Economical values, land-use security and ecological borders of oil-palm livestock farmers; lesson from West New Guinea Papua-Indonesia

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Abstract

The COVID-19 pandemic has had significant impacts on various aspects of society, including the life of farmers and their relationship with the ecological border, land-use security, and economic values. How community use and do interact with land use systems, become the paramount focus of this assessment. The study areas covered four districts, i.e. Warmare, Prafi, Masni and Sidey. The total areas of study are 1,022.67 km^2 (102,266.54 ha). By selecting 95 households using snowball samples technique combined with phone contacts, parameters of the data recorded. We applied three core variables i.e., economical values, land use security and ecological borders, added to this perception. SemPLS applied using 3.2.9. version for assessing correlation amongst indicators. The findings stated that sociotraits of farmers constitute age 42-50 y., senior high school level, 2-6 household size, land ownership 1 unit land in average. Time spent in land 4-5 hrs./hh. Economical values explained by plant grown, plant harvested, and sold resources such as vegetables, sweet potatoes, plant ingredient, fruits and grass as forages. Asset belong to community consist of land, livestock, seed, household labor, and wheel water. Well-off household reached IDR 50-100 million. Impact on land-use security commence from no-impact to fairly impact. Feeling of community shown fairly sorrow to less sorrow. Basic need shown fairly impact to no impact (34%-37%). Ecological border indicated by the 1st land bordered by watershed, primary forest, oil palm, farming land, houses and communal ranches. Land interaction of land vs watershed is fairly benefit, followed by land vs primary forest, land vs house, and land vs communal land. Ecology indicator shown strong effect on economic indicators, followed perception on social indicators. Land use security as well shown strong effect on economic indicators, likewise perception on economic and social on economic.The relationship of the model explained R^2-Adj= 0,711 (71,10%). This means that 71.10% of the indicators can explain the model. The rest of 29,90% is explained by outside indicators which are not counted in the model.

Keywords: Covid-19, Ecological border, Economical values, Essential asset, Land-use security, Manokwari

Introduction

West New Guinea Papua, with its rich biodiversity and diverse ecosystems (Indrawan et al. 2019; Antoh et al. 2019; Runtuboi et al. 2021; Purwanto et al. 2021), stands as an intriguing region for examining the ecological and socio-economic impacts of the COVID-19 pandemic (Hamilton et al. 2020). The region is characterized by its unique blend of cultures, traditional practices, and a strong reliance on agriculture for sustenance. The intricate balance between human activities and the environment, coupled with the challenges posed by the pandemic, makes West New Guinea Papua a critical focal point for this research. The region's distinct geographical and cultural features create a nuanced backdrop against which the consequences of the pandemic on the livelihoods of Farmers and the integrity of

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the ecological border can be explored. The global outbreak of the COVID-19 pandemic has brought about unprecedented challenges, impacting various facets of human life and societal systems (Ibrahim et al. 2021; Hamilton et al. 2020). West New Guinea, located in the eastern part of the island of New Guinea, is characterized by rich biodiversity and pristine natural resources. The region's indigenous communities, particularly Farmers, heavily rely on the land and its resources for their sustenance, cultural practices, and economic activities. However, the emergence of the COVID-19 pandemic has introduced unforeseen challenges, impacted their way of life and altered the delicate balance between ecological borders, land-use security, and economic stability.

The COVID-19 pandemic (Devasena 2021)has disrupted global systems, and its effects are particularly pronounced in vulnerable regions such as West New Guinea Papua. Farmers, who play a crucial role in the region's socio-economic fabric, face multifaceted challenges ranging from compromised land-use security to economic uncertainties. The COVID-19 pandemic has had significant impacts on various aspects of society, including the lives of Farmers and their relationship with the ecological border, land-use security, and economic values (Ibrahim et al. 2021; Dewaelheyns 2017). The pandemic has had mixed effects on the ecological border for Farmers. On one hand, lockdowns and travel restrictions imposed during the pandemic have led to reduced human activity in many areas. This could result in positive ecological impacts, such as reduced pollution, habitat restoration, and increased biodiversity in certain regions. Farmers who rely on natural resources for their livelihoods might have experienced some relief from environmental pressures (Brooks and Place 2019; Marcus and Asmorowati 2006; Mazumdar and Mazumdar 2012). On the other hand, the disruption caused by the pandemic, including reduced oversight and monitoring, may have led to increased illegal activities (Barri et al. 2019; Dahal et al. 2023; Meijaard and Sheil 2013) such as deforestation, poaching, and unsustainable resource extraction. The economic hardships faced by some Farmers could push them towards exploiting natural resources to meet their basic needs, further exacerbating ecological challenges.

The needs for converting lands into various development objectives and usages in developing countries are not questionable. Every space has important meaning when other users need. Competing lands between human and animals (Herforth and Ballard 2016; Lal 2023) and the roles of landscape cannot be refused. In developing countries such as Indonesia, animal agriculture such as cattle, goat and sheep and pigs can have free space for maintaining their natural living activities. This pattern of livestock rearing is called by free-range or scavenging livestock farming systems, similar to extensive livestock system (Kondombo 2005; Mutibvu et al. 2012).

What are the rest and left not taking into account are economical values (Mohri et al. 2013), i.e. plants grown on land, crops economic benefit products, frequent sold resources, assets availability, well-off community, perception on land. The land security (Indrawan et al. 2019; Ogahara et al. 2022) status consists of impact on land visitation, land security, land obstacle, perception of feelings, and basic needs. The last one is ecological borders (Carter and Walker 2010; Drenthen 2005) which consist of bordered land, land interaction with typical environment, and the rest objectives of using land. Farmers' land-use security during the pandemic may have been influenced by various factors. Lockdown measures and economic slowdowns may have disrupted agricultural supply chains (Góngora, Milán, and López-i-Gelats 2019; Sinclair et al. 2020), impacting Farmers' access to markets (Wijka et al. 2018; Santika et al. 2019), inputs, and credit. Farmers who rely heavily on cash crops or export-oriented agriculture may have faced significant challenges due to disruptions in global trade and demand. Additionally, restrictions on movement and

labor shortages may have affected Farmers' ability to cultivate their land effectively. This could result in reduced crop yields (Paul et al. 2018; Henry et al. 2018; Veysset et al. 2014; Descheemaeker et al. 2010), food insecurity, and income losses. Moreover, the pandemic's economic impact might have increased the vulnerability of Farmers to land grabs, eviction threats, or changes in land-use policies. Furthermore, land-use security has become a pressing concern for Farmers in West New Guinea, Papua, during the COVID-19 pandemic. Land tenure rights, resource access, and traditional land management practices have been disrupted due to the pandemic's impact on local economies, migration patterns, and government policies. Understanding the implications of these changes is crucial for developing strategies to safeguard the rights and well-being of Farmers while ensuring the sustainable use of natural resources.

The economic impacts from the COVID-19 pandemic have been far-reaching, and Farmers have not been immune to these effects. The economic values attributed to Farmers in West New Guinea, Papua, have undergone significant transformations during the pandemic. The disruption of supply chains, trade limitations, and reduced economic activities have impacted the livelihoods of Farmers who rely on agriculture, fishing, and local markets. Examining the economic repercussions faced by Farmers will shed light on their resilience, adaptation strategies, and the need for supportive policies to restore and strengthen their economic standing in the aftermath of the pandemic. Many Farmers depend on the sale of agricultural products for their income, and disruptions in supply chains, reduced market demand, and price fluctuations have significantly affected their economic values. Loss of income due to the pandemic has made it difficult for Farmers to meet their basic needs (Barron 2017; Poulsen 2017), resulting in increased poverty and food insecurity. Farmers who rely on informal markets or direct sales to consumers may have faced particular challenges due to mobility restrictions and shifts in consumer behavior

However, it's important to note that the extent of these impacts may vary depending on factors such as geographic location, market access, government support, and the resilience of local agricultural systems.Overall, the COVID-19 pandemic has brought both opportunities and challenges for Farmers (Acebes et al. 2021; Gigante et al. 2020; Atus et al. 2022; Ederer et al. 2023)in terms of ecological border, land-use security, and economic values. Efforts to address these challenges should focus on supporting sustainable agriculture practices, ensuring land tenure security, strengthening local food systems, and providing financial and technical assistance to vulnerable farmer communities, they were getting impact directly with covid-19 pandemic.Assessing the ecological border in the context of the COVID-19 pandemic involves understanding how the pandemic has influenced the interaction between human activities and the environment. The implementation of restrictions and lockdown measures has affected traditional farming practices, wildlife conservation efforts, and the overall ecosystem balance. This assessment will delve into the consequences of disrupted ecological borders on Farmers and their ability to maintain a sustainable livelihood amidst the pandemic.

