Chapter 10
Alternative Dispute Resolution Techniques for Intertwined Artisanal Mining–Communal Farming Conflict

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ABSTRACT

The chapter discusses challenges of artisanal mining (AM), a nature-based livelihood strategy, in promoting sustainable agricultural practices. It highlights how AM competes for biodiversity and ecosystem services and causes environmental damage and a shift from traditional sustainable agricultural practices land-use tenure to uncontrolled itinerant AM. Methodologically, the chapter reviewed secondary systematic-literature review (SLR) of articles articulating the use of alternative dispute resolution (ADR) techniques. These include facilitated mediation, negotiation, and arbitration that yield land-use zoning agreements (conciliation) to attain synergy and market convergencies. It recommends transforming negative-synergy and implementing zoning strategies that prevent land-use conflicts, conserve biodiversity, and extricate competing AM from communal farming to attain sustainability. The resultant, unbridled development would protect ecosystem-service producing biodiversity, converge AM-agricultural markets and sustainably, leading to sustainable agricultural growth and conservation.

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1. INTRODUCTION

Artisanal mining and communal farming are two nature-based livelihood strategies inextricably embedded on biodiversity's provisioning, regulating, supporting and cultural ecosystem services. They have however not been entirely socially, economically and environmentally compatible, raising sustainability of biodiversity at the centre of the seemingly polar opposite livelihood strategies whose interaction often sparks conflicts large and small among rural communities (Chari, Novukela & Ngcamu, 2022; Funoh, 2014). Tracking the drivers of land-use conflicts is necessary if lasting resolutions are to be achieved among actors involved in the dichotomised rural economy. Prime among the often-hidden factors driving conflicts among artisanal mining and communal farming communities is the pursuit of, and abuse of structures of power whose occupation results in classifications. These predispose such power structures to access to resources for self-aggrandisement. Kamncube's SPCR 4Δs Conflict Model depicted in Figure 1 below indicates various interdependencies among factors driving conflicts, including among artisanal miners and farming communities' land-use conflicts.

2. BACKGROUND OF THE STUDY

Individual and community access and use of natural resources in rural communities is under an ever-demanding global trends more focused on extraction and economic gains among competing livelihoods (Shackleton, 2020). People derive livelihood benefits from agriculture, livestock, and natural resources in ecosystems governed by a number of ecological (e.g., drought, floods, exhausted soils) and social factors (e.g., legislation, privatization, over-exploitation) factors (Moyo, Ncube & Mamhute, 2021; Shackleton, 2020; Agrawal and Ostrom, 2001; Chimhowu and Woodhouse, 2006). Losing access can render such communities vulnerable and have a negative impact on their resilience and general well-being (Shackleton, 2020).

Mining has negative impacts on rural farming communities and their means of subsistence worldwide, contributing to social-ecological change and conflict (Harlow, Hurley, Fox, Vargas-Guerra & Gibson, 2019; Bebbington, Bebbington, Bury, Lingan, Muñoz & Scurrah, 2018; Mtero, 2017; Andrews, 2018; Issah and Umejesi, 2018; Mnwana and Bowman, 2018; Kitula, 2006; Hilson, 2002). This is one factor influencing land-access and people's capacity to use natural resources. Across the world, rural farming communities depend on access to land and natural resources it offers for their subsistence. Livelihoods of millions of people are dependent on crop and cattle production, and the exploitation of non-timber forest products (NTFPs) on communal lands (de Sherbinin, VanWey, McSweeney, Aggarwal, Barbieri, Henry

& Walker, 2020; Mishra & Mishra, 2017; Shackleton & Luckert, 2015; Scoones, 1998). Thus, destroying these puts their livelihoods at risk, compelling those affected to defend their turf, even violently

