findings

This study used logistic regression to analyze technology adoption from sales media, payment, and delivery methods. Researchers made three research models. Model I was divided into five types of sales media, while models II and III each captured technology adoption in the aspects of payment methods and delivery methods (Table 8). Based on the goodness of fit test, the Hosmer-Lemesow significance value of the seven analyses was above 0.05. This means that the model fits the data.

Sales Media Aspects

In today's digital era, electronic commerce is a common activity in everyday life (Jiménez-Rodríguez et al., 2022). Online sales can be made through various media, including instant messengers, social media, marketplaces, email, and websites, so this research models technology adoption based on each of these media.

Table 8. Technology Adoption Logistic Regression Modeling

Independent Variable			Dependent Variable						
			Model I (Sales Media)					Model II (Payment Method)	Method III (Delivery Method)
			Instant Messager	Social Media	Market place	E-Mail	Website	payment_ method	delivery _method
			1	2	3	4	5	6	7
1	Education	coefficient	0.125	0.627	0.515	1,255	1,464	0.783	0.587
		odds ratio	1.133	1872	1673	3,506	4,321	2,188	1,798
		Sig.	0.367	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
2	Training	coefficient	-1,194	0.663	0.992	0.923	1,753	1.145	0.778
		odds ratio	0.303	1940	2,697	2,518	5,769	3.141	2.177
		Sig.	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
3	Age owner	coefficient	0.020	-0.046	-0.024	-0.002	0.014	-0.018	-0.035
		odds ratio	1020	0.955	0.976	0.998	1014	0.982	0.965
		Sig.	0.000***	0.000***	0.000***	0.672	0.019**	0.000***	0.000***
4	Gender	coefficient	-1,164	-0.189	0.493	0.401	0.927	0.273	-0.125
		odds ratio	0.312	0.828	1638	1,493	2,526	1,313	0.882
		Sig.	0.000***	0.001***	0.000***	0.000***	0.000***	0.000***	0.109
5	Lack of Capital	coefficient	1,069	0.245	-0.300	-0.101	-1,013	-0.410	-0.125
		odds ratio	2,913	1,278	0.741	0.904	0.363	0.664	0.883
		Sig.	0.000***	0.000***	0.000***	0.309	0.000***	0.000***	0.138
6	Lack Skilled Workforce	coefficient	0.733	-0.120	-0.330	0.254	0.515	-0.306	0.244
		odds ratio	2082	0887	0.719	1,289	1674	0.737	1,277
		Sig.	0.013**	0.349	0.027**	0.140	0.048**	0.038**	0.119
7	Limited Delivery Services	coefficient	0.205	0.037	-0.068	0.415	1014	0.154	-0.059
		odds ratio	1,228	1038	0.934	1,514	2,757	1.167	0.943
		Sig.	0.486	0821	0.706	0.051*	0.000***	0.375	0.783
Number of Observations			5543	5504	5543	5543	5543	5543	5543
HL test p-value			0.114	0.064	0.093	0931	0.171	0.343	0.293

Instant messaging and social media were most used by e-commerce businesses in Java island. The instant messengers used were WhatsApp, Line, Telegram, and so on, while the social media used were Facebook, Instagram, Twitter, and so on. The technology attached to these two media is a simple medium because it has minimal features to support business. However, social media is relevant for sales because of its ability to improve company performance (Rodriguez et al., 2012). Both of these media are very useful in customer relationship management, where management is very important for assessing customer satisfaction, which helps test service quality, and for getting referrals for future sales (Fraccastoro et al., 2021). In addition, this media is very suitable for SMEs because the costs required are minimal but can have growth potential in national and international markets (Fraccastoro et al., 2021). Communicating through social media is often used by salespeople to emphasize the quality and uniqueness of the company compared to other companies (Appel et al., 2020)