Understanding the multifaceted impacts of the COVID-19 pandemic on Farmers in West New Guinea, Papua, is essential for crafting effective responses that address the immediate needs of the communities and facilitate their long-term recovery. By recognizing the interconnectedness of ecological borders, land-use security, and economic values, we can work towards a more inclusive and sustainable future for all stakeholders involved in the region's socio-ecological systems.The intricate interplay between environmental dynamics, land utilization, and economic activities among Farmers in West New Guinea Papua serves as a compelling backdrop for this investigation. In this study, we aimed to provide evidence-based insights into the effects of the COVID-19 pandemic on the ecological borders, land-use security, and economic values of Farmers

in West New Guinea, Papua. By analyzing the experiences and challenges faced by Farmers, we seek to contribute to the development of targeted interventions and policies that promote sustainable land use, enhance ecological resilience, and ensure the well-being of indigenous communities during and beyond the pandemic.The research endeavors to shed light on the multifaceted implications of the pandemic on the ecological border, land-use security (Indrawan et al. 2019; Santika et al. 2019), and the economic values of Farmers (Mezgebe et al. 2018; Zhang et al. 2021) in the unique context of West New Guinea Papua. As the world grapples with the complexities of the ongoing health crisis, understanding its repercussions on vulnerable communities becomes paramount.

This research designed was aimed to identify and analyze the specific challenges and opportunities that have emerged in the wake of thepandemic Covid-19 under tropical Indonesia community dependent-palm oil plantation, with special focuses on the ecological border dynamics, land-use practices, and economic values of the local farmer communities.

Materials and Methods

General description of location

Astronomically, Manokwari Regency is placed under equator line, between 0" 14' S and 130" 31' E. The geographical boundaries of Manokwari Regency are West is Tambrauw Regency, North is Pacific Ocean, East is Pacific Ocean and South is TelukPegununganArfak and Manokwari Selatan Regency. Manokwari Regency is divided into 9 districts, which total area are 4.650,32Km^2 (Fig. 1). Sample locations from the review and field research were taken from the four districts in Manokwari district, West Papua. The fourth districts in Manokwari are Warmare, Prafi, Masni and Sidey (BPS 2019).

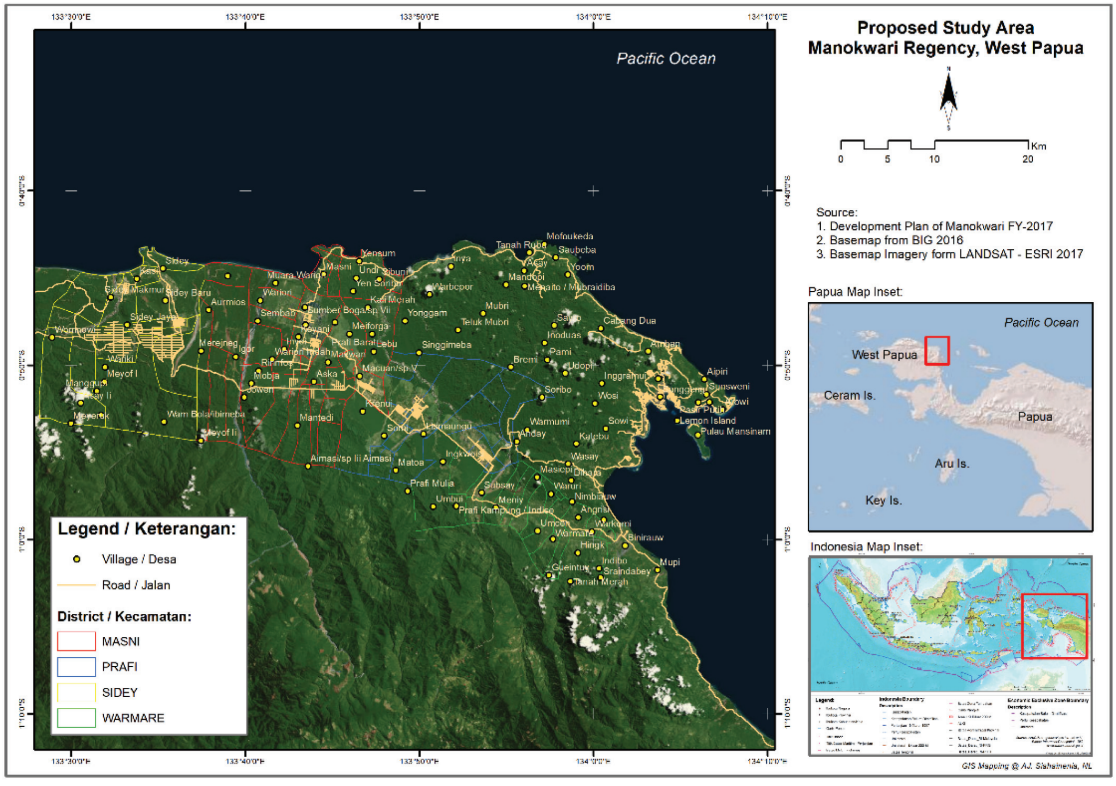

Figure 1. A spatial map of study areas used to determine the boundaries of study.

Livestock production in Manokwari is dominated by poultry, namely chickens, followed by pigs and cattle and a small number of goats. Chicken farming, in this case free-range chickens, still dominates the chicken population kept by almost every community in Manokwari. Cattle are conventional livestock and have been cultivated along with the influx of non-Papuans in Papua, especially Manokwari. The presence of cattle in various livestock assistance schemes cannot be denied that it has contributed to the prosperity of farmers and livestock. The livestock mentioned above are in the lowland agricultural areas of Manokwari, namely Warmare, Prafi, Masni and Sidey.

Animal feed can be sourced from natural feed, factory feed and other feed ingredients. The main animal feed ingredients come from the results and residues of agricultural crops which include rice, corn, peanuts, green beans, soybeans, sweet potatoes and cassava. These agricultural plants are located in the lowland agricultural areas of Manokwari, namely Warmare, Prafi, Masni and Sidey.

The basis for selecting these four areas is that these areas have been widely used for several types of use, namely plantations, transmigration areas, fertile land, communal land, and as livestock production centres in Manokwari. The total study area is 1,022.67 km^2 (102,266.54 ha). In general, the profile of the study area consists of coastal areas, lowland areas and highland areas. The precipitation conditions are clear between the wet months (rain) and the dry months based on information from BMKG Manokwari Regency data, namely the wet months are from December to May (6 months) for 221 days with rainfall of 287.4 mm^2. Meanwhile, the dry months are from June to November (6 months) every year.

Site selection

These areas of study were selected by the reasons that the areas have been used widely for several kinds of usages, i.e. plantation, transmigrate/urban areas, arable land, communal land, and livestock production. Human made areas tend to limiting and disturb the natural population of pig production. From the figure above, the study areas covered four districts, i.e. Warmare, Prafi, Masni and Sidey. The total areas of study therefore is 1,022.67 km^2 (102,266.54 ha). Data were analyzed using Statistical descriptive and shown in tables. Pictures were drawn using Arc GIS.

Respondents and ethical consideration

Respondents in the four districts in this region are quite diverse, consisting of indigenous people of the Arfak ethnicity, other Papuan ethnicities namely Byak, Onate, Dani, Mee, and Ayammaru. The 95 households as respondents were selected and participated using snowball combined phone techniquesby using the contact numbers provided by each district field assistants. By using the google form, the link created was then sent to the potential respondents (n=95).We applied google form due to government rules during Pandemic Covid-19. Consent has been obtained from all the participants for this research and the Ethical Committee of Papua University (ethical approval reference No. SP-004/UN42.3/PP/2022).

Variables

Parameters measured consisted of Economical values (EcV), i.e. plants grown on farming land, crops economic benefit products, frequent sold resources, assets availability, well-off community, and perception on land. The land security (LSc) status consisted of the impact on land visitation (frequent visit/month/hh), land security, land obstacle, perception of feelings, and basic needs. The last one is ecological borders (EcB) which consist of bordered land, land interaction with typical environment, and the rest objectives of using land.