In addition to providing food security, financial savings, and occasionally supplementary income, livestock and crops are significant cultural assets in many rural poor households (Aliber and Hart, 2009; Baiphethi and Jacobs, 2009). Additionally, unadulterated ecosystems offer essential services vital to human well-being, such as fruit, fuelwood, medicinal plants, and other natural resources collectively referred to as provisioning services or NTFPs (Shackleton, 2020; Shackleton & Luckert, 2015; Shackleton et al., 2007; de Groot, Wilson & Boumans, 2002). Artisanal mining has tended to be deleterious on farming land and other land-uses, decimating pastures and fostering environmental changes that are detrimental for agro-based livelihoods. Despite artisanal mining's beneficial effects to households and the economy, it has negative effects, particularly at the communal level where one clear consequence of mining has been the influx of itinerant mining communities into gold-rush locations in pursuit of jobs, economic opportunities, attracting people away from agriculture (Moyo, Ndlovu, Francis & Ncube, 2018; Tenkorang & Osei-Kufuor, 2013). Rising competition, not only for land use and dependence on the environment with negative externalities thereto, but also for housing, food, and employment drives up costs, rise in social vices like transactional sex, prostitution and crime, which increase demand for quick income that agriculture does not provide (Moyo et al., 2018; Akabzaa & Darimani, 2010).

The above result in outcomes that negate on social, economic and environmental sustainability elements of communities wherever the two livelihood strategies, regarded as detrimental to lives and the environment co-exist (Moyo et al., 2022; Tenkorang & Osei-Kufuor, 2013; Akabzaa & Darimani, 2001). There is need to harmonise and reconcile artisanal mining and communal farming livelihood strategies through deliberate rather than reactive conflict transformative models through the deployment of Alternative Dispute Resolution (ADR) mechanisms. This approach would be useful in dismantling the notions of superiority between artisanal mining and various strands of agriculture based on social class, power, and socio-economic structures to which individuals belong. The ADR would be helpful in ensuring mining and farming structures facilitate mediation, negotiation that results in conciliation among the actors in artisanal mining and communal farming.

3. RESEARCH OBJECTIVES

1. To highlight the role of traditional land-use tenure in conserving biodiversity and ecosystem services supporting agricultural production

2. To describe the increasing shift from agro-based livelihoods towards quick-wins offered by artisanal mining
3. To expose the paradox of artisanal mining and agricultural practices as unsustainable
4. To propose the alternative dispute resolution (ADR) as zoning strategy for competing land-uses

4. KAMNCUBE'S SPCR 4∆S CONFLICT MODEL

The author-proposed model, the SPCR depicts the interaction of **structures**, and the use of **power** derived therefrom to increase **class**-based identities that help society gain access to **resources** they desire. This happens in a manner skewed in favour of one or another societal group or class of people, resulting in conflicts large and small. The model explains the occurrence of conflict as an outcome of the pursuit of **structures**, the (ab)use of **class power**, to gain access to biodiversity **resources**. Such land-use leaves a trail of destruction that pits one group or class in society against another, all in pursuit of resources.

The matrix above explains how in pursuit of a **central element**, **a target factor** is sought with a view of achieving an **intended means** to acquiring an **envisaged outcome**, resulting in conflicts. For example, *in pursuit of occupation of esteemed*

Figure 1. Kamncube's SPCR 4∆s conflict model (Mthuthukisi Ncube's conceptualisation of conflict driver)