Marketplaces is a feature-rich medium but only ranked third in terms of usage by e-commerce businesses in Java island. A marketplace is a platform or place where sellers and buyers can meet and make buying and selling transactions of goods or services (Selvi Dass & Gapar Md Johar, 2022). Several marketplace brands available in Indonesia include Tokopedia, Shopee, Bukalapak, Gojek, Grab, Blibli, Lazada, Traveloka, Agoda, Pegipegi, and others. This sales medium provides many features that facilitate transactions, such as secure payment systems such as PayPal or credit cards, so that customers can feel calm when making payments. The next feature is customer reviews which allow customers to provide reviews about the products they have purchased so that other customers can read these reviews before deciding to buy the product. Thus, the marketplace functions as a persuasion tool (Fraccastoro et al., 2021). The same thing was expressed by Wu & Qiu (2023), who argued that with customer reviews, potential consumers can directly compare various sellers, brands or products, so it is not surprising that many consumers rely on

consumer reviews to make purchasing decisions. In line with the customer review feature, customer rating feature is a recommendation from previous buyers so that it further adds to the trust of buyers to customers.

Another feature that makes customers comfortable in shopping is search and filter. This feature allows customers to easily search for the desired product and filter search results according to the desired criteria. The next feature is delivery status which gives trust from consumers to sellers.

Website was a medium rarely used by e-commerce entrepreneurs. Website requires the availability of human resources who have high ICT knowledge to build it. Whereas, most e-commerce businesses in Java island, namely as many as 78%, had human resource with a high school education and below. Also, only 8% attended training on using technology for digital marketing.

Based on the binary logistic regression analysis that was carried out, as presented in Table 8, entrepreneur education had a positive relationship with technology adoption in all sales media except instant messengers. The biggest influence from education was on the website, where entrepreneurs with a tertiary education background had 4.3 times higher chances than entrepreneurs with a high school education or below. For the media marketplace, the opportunity was 1.9 times. The educational factor was not related to technology adoption in instant messenger sales media because the media is relatively easy to operate and has become a lifestyle for the community in general, so education did not help increase adoption. The results of this study are in line with Jiménez-Rodríguez et al. (2022). To build a website whose design can be tailored to user needs and is exclusive because it looks unique without any other merchants on it requires a higher education.

Apart from education, high digital competence is essential in building websites. One of the digital competencies is obtained through training. This factor could increase the chances of entrepreneurs adopting technology using website media 5.8 times compared to entrepreneurs who did not participate in training, being able to raise as much as 2.7 times higher in the media marketplace than those who did not participate in training. Digital competence is an urgent matter for adopting technology (Jim & Esteban, 2022). As shown in Table 8, training increases the opportunities for an entrepreneur to adopt technology through digital media, starting from social media, marketplaces, email to websites.

Table 8 shows that younger age increased entrepreneurs' chances of adopting technology in all sales media, except email. Young age is a productive age that tends to accept technology easily. This study's results align with Trinugroho et al. (2022). In terms of gender, the opportunities for men to adopt technology were higher than for women in all sales media. The chance to increase technology adoption on websites and marketplaces were 2.5 times and 1.6 times higher than women, respectively.

These results contradict the research by Higueras-Castillo et al. (2023), which stated that socio-demographic variables do not affect technology adoption. The study found that men and women were the same in terms of using technology, and the factors that most influenced the use of technology were cost and fear of technology.

Lack of capital related to technology adoption in marketplaces and websites. The greater the lack of capital, the lower the opportunity for entrepreneurs to adopt technology that did require costs on media marketplaces and websites. This is in line with Higueras-Castillo et al. (2023).

Aspects of Payment Methods

The payment method provided by a business is a unique attraction for consumers with the presence of fintech, which offers many conveniences for customers. A cashless society is a financial technology (fintech) revolution that is in line with the Fourth Industrial Revolution (IR 4.0) and refers to people who make purchase transactions using digital cards or electronic gadgets. The use of fintech generally uses technology such as mobile applications, web platforms, and electronic payment systems to provide financial services efficiently and quickly (Xie & Zhu, 2022). In this study, the scope of fintech was entrepreneurs who facilitated the use of payment methods through internet banking, mobile banking, credit cards, and e-wallets.