Data analysis

The data analysis used is descriptive statistic. The data obtained was then presented tabularly and descriptively to obtain an objective picture of the condition of farmers in experiencing Covid-19 on

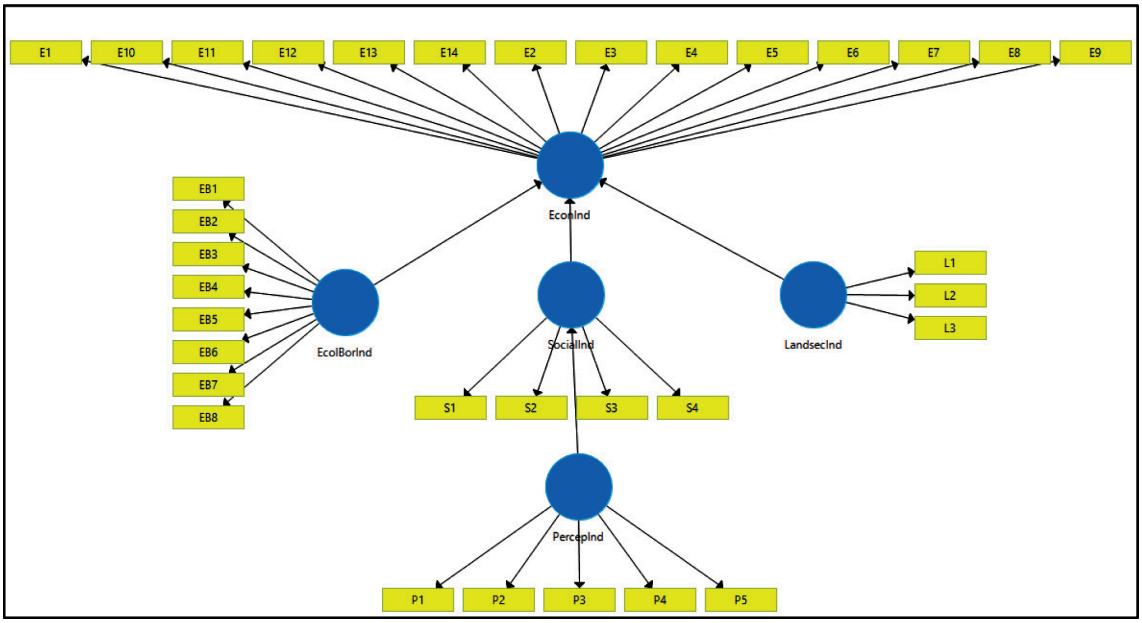

Figure 2: Model development of socio, ecological border, perception, and economic indicators.
S1: age, S2: education, S3: Household, S4: Land owner, L1: Distance of the first land, L2: Time spend in land, L3: Impact Pandemic during land visit, P1: Disturbance on land, P2: Perception on land, P3: Perception on food, P4: perception on natural forest, P5: Perception on palm oil, EB1: ecological border of primary forest, EB2: ecological border of watershed, EB3: Ecological border of ponds, EB4: Ecological border of palm oil, EB5: Ecological border of farming land, EB6: Ecological border of resettlement, EB7: Ecological border of livestock ranches, EB8: Ecological border of palm oil factory, E1: Sold vegetables,E2: Sold Sweet potatoes,E3: Sold ingredients, E4: Sold forages, E5: Sold fruits, E6: Total Asset, E7: Sold Floris, E8: Sold Oil-palm, E9: Sold hunting wild animal,E10: Sold livestock, E11: Sold taro, E12: Sold paddy, E13: Sold fish, E14: traditional bags.

farming activities Manokwari, West Papua Indonesia in terms of three sustainable indicators, i.e. economical values, land use security, and ecological borders utilization. We then pursued data analysis using SemPLS by computing the relationship of theses parameters towards economic indicators (Fig. 2).

Hypotheses

The hypotheses according to this research is economic indicator (EconInd) will be determined by Ecological borders (EcolBorInd), Social indicator (SocialInd), and Land Security indicator (LandsecInd). While Social Indicator (SocialInd) will be determined by Perception indicator (PercepInd)

Results and Discussion

Characteristic of Socio-identity

Socio-identity refers to the social aspects of an individual's identity, which are shaped by their membership in various social groups and the social roles they occupy. Characteristics of socio-identity can vary from person to person, but there are some common elements that observed such as age, household size, landownership, education and ethnicities. Socio-identity is influenced by the social groups to which individuals belong. These groups can include categories such as race, ethnicity, nationality, gender, religion, sexual orientation, and socioeconomic status (Table 1). Group membership provides individuals with a sense of belonging and shapes their experiences, values, and behaviors. Socio-identity is also influenced by the social roles that individuals occupy within their groups and communities. Roles such as parent, child, sibling, student, employee, or leader contribute to an individual's socio-identity by defining their responsibilities, expectations, and interactions with others.Culture plays a significant role in shaping socio-identity. Cultural norms, beliefs, values,

Table 1. Socio-cultural traits.

Socio-Cultural	Sum	Proportion	Mean+Stdv	Min	Max
Age			42.38+1.08	19	72
Hh.Size			6,37+0.51	2	30
Landownership			1.95+0.15	1	6
Gender					
Male	74	79.57			
Female	19	20.43			
Education					
No education	9	9.68			
Basic school	5	5.38			
Junior high school	15	16.13			
Senior high school	44	47.31			
Diploma	2	2.15			
Bachelor	16	17.20			
Master	2	2.15			
Ethnic					
Papua	50	53.76			
Arfak	31	33.33			
Wondama	3	3.23			
Onate	8	8.60			
Sarmi	1	1.08			
Genyem	1	1.08			
Damal	1	1.08			
Byak	3	3.23			
Dani	1	1.08			
Ayamaru	1	1.08			
Non Papua	43	46.24			
Java	29	31.18			
Bugis	1	1.08			
Makassar	4	4.30			
Ternate	3	3.23			
Manado	2	2.15			
Bali	1	1.08			
Buton	3	3.23			

traditions, and practices that are shared by particular ethnic groups contribute to the formation of an individual's socio-identity.

Socio-identity is influenced by an individual's own perception of themselves within the social context. It involves how they see themselves in relation to others, their understanding of their group memberships, and the significance they attach to those identities. Self-perception is subjective and can evolve over time as individuals develop a deeper understanding of themselves and their place in society.Intersectionality that is socio-identity is often multifaceted and intersecting. An individual's identity may be shaped by the intersection of various social categories and experiences. For example, a person's socio-identity can be influenced by their race, gender, and socio-economic background, and these identities interact and intersect to shape their unique experiences and perspectives.

Socio-identity is a concept that is often studied and analyzed through the lens of social identity theory. This theory proposes that individuals derive a part of their self-concept and self-esteem from the groups they belong to, and they tend to categorize themselves and others into social groups. It suggests that individuals strive for positive social identities and may engage in social comparison and group behavior to enhance their self-esteem. It's important

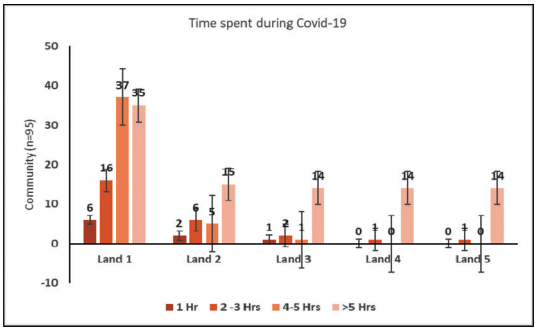

Figure 3. Time spent on community land ownership during Pandemic Covid-19.

to note that socio-identity is a complex and dynamic concept, influenced by various factors and subject to individual and societal changes. People may have multiple layers of socio-identity that interact and evolve over time, reflecting the intricate nature of human social identities.

Ages, Education profile, households, land ownership, time spent to farming land.

The ages of farmers can vary widely depending on the location and type of farming. In many developed countries, the average age of farmers tends to be higher, often in the range of 50 to 60 years old (Table 1). However, in developing countries, the average age may be lower, with many younger individuals engaged in agricultural activities.The education profile of farmers can also vary significantly. In some cases, farmers may have limited formal education, especially in rural areas of developing countries. However, there is also a growing trend of farmers obtaining higher education and specialized training in agriculture. This includes degrees in agricultural sciences, agribusiness, or related fields.