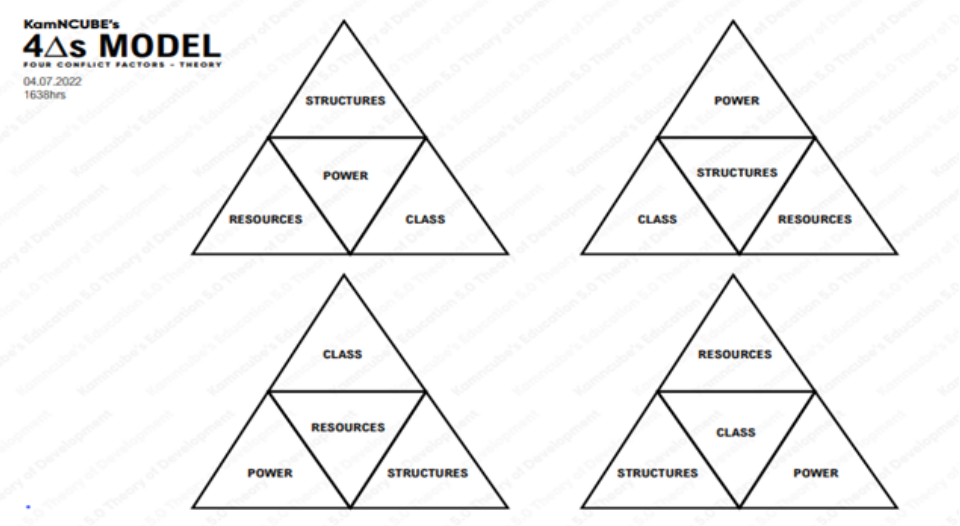

Table 1. Tabular explanation of Kamncube's SPCR 4Δs conflict model

Central Pursued Element	Target Factor	Intended Means	Envisaged Outcome
Structure	Power	Class	Resources
Power	Structures	Resources	Class
Class	Resources	Power	Structures
Resources	Class	Structures	Power

structures, power has been used, legitimately and illegitimately to create or belong to a given class that has access to certain privileges and resources. Secondly, *in pursuit of power (social, political, and economic), certain structures are (ab)used for their resources with a view of accessing certain classes for prestige as an outcome.* Thirdly, *in pursuit of a given class, resources have been deployed to attain power (rightly or wrongly so), which power is then (ab)used as a means to an end, which entails the occupation of structures desired for beneficial power purposes*. Fourthly, *in pursuit of resources, class has been the target factor. Such class is then (ab)used to yield access to structures of privilege and ultimately power as an envisaged outcome.*

Communal farmers tussle to occupy biodiversity structures of influence like water bodies and pastures while artisanal miners ride on the power and dominance of legal frameworks governing mining activities. This turn creates social classes where these groups have reduced or increased access to envisaged economic resources. It is important to understand how provisioning, regulating, supporting and cultural ecosystems services, communal farming land-use tenure, and artisanal mining interface in biodiversity conflicts. Kamncube's SPCR 4Δs Conflict Model helps identify interactions among the SPCR conflict factors, which channel alternative dispute resolution (ADR) efforts to separate artisanal mining from communal farming using zoning for each activity.

5. ARTISANAL-MINING, LAND-USE TENURE AND ECOSYSTEM SERVICES

Citing the World Bank Group (2001), Funoh (2014) posits small-scale mining is largely a poverty driven activity, typically practiced in the poorest and most remote rural areas of a country by a largely itinerant, poorly educated populace with few employment alternatives. Artisanal mining can be an unregistered or unlicensed mining and is carried out by lone individuals or small groups using a minimal amount of technology, equipment, inadequate health care and safety measures, and low environmental protection (Hentshel *et al*., 2001). Not only in developing

countries do individuals only survive on Artisanal mining but do also venture in farming activities. Agriculture is the engine of economic growth in many African countries, with a quarter of the global arable land in its possession. Africa has an estimated 30% of gross domestic product, and 60% of labour force employment attributed to the continent's agricultural sector (Chari, Novukela & Ngcamu, 2022).

In many developing countries, artisanal and small-scale mining (ASM) is largely a poverty-driven activity that plays an important socio-economic role and has thus experienced exponential growth in recent years, with millions of families in rural areas dependant on it for their livelihood (Chari et al., 2022). An estimated 13 million people from about 30 countries are directly engaged in small-scale mining, a significant proportion of whom are women and children. A further 80 to 100 million people across the developing world could depend on small-scale mining for some aspects of their livelihoods. Many have seen it as a panacea to poverty, unemployment, and unsustainable livelihoods (Adonten-Kissi and Adonteng-Kissi 2017). Only sixteen studies on the interactions between ASM and agriculture were found in a review by Ofosu *et al*. (2020), which emphasizes both synergistic and antagonistic relationships between the two major rural livelihood strategies (Moyo, Ncube & Ndlovu, 2022; Mkodzongi & Spiegel, 2019). However, Malone (2021) argues it is a common misconception that mining competes for scarce resources and land or has other detrimental effects on other livelihood strategies (Pijpers, 2011).