The logistic regression analysis results show that the higher the education level and the higher the digital competence, the more excellent the opportunity for entrepreneurs to adopt fintech with a chance of 2.1 and 3.1 times, respectively, compared to entrepreneurs with lower high school education and no training. This result is in line with research Higueras-Castillo et al. (2023). Entrepreneurs with a

high school education or below and who did not receive training tended to have limited technical knowledge and skills, such as the ability to access and operate technological devices or understand how fintech applications work. In addition, they had limited knowledge of the benefits of fintech or were unsure about the safety of fintech due to a lack of experience.

The analysis presented in Table 8 shows that age affected technology adoption in terms of payment methods. These results are in line with Trinugroho et al. (2022), who revealed the results of his research that the characteristics of entrepreneurs, such as younger entrepreneur ages and higher education are significant causes for increasing the probability of micro and small companies to adopt digital technology in terms of online payments.

The younger age increased the chances of entrepreneurs adopting fintech. Men tended to adopt fintech more than women. This is in line with research by Higueras-Castillo et al. (2023) and Venkatesh & Morris (2000) which stated that men tend to be more motivated in achievement-related tasks, such as usability when making adoption decisions, whereas women are highly motivated and influenced by ease of use. Other studies provided consistent results that men are more likely to engage in e-commerce than women (Liébana-Cabanillas et al., 2021). Ong & Lai (2006) found that men have a higher level of IT self-efficiency than women.

Table 8 shows that entrepreneurs who were increasingly short of capital were less likely to adopt fintech. This result is in line with Higueras-Castillo et al. (2023) that cost is a barrier to adopting the technology. Likewise with the variable lack of skilled labor. This result is in line with the research Kurnia et al. (2015) which stated that skilled human resources are needed to develop and maintain technology adoption.

Aspects of Delivery Methods

The researcher assumed that a non-face-to-face delivery method is a form of technology adoption in the delivery aspect. The non-face-to-face delivery method referred to in this study was through delivery services or by downloading from certain websites, applications, or software. This type of delivery is strongly influenced by aspects of convenience, trust, and security (Castillo et al., 2022)

The logistic regression analysis results show that the only variables related to the adoption of online delivery were education, training, and age. Table 8 shows that entrepreneurs with higher education were 1.8 more likely to adopt technology in the delivery aspect than entrepreneurs with a high school education and below. These results support the research by Wang et al. (2021), who argued that higher education levels are more likely to use delivery services than those with low education. Digital literacy supported by training increased the chances of technology adoption 2.2 times. This result is in line with Kurnia et al. (2015) that the lack of understanding of entrepreneurs about the benefits of technology adoption has proven to be a barrier for entrepreneurs to adopt. This problem demands more efforts from the government to increase understanding through training (Kurnia et al., 2015).

Table 8 proves that young entrepreneurs preferred to adopt online delivery compared to old entrepreneurs. These results confirm the study by Wang et al. (2021) that age has a negative effect on usage, namely young people tend to use delivery services more than others. Gender was not related to online delivery. These results are contradictory to Wang et al. (2021), which showed that males are 1.413 times more likely to adopt a new grocery delivery than females.

Lack of capital had no effect on the adoption of online delivery. This is contrary to Wang et al. (2021), who mentioned the high cost of shipping discouraged them from adopting online delivery. These findings are also contradictory to Marcucci et al. (2021).

Research Implication

The results of this study provide important implications for the government in encouraging e-commerce businesses in Indonesia. Moreover, this business is dominated by micro businesses, where most Indonesian households rely on this business for their income (Trinugroho et al., 2022). MSMEs have an important role in the Indonesian economy, especially when there is a crisis; MSMEs were able to get through the monetary crisis in 1998 and during the Covid-19 pandemic. More than that, MSMEs are a means of alleviating poverty.

First, this research reveals that based on the report from Statistics Indonesia, business in Indonesia is still dominated by conventional types of companies, and only 25.92% of businesses are conducting e-commerce activities as of June 30, 2021. However, even businesses that are already doing e-commerce

use the simple technology of media sales side. The same thing happens with payment methods and delivery methods. This is homework for the government to better introduce the benefits of e-commerce so that businesses can "level up" to a larger business scale.