Farm households can vary in size and composition from 2-6 head/hh (n=56), followed by 5,8-9,6 head/hh. In agricultural areas, it is common to have multigenerational households where several generations of a family live together and participate in farming activities. However, the size and structure of farm households can also differ depending on cultural, economic, and social factors.Land ownership patterns can vary widely across different regions. In some cases, farmers may own the land they cultivate, while in other cases, they may lease or rent the land. In certain countries, land may be collectively owned or owned by the state, with farmers granted long-term leasehold rights.

The amount of time spent farming land can depend on several factors, including the scale and type of farming, access to labor, availability of machinery, and use of modern agricultural practices. Some farmers work part-time on their land, while others engage in full-time farming as their primary occupation. Additionally, seasonal variations in farming activities can also affect the time spent on land.

Economic values

In this parameter, we tried to picture the economic values of planting crops and grass, its economic benefit products, frequent sold resources, asset availability, well-off and perception of community to the lands.Planting crops and grass can have several economic benefits, including the production of various agricultural products, the sale of resources, the availability of assets, and the overall well-being and perception of the community towards the land.

Planting crops can lead to the production of food, feed, fiber, and fuel. Examples include grains (wheat, rice, corn), vegetables, fruits, oilseeds, and cash crops like cotton or tobacco.Grasslands can be used for grazing livestock, which produces meat, milk, and other animal products. Harvested crops can be sold as raw produce or processed into value-added products. They can be sold directly to consumers, restaurants, or food processing companies.Livestock raised on grasslands can be sold as meat or dairy products. Additionally, grass itself can be harvested and sold as hay or forage for livestock.Planting crops on land can increase its economic value. Cultivated land can be owned or leased, providing an asset that can generate income through agricultural production. Grasslands can also be owned or leased for livestock grazing. These

lands provide an asset for livestock production.

Planting crops and grass can contribute to the economic prosperity of farmers and communities (Fig. 2). It creates job opportunities, generates income, and boosts local businesses that support agriculture.By growing crops, communities can enhance their food security by producing their own food locally. Planting crops and grass can have positive environmental impacts, such as reducing soil erosion, conserving water resources, and promoting biodiversity. These benefits can contribute to the overall well-being and perception of the community towards the land. It's important to note that the economic values, benefits, and community perceptions can vary depending on factors like geographical location, climate, market demand, agricultural practices and cultural context.

Growing plants during covid-19

During the COVID-19 pandemic, the importance of plants and their products grown on lands became even more significant. Plants provide a range of resources that are essential for various aspects of human life, including food, medicine, and materials. The pandemic disrupted global supply chains and highlighted the importance of local food production. Plants grown on lands, such as vegetables, fruits, grains, and legumes, played a crucial role in ensuring food security for communities (Fig. 4). They provided essential nutrients and sustenance to individuals and helped meet the increased demand

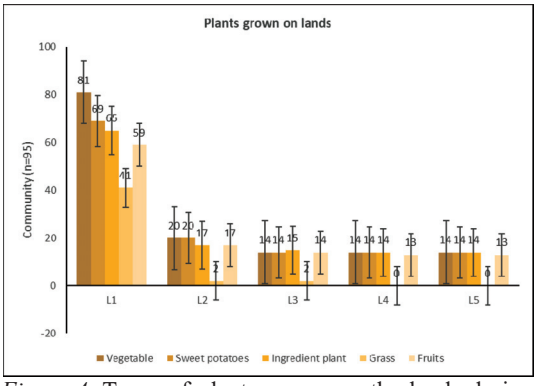

Figure 4. Types of plants grown on the lands during Pandemic Covid-19

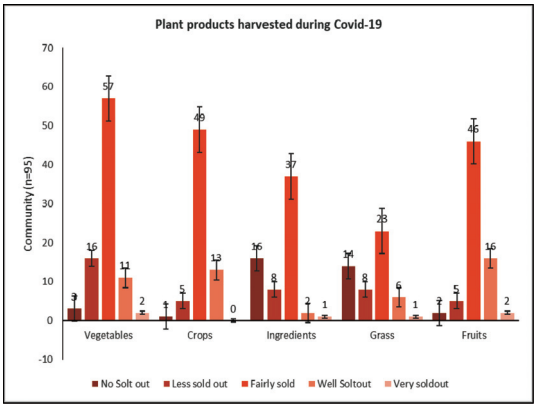

Figure 5. Plants products harvested on the lands during Pandemic Covid-19

for fresh, nutritious food such as vegetables, crops, fruits, ingredients and grass (Fig. 5).

Several plants possess medicinal properties and are used to develop drugs and traditional remedies. During the pandemic, the demand for herbal medicines, immune-boosting supplements, and natural remedies increased. Plants like echinacea, elderberry, ginger, turmeric, and garlic gained popularity due to their potential health benefits. With lockdowns and restrictions on outdoor activities, people spent more time indoors. As a result, the demand for indoor plants surged. Indoor plants not only add beauty to living spaces but also improve air quality, reduce stress, and promote well-being. Common indoor plants include peace lilies, spider plants, snake plants and succulents. Essential oils extracted from various plants have therapeutic properties and are used in aromatherapy, personal care products and cleaning supplies. During the pandemic, the use of essential oils increased as people sought ways to relax, reduce anxiety and maintain a clean and hygienic environment.

Many individuals turned to gardening and home farming as a way to engage in productive and rewarding activities while being confined to their homes. People grew vegetables, herbs and fruits in their gardens or small-scale setups like balconies, rooftops or indoor spaces. This helped individuals supplement their food supply, reduce grocery store

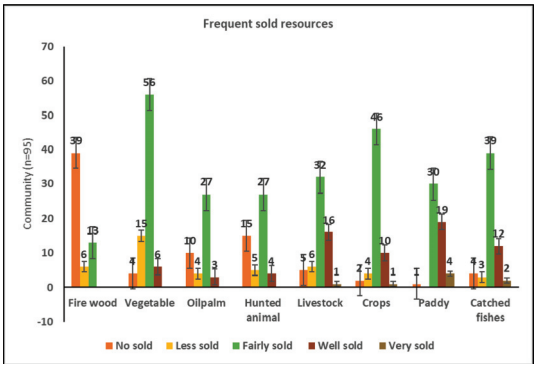

Figure 6. Frequent sold resources done during Pandemic Covid-19

visits and foster self-sufficiency.

Frequent sold resources during the pandemic varied depending on the region (Fig. 6), but some commonly sought-after plant-based products included fresh produce, seeds for gardening, gardening tools, potting soil, fertilizers, herbal supplements, essential oils and indoor plants. These items were often in high demand as people focused on health, self-sufficiency and creating a pleasant living environment. Overall, plants and their products played a critical role during the COVID-19 pandemic by providing sustenance, supporting health and well-being, and promoting self-sufficiency.

During the COVID-19 pandemic, the availability of assets was affected by various factors (Fig. 7). The term "assets" can refer to a wide range of resources,

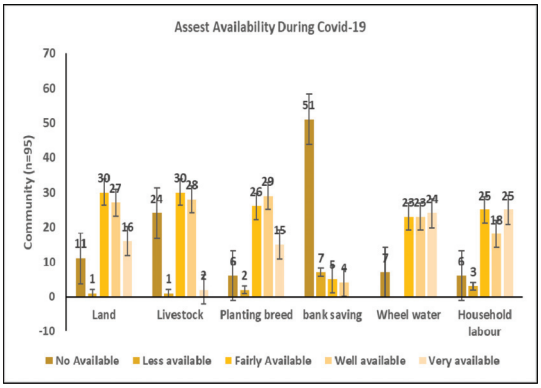

Figure 7. Asset belongs to community during Pandemic Covid-19

including physical, financial and human resources. Few key points regarding asset availability during this time, i.e. Supply chain disruptions (SCD). COVID-19 led to disruptions in global and local supply chains, impacting the availability of various goods and services. Lockdowns, travel restrictions and workforce shortages affected the production, distribution and delivery of assets.Essential goods and services (EGS). There was a particular focus on ensuring the availability of essential assets like food, medicine, personal protective equipment (PPE) and healthcare services. Governments and organizations took measures to prioritize the production and distribution of these critical assets to meet the increased demand. Shift to remote work (SRW). With many businesses and organizations implementing work-from-home policies, there was a greater emphasis on digital assets and technology infrastructure. Access to reliable internet connections, computers, and software tools became essential for maintaining productivity and communication. Financial assets (FA). The pandemic had a significant impact on the economy, leading to job losses, reduced incomes, and financial instability for many individuals and businesses. This affected the availability of financial assets, such as savings, investments and credit. Government interventions, such as stimulus packages, were implemented to mitigate the financial impact and support asset availability.