However, the influx of artisanal miners in communities has led to direct competition for resources with small-scale farmers, leading to community protests and in some cases, violent conflict (Crawford and Botchwey, 2017). Small holder farming and artisanal mining are both significant contributors to Zimbabwe's economy; with smallholder farming employing nearly 70%, while mining employs 7.1% of the country's economically active population (World Bank, 2019). However, there has been a major rise in conflict between miners and farmers primarily brought on by land use and tenure issues of entitlement. The link between artisanal mining activities and economic sustainability of agricultural food supply chain is accounted for by the conflict theory. Propagated by Karl Marx in 1867, the conflict theory claims society is in a state of perpetual conflict because of competition for limited resources (Cross-man, 2019). According to McCafferty (2006), the conflict theory focuses on competition for social, political, or economic supremacy, which finds expression in mining and agricultural conflict.

The conflict theory opines that individuals and groups within society have differing amounts of material and non-material resources. The powerful group dictates the terms and conditions to the oppressed majority because they have control over resources (McCafferty, 2006). Inspired by Karl Marx's Structural Conflict Theory, Ncube suggested that **structures** (S) have been manipulated to gain **power** (P), which is used in the **classification** (C) of society with a view of limiting or

regulating access to **resources** (R) resulting in conflicts large and small as explained by Kamncube's subsequent SPCR 4Δs Conflict Model (Ncube, unpublished). The model depicts the root causes of conflict as pursuit or abuse of **structures**, pursuit of or abuse of **power**, pursuit of or abuse of **class**, with a view of gaining access to desired **resources**.

That artisanal mining and agriculture are the main livelihood strategies pursued by the country towards attaining the Middle Upper Income economy under Vision 2030 has sparked fierce conflict between them. What has exacerbated the conflict is the high unemployment and climate change that has drawn village farmers into ASM. Although local organizations have stepped in to arbitrate on these disputes, it is not clear whether the land can be divided based on zones. Although mining has helped grow the country's economy, it has also ruined the environment for farmers.

This book chapter presents an overview of the conflict between artisanal mining and the farming community, and suggests the adoption of transformative leadership and Alternative Dispute Resolution (ADR) techniques to resolve these conflicts peacefully. The Fast Track Land Redistribution Programme in the 2000s generated significant new modes of "belonging" in rural lands, which prompted modifications to farming along with new artisanal mining activities as articulated by the late agricultural expert Sam Moyo (Mkodzongi and Spiegel, 2019). Years later, mining-farming interface still influence rural labour trajectory and demand close examination (Moyo, Ncube, and Ndlovu, 2022). Artisanal gold mining, and small-scale communal agriculture remain two of Zimbabwe's economic foundations (Moyo *et al*., 2022). Despite being prohibited by Zimbabwe's colonial-era mining laws, which continue to influence modern mining policies (Spiegel, 2015; Dube *et al*., 2016), ASM has grown to be a common economic activity carried out by socially diverse groups with a variety of educational backgrounds and socioeconomic statuses (Mabhena, 2012; Mpofu and Mpofu, 2017). Over a million people's livelihoods directly depend on ASM across the nation (PACT, 2015; Mkodzongi and Spiegel, 2019).

Individuals may engage in a variety of ASM activities, including diamond or gold rushes, which are characterized by unsteady communities that are conflict-prone and are often transitory and driven by recession with examples such as gold-mining nations of Zimbabwe, Peru, Venezuela, and Bolivia (Hentschel *et al*., 2003). Communities with substantial population swings and initial instability may either go away after a few years or develop into permanent communities alone (Hentschel *et al*., 2003).