Second, this study reveals that the condition of the e-commerce business in Java is still quite apprehensive due to unprofessional financial management. This is evident from the low awareness of entrepreneurs to prepare financial reports. The government needs to pay more attention to this matter so that businesses can be more focused and more developed.

Finally, the results of this study reveal the magnitude of the influence of education and digital literacy to increase awareness of adopting technology in all aspects, both sales media, payment methods and delivery methods. Digital literacy is important not only for entrepreneurs but also for the workforce, and society in general, whose position is as consumers. Moreover, Indonesia is one of the countries with the largest number of internet users in the world, after China, India, and the United States, namely 204.7 million people (Zulfikar, 2023). The Importance of Education has been confirmed by Jiménez-Rodríguez et al. (2022) that the level of education acts as a factor that can increase digital competence in e-commerce and is helpful for detecting digital fraud practices. In addition, the Education level can minimise risks such as misuse of personal data and breach of privacy, for example, sending email without prior request from the user (Kumar & Roy, 2021).

CONCLUSION AND SUGGESTION

Shopping through e-commerce has become a lifestyle for today's modern society. Traditional shopping has begun to be abandoned because it is less relevant to technological advances. What's more, the sudden outbreak of the Covid-19 pandemic has ravaged the health system and economy around the world, including Indonesia. The covid pandemic forces everyone to interact physically. Many physical stores were forced to close due to government restrictions. This condition increases people's need to be able to access goods online, so many new e-commerce businesses have sprung up. However, in reality, e-commerce businesses have not been able to experience significant business growth. This can be seen from e-commerce businesses in Java island, which are still dominated by micro-enterprises with an annual turnover of less than Rp. 300 million in a year with a total of 82.07 percent. This income can actually be increased by optimal use of technology because technology can be used to improve competitiveness and business performance.

A descriptive analysis of e-commerce businesses in Java island shows that they still use simple technology through instant messaging and social media. Technologies with more relevant features to sales, such as marketplaces and websites, are not used optimally. The low technology adoption can also be seen from the payment method, which is still dominated by cash at 77%, and the delivery method by face-to-face at 85%. A descriptive analysis also shows that 78% of e-commerce entrepreneurs in Java island have a high school education or below, and only 8% have attended training on using technology for digital marketing. This is in line with the index score of Indonesia's digital society in 2022, which only reached 37.8 out of a maximum score of 100. E-commerce businesses in Java island are also not good in terms of management. This can be seen from the few entrepreneurs who compile financial reports, only 25%.

This research attempts to discuss how e-commerce businesses in Java adopt technology in a comprehensive manner, both from the aspects of sales media, payment methods, and delivery methods. This research also combines the acceptance of technology by entrepreneurs as well as inhibiting factors. For this, logistic regression analysis was developed to examine the factors that influence technology adoption by e-commerce businesses in Java. The results show that the variables of education, training, age, gender, lack of capital, and lack of skilled labor tend to be related to technology adoption. The variable delivery service limitations tend not to be related to technology adoption.

Digital literacy is a key factor in the diffusion of innovations. To increase the digital competence of e-commerce entrepreneurs, the government needs to launch education that encourages the use of critical, safe and sustainable digital skills related to e-commerce in primary and secondary schools. All citizens will be able to interact with a technology-mediated environment where transactions and e-commerce are a regular occurrence after completing the required part of their education. Without these

skills, the digital divide will widen even more for the less educated and disadvantaged. As previously said, COVID-19 has significantly accelerated the growth of e-commerce, making it one of the safest ways to make transactions during the lockdown. To do this, citizens must develop their digital skills.

This study has limitations in terms of the data used because it is one point in time (cross-section), so it is impossible to observe trends regarding technology adoption along with dynamic phenomenon. In addition, this study does not discuss other important factors in technology adoption, such as organisational culture factors and data security factors in electronic commerce technology. Future research can broaden the discussion by adding these variables and adding time references so that time comparisons can be discussed in full along with the development of technology.