The impact of COVID-19 on the well-off or wealthier members of the community varied depending on individual circumstances and the overall economic context (Fig. 8). Some key aspects to consider are Economic resilience (ER). Individuals or households with higher incomes, savings, and diversified investments often had greater economic resilience during the pandemic. They were better positioned to weather the financial challenges, such as job losses or reduced business revenues. Remote work advantages (RWA). Professionals in white-collar jobs who could work remotely experienced fewer disruptions to their income and employment compared to those in

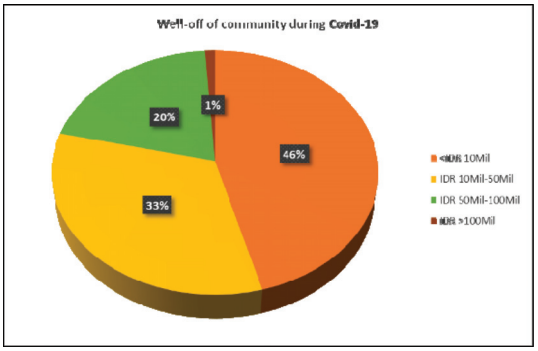

Figure 8. Status of well-off on community during Pandemic Covid-19

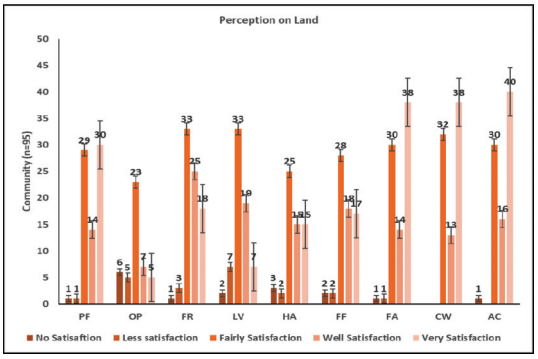

Figure 9. Perception on the land during Pandemic Covid-19

service or blue-collar industries. This often included higher-income individuals who had the flexibility to continue working from home.Investment opportunities (IO). For those with surplus funds, the pandemic presented investment opportunities, such as stock market fluctuations or real estate market trends. While there were risks involved, some individuals were able to take advantage of market conditions to grow their wealth. Philanthropic efforts (PE). Some wealthier individuals and organizations stepped up their philanthropic efforts during the pandemic, providing financial support to communities in need. This included donations for healthcare infrastructure, medical research, and relief initiatives. Notes are that the well-off segment of society is diverse and while some individuals may have benefited during the pandemic, others may have faced challenges or experienced a decline in their wealth due to specific circumstances or business sectors being heavily impacted.

The perception of land during COVID-19 can vary based on various factors (Fig. 9), including geographical location, cultural context, and individual perspectives. Few general points are Safety and security (SS). During the pandemic, land ownership or access to personal spaces like homes and gardens became more crucial as people sought to create a secure environment for themselves and their families. The perception of land shifted towards its role in providing a safe haven and a sense of control amidst uncertain times.Value and investment (VI). The pandemic highlighted the value of land as a long-term investment and asset. With volatile financial markets, some individuals considered land and real estate as relatively stable and tangible assets. This perception may have been reinforced by historically low interest rates, making real estate investments more attractive.Impact on commercial property (ICP). The perception of land, particularly in commercial areas, changed due to the rise in remote work and the economic impact on businesses.

Vacant officespaces and struggling retail sectors led to concerns about the future demand and utilization of land for commercial purposes. Environmental awareness (EA). The pandemic raised awareness about the importance of natural spaces and green areas for mental and physical well-being. There was an increased appreciation for land with recreational opportunities, such as parks, hiking trails and open spaces.Economic values refer to the principles or standards that guide economic decision-making and determine the worth or importance assigned to goods, services, resources, and activities within an economic system. These values shape how individuals, businesses and societies allocate their limited resources to meet their needs and wants. Some common economic values are efficiency, this value emphasizes the optimal use of resources to maximize output or benefits. Efficiency implies minimizing waste, reducing costs and increasing productivity. Utility refers to the satisfaction or usefulness that individuals derive from consuming goods and services. Economic value is often

associated with the utility individuals obtain from consuming or owning a particular item.

Scarcity recognizes that resources are limited relative to unlimited human wants. Economic value is often attributed to goods and services that are relatively scarce, as they tend to command a higher price or greater importance. Opportunity cost refers to the value of the next best alternative forgone when making a choice. Economic value takes into account the trade-offs involved in choosing one option over another. Market value is determined by the forces of supply and demand in a competitive market. It represents the price at which goods and services are exchanged voluntarily between buyers and sellers. Profitability is a key economic value for businesses and entrepreneurs. It is the ability to generate a financial gain or surplus by selling goods and services at a price higher than the cost of production. Sustainability recognizes the importance of long-term economic and environmental well-being. Economic value increasingly includes considerations of environmental impact, social responsibility, and intergenerational equity. Innovation is highly valued in many economies as it drives technological advancement, productivity growth and new opportunities for economic development. The ability to create and adopt new ideas, products, and processes is seen as a source of economic value. Equity refers to fairness and the distribution of economic benefits and burdens across individuals and groups. Economic value is often assessed based on its impact on reducing inequalities and promoting social justice. Economic stability is an important value, focusing on maintaining a steady and predictable economic environment. Stability includes stable prices (low inflation), low unemployment rates, and a reliable financial system.

Impact

We eager to diagnose the impact of pandemic on several issues such as visiting lands (Fig. 10), land security (Fig. 11), land obstacle (Fig. 12), perception of feelings (Fig. 13) and basic needs (Fig. 14). The COVID-19 pandemic has had a significant impact on various aspects related to visiting lands, land security, land obstacles, perception of feelings and basic needs. Here's a breakdown of how these areas have been affected.Visiting lands. Travel and tourism have been heavily impacted by the pandemic. Many countries-imposed travel restrictions, including border closures, mandatory quarantines and suspension of international flights. These measures aimed to limit the spread of the virus but resulted in a significant decrease in tourism and the ability to visit lands. Travelers had to cancel

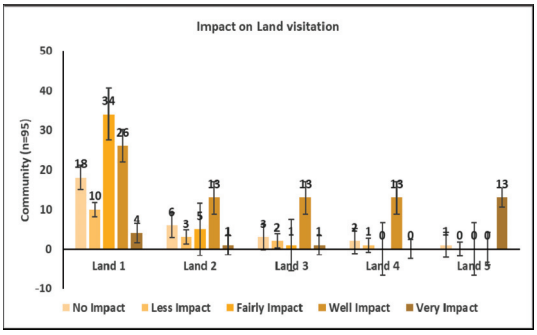

*Figure 10.*Sizing impact on land visitation

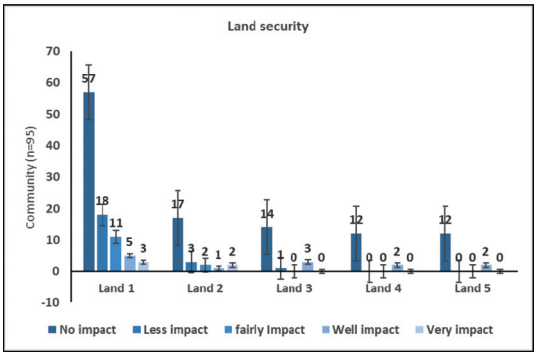

Figure 11. Impact on land security

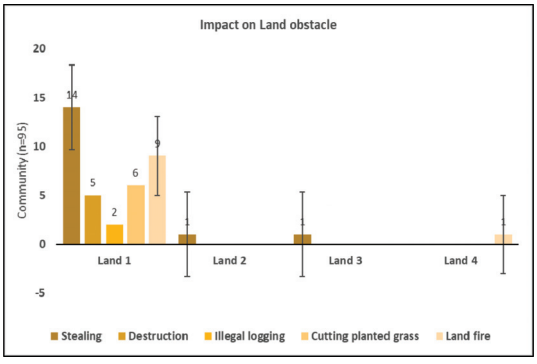

Figure 12. Impact on land obstacle

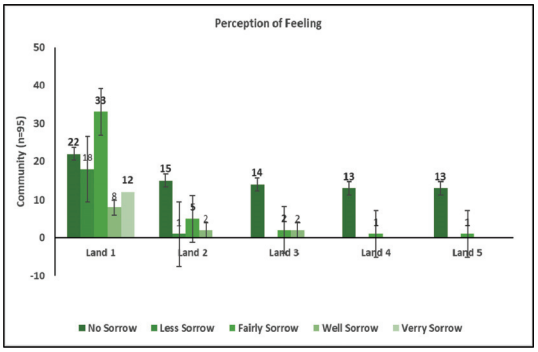

Figure 13. Impact on perception of community feeling

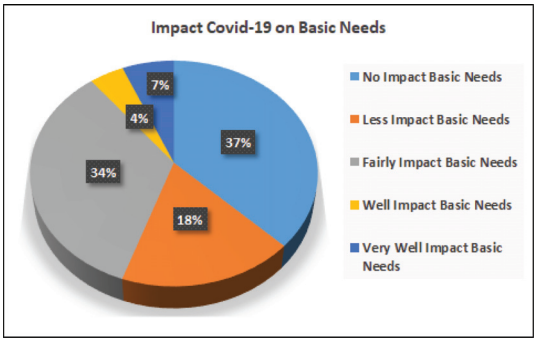

Figure 14. Impact of Pandemic Covid-19 on community basic needs.

or postpone their trips, leading to economic losses for the tourism industry.