Mining and farming have frequently coexisted in Zimbabwe with many other informal revenue generating tactics (Sachikonye, 2011; Mkodzongi and Spiegel, 2019). In 1990s and early 2000s, participation in the ASM industry in Zimbabwe evolved into a seasonal, part-time, and permanent source of income (Mondlane and Shoko, 2003; Maponga and Ngorima, 2003). With the adverse effects of Economic Structural Adjustment Programmes (ESAPs) and drought-restricted employment

prospects in agriculture, national increases in ASM activity began to appear in the 1990s (Mabhena, 2012; Mkodzongi and Spiegel, 2019).

Since the early 2000s, the resource boom has brought up significant issues regarding how projects affect social dynamics and conflict as well as livelihoods (Bebbington *et al*., 2008; Brain, 2017; Malone, Smith and Zeballos, 2021). As opponents rally around environmental concerns, requests for benefits and compensation, and demands for territorial sovereignty and local authority, large-scale extractive activities have historically been accompanied by conflict (Helwege, 2015; Paredes, 2016; Malone *et al*., 2021). However, very little empirical studies have been done to gain insight into how Zimbabwe's Fast Track Land Reforms changed livelihoods of newly resettled peasant farmers, legally designated as "A1 farmers," despite the rise in ASM activities that followed (Mabhena, 2012; Moyo, Ncube, and Ndlovu, 2022). Discussions about artisanal mining in Zimbabwe have frequently centred on allegations of political favouritism and elite takeover of natural resources (Mawowa, 2013). In contrast, narratives about the connections between mine and farming in Africa more generally have a tendency to portray artisanal mining as an off-farm endeavour that is replacing or destroying peasant farming rather than enhancing it.

Such perspectives have occasionally given rise to calls for fundamentally rethinking the nature of mining-farming linkages in African contexts, with much critical research focusing on West Africa and in some cases pointing to significant ASM-generated funds complementing and supporting investment into smallholder farming (Bryceson and Jnsson 2009; Banchrigah and Hilson 2010; Maconachie, 2011; Maconachie and Hilson 2011; Hilson, 2016; Moyo *et al*., 2022). The two activities are increasingly intertwined in many rural areas of Zimbabwe although some studies have highlighted recent disputes between farmers and miners with lengthy histories of miner-farmer contestations (Musemwa, 2009). This is despite well-documented environmental changes, destruction and land degradation associated with ASM (Ncube-Phiri, Mucherera, and Ncube, 2015; Mkodzongi and Spiegel, 2019; Moyo *et al*., 2022).

A few exceptions do look at disagreements involving how ASM interacts with other sources of income. Occasionally, illegal miners seized land and displaced crops (Gilbert and Albert 2016). In other instances, ASM activity affected traditional subsistence livelihoods, forcing local communities to adopt ASM to make a living, setting off a vicious cycle that further weakened traditional livelihoods (Hennessy, 2015; Ofosu *et al*, 2020). Other instances include the harm caused by ASM-driven deforestation to livelihoods reliant on the forest resources (Theije and Salman 2018) and ASM lead poisoning pollution to fishing (Hook 2019).

Communal farmers livestock have perished in abandoned pits of unregistered artisanal miners. Unemployment surge in the country is causing most people

especially males to engage in artisanal gold mining (Moyo & Chinembiri, 2019). Artisanal miners have created danger for communal farmers livestock leaving behind remnants of chemicals like mercury being eaten by livestock, the chemicals getting into water sources hence being hazardous to both humans and animals some burning the veld so as to use gold sensors thus reducing the grazing area and biodiversity. In Matabeleland South some Non-Governmental Organization (ZimPro) are trying to engage the two parties (miners and farmers) to minimize conflict (Moyo & Chinembiri, 2019). The conflict therefore would require a holistic approach with different stakeholders (miners, farmers, environmental management agency, police, ministry of health) engaging to minimize the conflict.