REFERENCES

Alfian, R. (2022). Bonus Demografi Dorong Akselerasi Ekonomi Digital. Retrieved from https://validnews.id/ekonomi/bonus-demografi-dorong-akselerasi-ekonomi-digital

Alturki, U., & Aldraiweesh, A. (2021). Application of Learning Management System (LMS) during the COVID-19 Pandemic: A sustainable acceptance model of the expansion technology approach. Sustainability, 13(19), 10991. https://doi.org/10.3390/su131910991

Appel, G., Grewal, L., Hadi, R., & Stephen, A. T. (2020). The future of social media in marketing. Journal of the Academy of Marketing Science, 48(1), 79–95. https://doi.org/10.1007/s11747-019-00695-1

Belletier, C., Robert, A., Moták, L., & Izaute, M. (2018). Toward explicit measures of intention to predict information system use: An exploratory study of the role of implicit attitudes. Computers in Human Behavior, 86, 61–68. https://doi.org/10.1016/j.chb.2018.04.029

BPS. (2021). Statistik E-Commerce 2021. BPS Pusat, Jakarta

Caballero-Morales, S. O. (2021). Innovation as recovery strategy for SMEs in emerging economies during the COVID-19 pandemic. Research in International Business and Finance, 57. https://doi.org/10.1016/j.ribaf.2021.101396

Caffaro, F., Micheletti Cremasco, M., Roccato, M., & Cavallo, E. (2020). Drivers of farmers' intention to adopt technological innovations in Italy: The role of information sources, perceived usefulness, and perceived ease of use. Journal of Rural Studies, 76, 264–271. https://doi.org/10.1016/j.jrurstud.2020.04.028

Castillo, C., Viu-Roig, M., & Alvarez-Palau, E. J. (2022). COVID-19 lockdown as an opportunity to rethink urban freight distribution: Lessons from the Barcelona metropolitan area. Transportation Research Interdisciplinary Perspectives, 14(April), 100605. https://doi.org/10.1016/j.trip.2022.100605

Costa, J., & Castro, R. (2021). Smes must go online—e-commerce as an escape hatch for resilience and survivability. Journal of Theoretical and Applied Electronic Commerce Research, 16(7), 3043–3062. https://doi.org/10.3390/jtaer16070166

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13(3), 319. https://doi.org/10.2307/249008

Deng, R.-X., Zhu, X.-L., Zhang, A.-B., He, Y., Fu, H.-X., Wang, F.-R., Mo, X.-D., Wang, Y., Zhao, X.-Y., Zhang, Y.-Y., Han, W., Chen, H., Chen, Y., Yan, C.-H., Wang, J.-Z., Han, T.-T., Chen, Y.-H., Chang, Y.-J., Xu, L.-P., … Zhang, X.-H. (2022). Machine learning algorithm as a prognostic tool for venous thromboembolism in allogeneic transplant patients. Transplantation and Cellular Therapy. 29(1), 57.e1-57.e10 https://doi.org/10.1016/j.jtct.2022.10.007

Doanh, N. K., Do Dinh, L., & Quynh, N. N. (2022). Tea farmers' intention to participate in Livestream sales in Vietnam: The combination of the Technology Acceptance Model (TAM) and barrier factors. Journal of Rural Studies, 94, 408–417. https://doi.org/10.1016/j.jrurstud.2022.05.023

Fraccastoro, S., Gabrielsson, M., & Pullins, E. B. (2021). The integrated use of social media, digital, and traditional communication tools in the B2B sales process of international SMEs. International Business Review, 30(4), 101776. https://doi.org/10.1016/j.ibusrev.2020.101776

Ha, V. D. (2020). Enhancing the e-commerce application in SMEs. Management Science Letters, 2821–2828. https://doi.org/10.5267/j.msl.2020.4.027

Higueras-Castillo, E., Liébana-Cabanillas, F. J., & Villarejo-Ramos, Á. F. (2023). Intention to use e-commerce vs physical shopping. Difference between consumers in the post-COVID era. Journal of Business Research, 157. https://doi.org/10.1016/j.jbusres.2022.113622