The pandemic has raised concerns about land security in several ways. Firstly, with lockdowns and movement restrictions, some areas experienced an increase in crime rates, including theft, burglary and vandalism. Secondly, the closure of businesses and economic uncertainty led to job losses and financial hardships for many people. These economic pressures can contribute to social unrest and potentially impact land security in certain regions.

The COVID-19 pandemic introduced various obstacles related to land use and management (Fig. 12). For example, social distancing measures and hygiene protocols limited the capacity and operations of businesses, public spaces, and recreational areas. Many national parks, natural reserves and other tourist destinations were temporarily closed or operated with restricted access. The pandemic also affected construction projects and infrastructure development, causing delays and disruptions.

The pandemic has had a significant impact on people's perception of feelings towards lands and their environment (Fig. 13). With limited mobility and increased time spent indoors, individuals may have developed a heightened appreciation for nature and outdoor spaces. Being unable to visit lands freely may have created a sense of longing and desire for connection with nature. On the other hand, concerns about virus transmission and the perception of public spaces as potential hotspots might have induced feelings of fear and hesitancy. The COVID-19 pandemic has highlighted the importance of ensuring basic needs (Fig. 14) such as food, shelter and healthcare. Economic disruptions caused by the pandemic have led to job losses and income reduction for many individuals, making it challenging to meet these needs. Additionally, supply chain disruptions and panic buying during the initial stages of the pandemic created shortages of essential goods in some areas, further impacting access to basic needs.

Ecological Border

We come into ecological border of sustainability i.e. utilization of site-land transition (Fig. 15), land interaction with typical environment (Fig. 16) and objective of using land (Fig. 17). The ecological border of sustainability refers to the limits and boundaries within which human activities can occur while maintaining the long-term health and viability of ecosystems and the environment. It encompasses various aspects related to the utilization of land, the interactions between land and the surrounding environment, and the objectives of land use. This refers to the way land is utilized as it transitions from its natural state to a developed or modified state. It involves considering the impacts of human activities on the land, such as construction, agriculture or industrial development. Sustainable

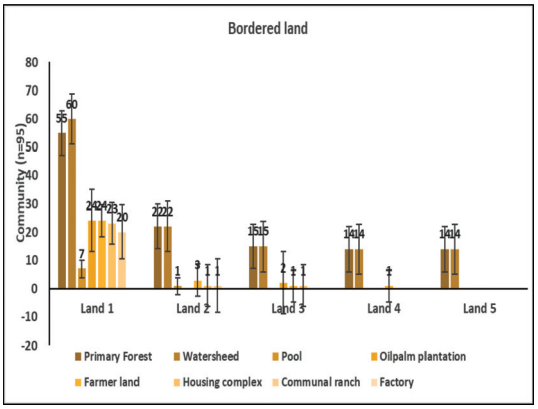

Figure 15. Ecological border on the land during Pandemic Covid-19

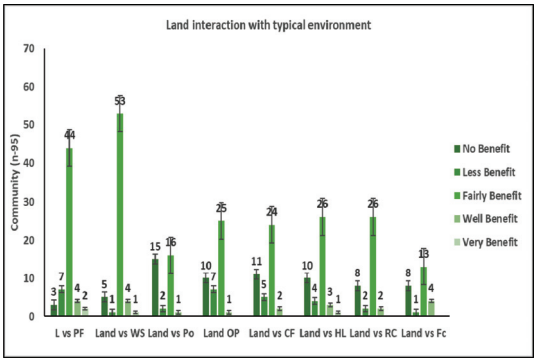

Figure 16. Land interaction with typical environment during Pandemic Covid-19

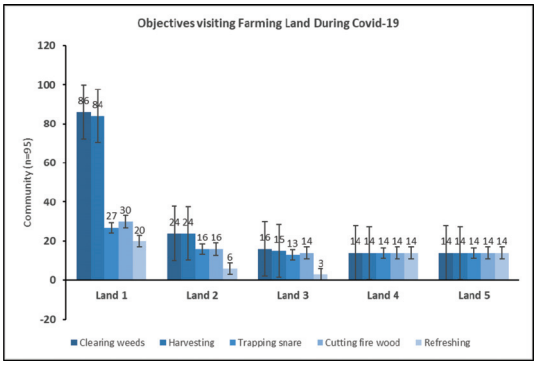

Figure 17. Objectives of community visiting farming land during Pandemic Covid-19

land utilization involves minimizing negative impacts on ecosystems, preserving biodiversity, and promoting the efficient use of resources. Land interacts with the environment in multiple ways, including the exchange of energy, water and nutrients. Sustainable land management seeks to ensure that these interactions are balanced and in harmony with natural processes. For example, preserving natural vegetation can help regulate water cycles, prevent soil erosion and provide habitat for wildlife. The objectives of land use can vary depending on the context and specific needs of a region or community. However, sustainable land use generally aims to achieve multiple goals simultaneously. These may include conserving natural resources, protecting biodiversity, promoting resilience to climate change, supporting food and water security and providing social and economic benefits to local communities.

Analysis of the model

Cronbach's Alpha, rho A, Composite Reliability, and Average Extracted (AVE) measures internal consistency, often used to assess the reliability of a set of items (e.g., a questionnaire) that measure the same underlying construct. Ecological indicators, and Economic indicators shown consistency. In rho A, ecology indicators, economic indicators, Land use security and social indicators shown more robust and accurate in PLS-SEM (Table 2). The values of CR shown well constructs on Economic indicators, followed by Land use security and social indicators.

Discussion

The COVID-19 pandemic has had significant impacts on various aspects of society, including ecological borders (Drenthen 2005; Carter and

Table 2. Indicator of the pre-requisite established model.

	Cronbach's Alpha	rho_A	Composite Reliability (CR)	Average Variance Extracted (AVE)
EcolBorInd	0.689	0.840	0.121	0.305
EconInd	0.842	0.910	0.876	0.384
LandsecInd	0.427	0.740	0.603	0.499
PercepInd	0.013	0.320	0.460	0.285
SocialInd	0.071	0.741	0.550	0.427

Walker 2010; Shuaib et al. 2019), land-use security (Yeshey et al. 2023; Santika et al. 2019; Indrawan et al. 2019) and the economical values (Mohri et al. 2013; Iyai, Gobay and Yaku 2015; Dewaelheyns 2017) of the farmers. The pandemic has had both positive and negative effects on ecological borders. On one hand, the restrictions on international travel and reduced industrial activities have led to a decrease in air and water pollution, resulting in improved air quality and ecosystem health in some areas. Reduced human interference in ecologically sensitive areas due to lockdowns has allowed wildlife to thrive in certain regions. On the other hand, the pandemic has also highlighted the vulnerabilities of ecological borders. Ecological border has strong correlation (r=0,963) with economic indicator (Table 3), as well as land use security (r=0.850). Fig. 18 shown output of the static model of SemPLS.

Land use security has strong correlation with economic indicator (r=0.762). The enforcement of pandemic control measures has been challenging in some areas, resulting in an increase in deforestation (Cortner et al. 2019; Obidzinski et al. 2012), illegal logging (Barri et al. 2019) and poaching (Coulter 2016; Ogahara et al. 2022; Dahal et al. 2023), as authorities may have diverted their attention away from environmental protection. Likewise, perception indicator has negative correlation on ecological borders (r=-0.549), followed by economic indicators (r=-0.321), land use security (r=-0.457).