From the review of literature, it has emerged that the impacts of artisanal mining are mainly felt in five areas. These are pollution, land degradation, loss of land, labour migration, and social ills (Jnr *et al*. 2014; Poku 2016). The production process in artisanal mining has the potential to affect the environment in several ways. The pollution index shows that mine sites are "heavily polluted" with abnormally high concentrations of chemicals (Eludoyin *et al*., 2017). Illegal miners pollute water bodies destroy farmlands and they do not reclaim the land (Poku, 2016). The opened land portions are rarely filled up, causing them to be dangerous causes of accidents to victims that fall in them, or serve as habitats for reptiles and dangerous animals (Eludoyin *et al*., 2017). For agricultural food supply chains, generally, these are linked directly by one or more of the upstream or down stream flows of products, services, and information (Sodhi and Tang, 2012).

Mining operations further affect water quality through infiltration of waste water into ground water thereby polluting it with chemicals. There is existing biological evidence linking this pollution to reduction in crop yields (Aragon and Rud, 2012; Poku, 2016). Mining activities consume large tracts of land, there by eating into and reducing, agricultural land for farming community. The negative impacts from the mining activities can be permanent and render previously fertile agricultural land barren. This sets up a direct competition with small-scale farmers for control and use of land (Slack, 2013). Large numbers of people are displaced by mining operations resulting in loss of farmlands (Slack, 2013). Additionally, Jnr *et al*. (2014) found out that farmers in Ghana who were displaced by mining activities were not compensated in the form of alternative land. The areas lost represented a substantial portion of the affected communities' farmlands. A significant reduction in food security is inevitable in areas where artisanal mining is practiced. All these issues and problems caused by artisanal mining has frustrated the farmers to a greater extent and caused them to retaliate in order to preserve their agricultural land.

6. ARTISANAL MINING-COMMUNAL FARMING IMPACTS ON THE ENVIRONMENT

Communal livestock farming is a type of agriculture where livestock farmers share a common area and manage their holdings as cooperative businesses. A portion of these units is situated on privately held, leased, or state-owned property (Molieleng, Fourie and Nwafor, 2021). This farming strategy, which is still in use in many southern African rural areas, is the oldest and most reliable way to increase household farming security. Communal livestock husbandry then becomes a means of ensuring food security, since over 75% of the world's poorest population live in rural areas and 2.5 billion people live on tiny farms and are solely dependent on agriculture for their living (Molieleng et al., 2021).

For instance, over 10,000 people rely on Ghana's forest reserves for their food and livelihood, and their degradation is largely linked to mining (Adjei, 2017). Only 1.2 million of Ghana's 8.3 million hectares of forest estate remain today, primarily due to the country's decision to let mining operations within the forests after it gained independence in 1957 (Adjei, 2017). The eviction of indigenous people from their communal and ancestral lands where they had been engaged in economic activities like farming to sustain their families is underscored as an impact of artisanal mining on communal farming (Adjei, 2017). The rangeland management policies in southern Africa are shaped by a three-tiered conceptual model of development, a model that applies the modernization theory of development to two compelling environmental narratives: the tragedy of the commons, and land degradation (Rohde, Moleele, Mphale, Allsopp, Chanda, Hoffman, Magole and Young, 2006).

Raising of livestock poses a risk to the ecosystem (Dopelt, Radon and Davidovitch, 2019), with main effects evident through the high rates of greenhouse gas (GHG) emissions, water and land pollution, and deforestation. van Noordwijk, Minang, Dewi, Hall and Rantala (2009) assert that 96% of the world's deforestation is caused by livestock farming that produces feed, fodder, and grazing areas. Additionally, the management of animal manure and the use of pesticides and herbicides are significant causes of water and land contamination (Grossi, Goglio, Vitali and Williams, 2019; Neeliah, Rajkomar, Dookun-Saumtully and Ramkissoon, 2006). The two main greenhouse gasses that come from animal agriculture are methane and nitrous oxide. Grossi et al. (2019) argue that nitrous oxide, which is produced when manure and fertilizers are stored, contributes to global warming 265 times more than carbon dioxide, whereas methane influences global warming 28 times more than carbon dioxide. Consequently, the production of livestock is also negatively impacted by climate change (Grossi et al., 2019).