Jim, E., & Esteban, V. (2022). Influence of computer knowledge and level of education on Spanish citizens' propensity to use e-commerce. 40(6), 1376–1392. https://doi.org/10.1177/08944393211007313

Jiménez-Rodríguez, E., Vázquez-Cano, E., Cebrián-Hernández, Á., & López-Meneses, E. (2022). Influence of computer knowledge and level of education on Spanish Citizens' Propensity to Use E-Commerce. Social Science Computer Review, 40(6), 1376–1392. https://doi.org/10.1177/08944393211007313

Kawasaki, T., Wakashima, H., & Shibasaki, R. (2022). The use of e-commerce and the COVID-19 outbreak: A panel data analysis in Japan. Transport Policy, 115, 88–100. https://doi.org/10.1016/j.tranpol.2021.10.023

Khurana, I., Dutta, D. K., & Singh Ghura, A. (2022). SMEs and digital transformation during a crisis: The emergence of resilience as a second-order dynamic capability in an entrepreneurial ecosystem. Journal of Business Research, 150, 623–641. https://doi.org/10.1016/j.jbusres.2022.06.048

Kominfo. (2022). Skor Indeks Masyarakat Digital 37,8 dari 100: Literasi Digital RI Masih Rendah Retrieved from https://kumparan.com/kumparantech/skor-indeks-masyarakat-digital-37-8-dari-100-literasi-digital-ri-masih-rendah-1zTXxrvrAHO/4

Kumar, B., & Roy, S. (2021). An Empirical Study on Usability and Security of E-Commerce Websites (pp. 735–746). https://doi.org/10.1007/978-981-15-7527-3_69

Kurnia, S., Choudrie, J., Mahbubur, R. M., & Alzougool, B. (2015a). E-commerce technology adoption: A Malaysian grocery SME retail sector study. Journal of Business Research, 68(9), 1906–1918. https://doi.org/10.1016/j.jbusres.2014.12.010

Liébana-Cabanillas, F., Singh, N., Kalinic, Z., & Carvajal-Trujillo, E. (2021). Examining the determinants of continuance intention to use and the moderating effect of the gender and age of users of NFC mobile payments: a multi-analytical approach. Information Technology and Management, 22(2), 133–161. https://doi.org/10.1007/s10799-021-00328-6

Marcucci, E., Gatta, V., le Pira, M., Chao, T., & Li, S. (2021). Bricks or clicks? Consumer channel choice and its transport and environmental implications for the grocery market in Norway. Cities, 110, 103046. https://doi.org/10.1016/j.cities.2020.103046

Nicewicz, R., & Bilska, B. (2021). Analysis of changes in shopping habits and causes of food waste among consumers before and during the COVID-19 pandemic in Poland. Environmental Protection and Natural Resources, 32(3), 8–19. https://doi.org/10.2478/oszn-2021-0010

OECD. (2013). OECD Glossary of Statistical Terms - Electronic commerce Definition. Retrieved from https://stats.oecd.org/glossary/detail.asp?ID=4721

OECD. (2019). Unpacking E-commerce. OECD. https://doi.org/10.1787/23561431-en

Ong, C.-S., & Lai, J.-Y. (2006). Gender differences in perceptions and relationships among dominants of e-learning acceptance. Computers in Human Behavior, 22(5), 816–829. https://doi.org/10.1016/j.chb.2004.03.006

Rodriguez, Michael, Peterson, R. M., & Krishnan, V. (2012). Social Media's Influence on Business-to-Business Sales Performance. Journal of Personal Selling & Sales Management, 32(3), 365–378. https://doi.org/10.2753/PSS0885-3134320306

Roy, R., Lampert, C. M., & Stoyneva, I. (2018). When dinosaurs fly: The role of firm capabilities in the 'avianization' of incumbents during disruptive technological change. Strategic Entrepreneurship Journal, 12(2), 261–284. https://doi.org/10.1002/sej.1278