From the analysis of SemPLS shown that Ecological border has significant effect on economical indicators (p<0,01) as well as Perception indicators. The rest of indicators such as Land security and social indicators do not have effect on economic

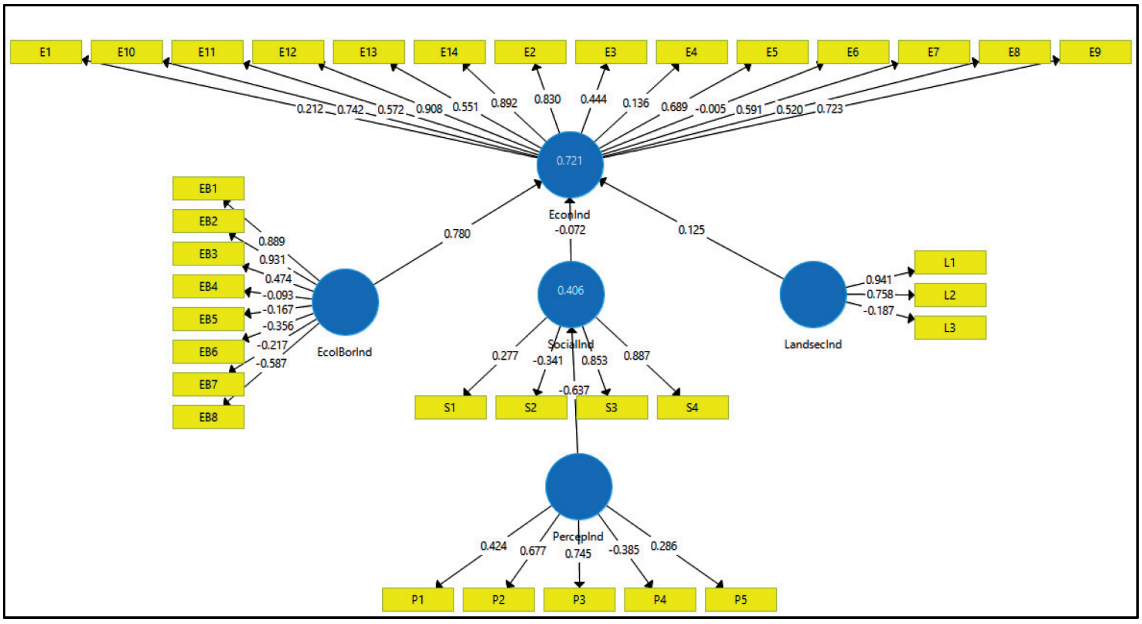

Figure 18. Output of SemPLS Algorithm. Explanation: S1: age, S2: education, S3: Household, S4: Land owner, L1: Distance of the first land, L2: Time spend in land, L3: Impact Pandemic during land visit, P1: Disturbance on land, P2: Perception on land, P3: Perception on food, P4: Perception on natural forest, P5: Perception on palm oil, EB1: ecological border of primary forest, EB2: ecological border of watersheet, EB3: Ecological border of ponds, EB4: Ecological border of palm oil, EB5: Ecological border of farming land, EB6: Ecological border of resettlement, EB7: Ecological border of livestock ranches, EB8: Ecological border of palm oil factory, E1: Sold vegetables,E2: Sold Sweet potatoes,E3: Sold ingredients, E4: Sold forages, E5: Sold fruits, E6: Total Asset, E7: Sold Floris, E8: Sold Oil-palm, E9: Sold hunting wild animal,E10: Sold livestock, E11: Sold taro, E12: Sold paddy, E13: Sold fish, E14: traditional bags.

Table 3. Correlation amongst indicators

	EcolBorInd	EconInd	LandsecInd	PercepInd	SocialInd
EcolBorInd	1.000	0.963	0.850	-0.549	0.374
EconInd	0.963	1.000	0.762	-0.321	0.240
LandsecInd	0.850	0.762	1.000	-0.457	0.416
PercepInd	-0.549	-0.321	-0.457	1.000	-1.309
SocialInd	0.374	0.240	0.416	-1.309	1.000

Table 4. Path analysis of the model.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
EcolBorInd ->EconInd	0.780	0.753	0.126	6.177	0.000
LandsecInd ->EconInd	0.125	0.155	0.133	0.936	0.350
PercepInd ->EconInd	0.046	0.037	0.054	0.849	0.397
PercepInd ->SocialInd	-0.637	-0.654	0.059	10.747	0.000
SocialInd ->EconInd	-0.072	-0.056	0.079	0.910	0.363

indicators (Table 4).

The relationship of the model explained R^2-Adj= 0,711 (71,10%). This means that 71.10% of the indicators can explain the model. The rest of 29,90% is explained by outside indicators which are not counted in the model.

Land-use security refers to the stability and assurance of land rights for individuals, communities and farmers. During the pandemic, land-use security has faced several challenges. The economic fallout and increased unemployment rates have affected the livelihoods of farmers who rely on agriculture and land-based activities. The loss of income and financial stability may have resulted in increased vulnerability to land grabbing, eviction, and encroachment on their lands.Moreover, restrictions on movement and limited access to markets and resources have disrupted agricultural activities, affecting food production and food security. Farmers may have faced difficulties in accessing seeds, fertilizers and other inputs, which could impact their ability to sustain agricultural production and maintain land-use security.

Farmers play a crucial role in providing food security and contributing to local economies. However, the COVID-19 pandemic has posed significant economic challenges for farmers. Lockdowns, travel restrictions, and market closures have disrupted the supply chains, resulting in reduced demand for agricultural products, lower prices, and income loss for farmers. Farmers who rely on labor-intensive agriculture may have faced additional challenges due to labor shortages caused by movement restrictions and migration disruptions. The closure of restaurants, hotels and tourism activities has also impacted the demand for locally produced agricultural products, affecting the income and livelihoods of farmers' dependent on these markets.

During the COVID-19 pandemic, it is crucial to consider ecological border management, land-use security and the economic well-being of farmers. While some positive ecological changes have been observed, the pandemic has also exposed vulnerabilities and challenges in these areas. It is essential to prioritize support for Farmers, strengthen land rights, provide access to resources and ensure sustainable practices to build resilience and promote the well-being of farmers during and after the pandemic.

In Ecological Border Management, strengthen surveillance and control measures at ecological borders to prevent the illegal trade of wildlife and the introduction of zoonotic diseases.Implement strict regulations on the transportation and handling of wildlife, promoting sustainable and responsible practices. Collaborate with international