The primary driver of forest clearing is the rising demand for animal products, which inevitably leads to the need for new pastures to accommodate the growing

animal population (Dopelt, Radon, Davidovitch, 2019). Expanding agriculture is the primary cause of deforestation worldwide, accounting for 96% of it. Indirect causes of deforestation at the local level include political, cultural, and socioeconomic variables such as poor governance and policies, corruption, landlessness and ambiguous allocation rights, migration, rural poverty, and a lack of capital and funding (Dopelt, Radon, Davidovitch, 2019; van Noordwijk, Minang, Dewi, Hall and Rantala, 2009). In Africa, agriculture was found to be the primary cause of deforestation where poor farmers and communities depend on forest lands for agricultural and fuelwood collection, often adopt slash-and-burn/fallow techniques were found to be the primary cause of deforestation in the Congo Basin rainforest (Dopelt et al., 2019; van Noordwijk et al., 2009).

Most of the developing countries especially in the southern Africa have adopted the communal land tenure system (Gottlieb & Grobovšek, 2019). The principle here is "use it or lose it", if not in use, communal owners lose their land and are not allowed to transfer it, while rentals may be allowed, there is risk of losing ones' land. It is governed by customary law and varies among countries. Land property rights are not complete as the land either belongs to the state or to the community. When people acquire full property rights, it was noted that they would be a large shift of unskilled workers from agriculture into non-agricultural productivity (Gottlieb & Grobovšek, 2019). Additionally, the restrictive nature of land-rich farmers who limit the amount of land they rent out to highly-skilled land-poor individuals adds to the negative effects of communal land ownership due to risk of expropriation. Thus, skilled land-poor people end up paying exorbitant rentals and being allocated little land. If this misallocation is removed, they will be an estimated one-fifth increase in agricultural productivity. The Communal Land Act of Zimbabwe section number nine (9e), states that, 'a rural district council may, with the approval of the Minister, issue permit authorizing any person or class of persons to occupy and use, subjects to Regional, Town and Country Planning Act [Chapter 29:12] and any other order issued in terms thereof, any portion of communal land within the area of such rural district council, where such occupation or use is for any of the following purposes – (e) any purpose whatsoever which, in the opinion of the rural district council, is in the interests of inhabitants of the area concerned (Legislation, 2023). This could be the reason why in Zimbabwe gold panning is rampant and some rural houses have been demolished by such acts.

After the attainment of independence in 1980 wildlife habitats decreased however due to the introduction of Communal Areas Management Program for Indigenous Resources (CAMPFIRE) the loss slowed down (Taylor, 2009). Recently though there has been pressure on habitats and other natural resources due to deteriorating socio-economic conditions in the country. Food security among smallholder farmers is threatened in Zimbabwe, especially due to drought hence there are not able to

generate extra income. Low yields therefore are compensated by extensification rather than intensification (Marongwe et al., 2011). This threatens the distribution of already thin resources of labour and inputs and of land degradation as farmers move to marginal and fragile environments.

A great deal of these communal farmers practice unsustainable soil and crop management activities. Sustainability of food production in southern Africa is mostly threatened by water scarcity and degradation of soil through salinization, water logging, soil erosion and nutrient depletion. Yield reduction has also been aggravated by conventional tillage which results in fertile top soil erosion and the expansion of cropping into unsuitable areas like steep slopes and river banks (Marongwe et al., 2011). In order to increase yields, reduce effects of low rainfall, and thus, conserve moisture through reduced soil disturbance, Zimbabwe communal farmers have been introduced to conservation agriculture (conservation farming), natively called "Ga-Tshompo" under the Pfumvudza Zimbabwean government program. The main principles with this conservation agriculture are (i) minimum mechanical soil disturbance (ii) maintenance of ground cover with organic matter and (iii) diversification of crop species grown in rotation, sequence or association (Marongwe et al., 2011).