Saridakis, G., Idris, B., Hansen, J. M., & Dana, L. P. (2019). SMEs' internationalisation: When does innovation matter? Journal of Business Research, 96, 250–263. https://doi.org/10.1016/j.jbusres.2018.11.001

Selvi Dass, M., & Gapar Md Johar, M. (2022). Leveraging the use of online marketplace for SMEs in Malaysia: A review. Journal of Management & Science, 20(1), 11. https://doi.org/10.57002/jms.v20i1.212

Sharma, A., Sharma, S., & Chaudhary, M. (2020). Are small travel agencies ready for digital marketing? Views of travel agency managers. Tourism Management, 79. https://doi.org/10.1016/j.tourman.2020.104078

Skare, M., de las Mercedes de Obesso, M., & Ribeiro-Navarrete, S. (2023). Digital transformation and European small and medium enterprises (SMEs): A comparative study using digital economy and society index data. International Journal of Information Management, 68. https://doi.org/10.1016/j.ijinfomgt.2022.102594

Stuebs, M., Bryant, S. M., Edison, C., & Stanley, C. (2022). Brittney's boutique: Tailoring financial

statements for function as well as fashion. Journal of Accounting Education, 58, 100768. https://doi.org/10.1016/j.jaccedu.2022.100768

Susanty, A., Handoko, A., & Puspitasari, N. B. (2020). Push-pull-mooring framework for e-commerce adoption in small and medium enterprises. Journal of Enterprise Information Management, 33(2), 381–406. https://doi.org/10.1108/JEIM-08-2019-0227

Tan, Y., & Li, X. (2022). The impact of internet on entrepreneurship. International Review of Economics and Finance, 77, 135–142. https://doi.org/10.1016/j.iref.2021.09.016

Trinugroho, I., Pamungkas, P., Wiwoho, J., Damayanti, S. M., & Pramono, T. (2022). Adoption of digital technologies for micro and small business in Indonesia. Finance Research Letters, 45. https://doi.org/10.1016/j.frl.2021.102156

Tut, D. (2023). FinTech and the COVID-19 pandemic: Evidence from electronic payment systems. Emerging Markets Review, 54, 100999. https://doi.org/10.1016/j.ememar.2023.100999

Ünver, Ş., & Alkan, Ö. (2022). Examining the Factors Affecting the Problem of Experiencing Difficulties while Online Shopping in Turkey with Categorical Data Analysis. Toros Üniversitesi İİSBF Sosyal Bilimler Dergisi. https://doi.org/10.54709/iisbf.1152952

Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? gender, social influence, and their role in technology acceptance and usage behavior. MIS Quarterly, 24(1), 115. https://doi.org/10.2307/3250981

Wang, X. (Cara), Kim, W., Holguín-Veras, J., & Schmid, J. (2021). Adoption of delivery services in light of the COVID pandemic: Who and how long? Transportation Research Part A: Policy and Practice, 154, 270–286. https://doi.org/10.1016/j.tra.2021.10.012

Wirdiyanti, R., Yusgiantoro, I., Sugiarto, A., Harjanti, A. D., Mambea, I. Y., Soekarno, S., & Damayanti, S. M. (2022). How does e-commerce adoption impact micro, small, and medium enterprises' performance and financial inclusion? Evidence from Indonesia. Electronic Commerce Research. https://doi.org/10.1007/s10660-022-09547-7

Wu, R., & Qiu, C. (2023). When Karma strikes back: A model of seller manipulation of consumer reviews in an online marketplace. Journal of Business Research, 155, 113316. https://doi.org/10.1016/j.jbusres.2022.113316

Xie, X., & Zhu, X. (2022). FinTech and capital allocation efficiency: Another equity-efficiency dilemma? Global Finance Journal, 53(May), 100741. https://doi.org/10.1016/j.gfj.2022.100741

Zulfikar, F. (2023). 10 Negara dengan Pengguna Internet Tertinggi di Dunia, Indonesia Nomor Berapa? https://www.detik.com/edu/detikpedia/d-6502474/10-negara-dengan-pengguna-internet-tertinggi-di-dunia-indonesia-nomor-berapa

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