Appendix 1

	S1	S2	S3	S4	L1	E1	E2	E3	E4	E5	L2	L3	P1	P2	E6	P3	EB1	EB2	EB3	EB4	EB5	EB6	EB7	EB8	E7	E8	E9	E10	E11	E12	E13	E14	P4	P5
S1	1.000																																	
S2	-0.432	1.000																																
S3	0.128	-0.096	1.000																															
S4	0.082	-0.162	0.592	1.000																														
L1	0.006	0.122	0.349	0.330	1.000																													
E1	-0.064	0.132	0.018	0.004	0.039	1.000																												
E2	-0.121	0.112	0.241	0.205	0.551	0.201	1.000																											
E3	-0.080	-0.084	0.308	0.365	0.377	0.202	0.477	1.000																										
E4	0.167	0.077	-0.173	-0.313	-0.056	0.132	0.104	0.045	1.000																									
E5	0.046	0.127	0.209	0.122	0.451	0.127	0.695	0.305	0.296	1.000																								
L2	0.220	-0.148	0.280	0.173	0.546	0.097	0.180	0.132	0.111	0.303	1.000																							
L3	0.207	-0.201	0.221	0.138	-0.098	-0.016	-0.148	0.206	-0.107	-0.075	0.148	1.000																						
P1	-0.229	0.151	-0.116	0.019	0.014	-0.103	-0.155	0.006	0.054	-0.093	-0.099	-0.049	1.000																					
P2	0.051	0.043	-0.458	-0.486	-0.541	-0.067	-0.443	-0.309	0.168	-0.256	-0.359	0.157	0.149	1.000																				
E6	0.076	-0.182	0.439	0.505	0.172	0.099	0.065	0.264	-0.004	0.014	0.348	0.262	-0.007	-0.339	1.000																			
P3	-0.201	0.144	-0.275	-0.337	-0.035	-0.083	-0.095	-0.348	-0.025	-0.193	-0.153	-0.162	0.368	0.191	-0.051	1.000																		
EB1	-0.033	0.003	0.357	0.256	0.602	0.120	0.597	0.359	-0.081	0.492	0.340	-0.171	-0.123	-0.548	0.016	-0.280	1.000																	
EB2	-0.093	0.087	0.352	0.255	0.650	0.200	0.695	0.407	-0.093	0.536	0.390	-0.101	-0.097	-0.536	0.060	-0.209	0.813	1.000																
EB3	-0.219	0.041	-0.037	-0.127	0.192	0.236	0.388	0.222	0.186	0.318	0.005	-0.164	-0.041	0.018	-0.098	0.028	0.249	0.319	1.000															
EB4	0.099	-0.021	-0.245	-0.359	-0.121	0.048	-0.093	-0.042	0.250	0.055	0.021	0.168	-0.201	0.301	-0.284	-0.059	-0.105	-0.120	0.382	1.000														
EB5	0.144	-0.152	-0.278	-0.330	-0.265	0.019	-0.120	-0.128	0.062	0.007	-0.129	0.188	-0.108	0.346	-0.288	-0.020	-0.143	-0.146	0.353	0.662	1.000													
EB6	0.112	-0.139	-0.338	-0.397	-0.410	-0.106	-0.160	-0.085	0.246	-0.036	-0.068	0.184	-0.256	0.460	-0.213	-0.145	-0.273	-0.319	0.284	0.527	0.608	1.000												
EB7	0.134	-0.198	-0.259	-0.354	-0.293	-0.128	-0.102	-0.191	0.208	0.068	-0.022	0.153	-0.255	0.311	-0.258	-0.062	-0.141	-0.146	0.239	0.585	0.636	0.675	1.000											
EB8	0.237	-0.182	-0.290	-0.320	-0.554	-0.129	-0.459	-0.282	0.003	-0.262	-0.152	0.362	-0.177	0.533	-0.156	-0.054	-0.370	-0.429	-0.111	0.387	0.491	0.581	0.592	1.000										
E7	0.026	-0.231	0.435	0.477	0.490	-0.013	0.429	0.360	-0.064	0.363	0.421	0.096	-0.051	-0.559	0.363	-0.321	0.587	0.630	0.154	-0.126	-0.173	-0.242	-0.099	-0.316	1.000									
E8	0.097	0.053	0.221	0.207	0.480	0.190	0.399	0.257	-0.045	0.216	0.306	-0.051	0.054	-0.192	0.166	-0.041	0.351	0.392	0.119	-0.069	-0.073	-0.167	-0.096	-0.182	0.303	1.000								
E9	-0.034	0.168	-0.149	-0.295	0.416	0.005	0.471	0.076	0.189	0.369	0.140	-0.278	-0.001	-0.105	-0.330	0.115	0.462	0.588	0.414	0.220	0.159	0.012	0.124	-0.179	0.217	0.280	1.000							
E10	-0.004	0.036	0.215	0.142	0.451	0.009	0.518	0.169	-0.001	0.395	0.209	-0.145	-0.156	-0.259	-0.176	-0.123	0.583	0.646	0.340	0.143	0.055	-0.043	0.063	-0.227	0.390	0.361	0.589	1.000						
E11	0.026	0.037	-0.091	-0.168	0.251	-0.016	0.385	-0.015	0.303	0.359	0.142	-0.376	0.020	-0.016	-0.156	0.091	0.292	0.407	0.339	0.077	0.026	0.028	0.096	-0.230	0.104	0.128	0.637	0.518	1.000					
E12	0.033	0.017	0.212	0.172	0.620	0.226	0.734	0.446	0.038	0.546	0.344	-0.125	-0.124	-0.408	0.006	-0.133	0.673	0.766	0.363	0.046	-0.052	-0.246	-0.050	-0.342	0.478	0.493	0.631	0.606	0.471	1.000				
E13	0.099	0.098	-0.288	-0.367	0.142	0.134	0.268	-0.043	0.337	0.409	0.203	-0.186	-0.155	0.036	-0.375	-0.035	0.281	0.411	0.292	0.395	0.296	0.201	0.338	0.101	0.058	0.025	0.655	0.376	0.542	0.521	1.000			
E14	0.001	0.028	0.223	0.222	0.537	0.192	0.702	0.311	-0.011	0.513	0.335	-0.145	-0.212	-0.468	-0.010	-0.219	0.696	0.800	0.300	0.022	-0.023	-0.152	0.005	-0.291	0.610	0.472	0.616	0.638	0.385	0.807	0.501	1.000		
P4	0.044	-0.179	0.114	0.180	-0.004	0.078	0.075	0.195	-0.104	0.228	0.238	0.345	-0.352	0.036	0.082	-0.421	0.276	0.245	0.153	0.216	0.286	0.303	0.313	0.400	0.321	0.146	0.077	0.174	-0.069	0.220	0.274	0.376	1.000	
P5	-0.053	0.149	-0.175	-0.315	0.428	0.068	0.458	0.125	0.213	0.378	0.212	-0.239	-0.094	-0.103	-0.328	0.086	0.462	0.526	0.380	0.287	0.178	0.050	0.114	-0.151	0.150	0.278	0.832	0.525	0.514	0.642	0.673	0.659	0.166	1.000

organizations and neighboring countries to establish coordinated efforts in ecological border management. Raise awareness among the local population about the importance of protecting ecosystems and biodiversity.

In the component of Land-use Security (LuS), support and promote sustainable agriculture practices that minimize the negative environmental impacts, such as agroecology and organic farming. Provide financial incentives and technical assistance to farmers for adopting sustainable land-use practices, including crop rotation, agroforestry, and soil conservation techniques. Develop land-use policies that prioritize the conservation of natural resources, protection of biodiversity, and preservation of critical ecosystems.Strengthen land tenure rights for Farmers to ensure their long-term access to land and protect them from displacement and land grabbing.

For Economic Values for Farmers (EVP), it needs to establish and enhance local and regional food systems to ensure food security (Ferdous et al. 2016; Brooks and Place 2019) and reduce dependence on global supply chains (Hamilton et al. 2020; Sun et al. 2020). Added to this is a support small-scale farmers and Farmers by providing access to credit (Chauke et al. 2013; Nuhung 2015; Winarso and Basuno 2013), agricultural inputs (Herforth and Ballard 2016; Christiaensen et al. 2011; Thurlow et al. 2019) and modern farming technologies (Sæther et al. 2006; Boogaard et al. 2011; Garrett et al. 2017). Facilitate the marketing and distribution of local agricultural products through farmers' cooperatives and direct-to-consumer platforms.Lastly is promoting value-added activities and diversification of income sources for Farmers, such as Agri-tourism, processing of agricultural products, and crafts.

Conclusion

In conclusion, the research has shed light on the intricate interplay between ecological border dynamics, land-use security and the economic well-being of the farmers in the region during the unprecedented challenges posed by the COVID-19 pandemic. The study find that Ecological border has strong correlation with economic indicator, as well as land use security (r=0.850). Land use security has strong correlation with economic indicator. Perception indicator has negative correlation on ecological borders, followed by economic indicators and land use security. The relationship of the model explained R^2-Adj= 0,711 (71,10%). This means that 71.10% of the indicators can explain the model. The rest of 29,90% is explained by outside indicators which are not counted in the model.

Economically, the research highlights the intricate connections between ecological stability, land-use security and the financial resilience of farmers. The pandemic has exposed the fragility of existing economic structures, revealing the need for adaptive strategies that consider the unique ecological and socio-economic context of West New Guinea Papua. The economic values derived from land-based activities have been significantly impacted, necessitating innovative solutions and policies to support the recovery and sustainable development of the region.

The research may have several limitations.The findings of the study may be specific to the context of West New Guinea Papua and may not be generalizable to other regions or countries. Factors such as cultural, economic, and ecological differences could affect the applicability of the research findings elsewhere. The COVID-19 pandemic might have posed challenges in collecting accurate and reliable data due to restrictions on movement, social distancing measures and potential reluctance of participants to engage in interviews or surveys during such a crisis. The sample size and selection process could introduce bias, especially if certain groups of farmers were underrepresented or overrepresented in the study. This could limit the external validity of the findings.The study's focus on the pandemic period may limit its ability to draw

long-term conclusions about the ecological border, land-use security, and economic values.

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