This was implemented by non-governmental organisations in Zimbabwe in 2003-2004. This was introduced in order to curb low productivity, and hence improve food security and to address the draught-power shortages. There is increased adoption of conservation farming by communal farmers in Zimbabwe, mostly inspired by inputs-supply, and ready markets for outputs (Marongwe et al., 2011). A number of advantages of practicing conservation farming abound in Zimbabwe, namely; climate change mitigation through increased seed germination and reduced moisture stress; mitigation of land degradation by reduction in soil loss and increased soil carbon content. Farmers have lamented the increased need for weeding and base preparation labour, hence the need to come up with a locally adapted machinery to move from totally manual system (Marongwe et al., 2011).

7. MATERIALS AND METHODS

The study was informed by a documentary review of existing literature based on the preferred reporting items for systematic analyses focusing on a combination of 30 PRISMA-based documents including peer-reviewed journal articles, books, edited book chapters, relevant policy, laws, programmes and implementation strategies related to resource conservation, protected area management, threats and challenges to biodiversity conservation. The Zimbabwe Mines and Mineral Act of 1961 gives more power to mineral prospects than farming and other land-

Table 2. Comparison of improved communal land farming and artisanal gold mining impact on conservation and biodiversity

Variable	Communal Land Farming (Conservation Farming)	Artisanal Mining
Climate change factors	Addressed through increased rainfall use efficiency by employing techniques that increase water infiltration and reduce moisture evaporation from the soil	No climate change factors employed
Mitigation land degradation	Soil loss due to erosion reduced, (5t/ha/year) in mulch ripped conservation agriculture systems.	Increased soil loss
Soil carbon content	Increased soil carbon content	Reduced soil carbon content
Biodiversity	Increased due to intensification rather than extensification	Reduced due to burning of bush and land degradation

uses (Moyo & Chinembiri, 2019). The Act has been on hold on 61 proposed amendments in Parliament since 2015 although there is a headway in the Bill awaiting Presidential Assent that mandates miners to seek the consent of the land owner before prospecting, which is a move towards balancing the two-nature based livelihoods.

8. RESULTS AND DISCUSSION: POSSIBLE RESOLUTIONS TO ARTISANAL MINERS-FARMERS CONFLICT

The conflict between artisanal miners and farmers indicated above can be successfully resolved by using the transformative leadership approach. Involving those who are fuelling the dispute, educating them to better understand both sides, and helping them to identify common ground that will allow both sides to coexist in the same area. It is possible to urge artisanal miners to abide with environmental laws such as controlling chemically contaminated process water so that it does not contaminate natural water sources like wells and rivers used by farmers and their livestock. Additionally, miners can fence and enclose only the active sites if their pegged blocks leaving the idle portions open for usage by local farmers as grazing areas and farming operations. It is possible to appropriate dispute resolution due to its contextual nature, offering routes for resolving disputes through the use of alternative dispute resolution methods. In most cases, state courts or traditional court systems are used to resolve land disputes motivate miners to plant trees after closing the pits they would have left open while mining.

According to the Mines and Minerals Act, miners must obtain the landowner's consent before prospecting on any parcel of land that is smaller than 200 hectares. Such cooperation and understanding will result in a win-win situation

that allow both parties to exist without interfering with each other's business. Alternative Dispute Resolution, often abbreviated as ADR, entails a range of approaches aimed at resolving disputes devoid of confrontation (Shamir, 2016; Afolabi *et al*., 2019; Nwachukwu, 2020). The ADR as an 'alternative' dispute settlement mechanism takes place outside the statutory court system, typically not akin to statutory court procedures (Kumari, 2020). Particularly in light of the complexity of the customary land realm, the state courts are sometimes characterized by exacting and bureaucratic judicial norms and processes that cause delays in the justice delivery process (Crook *et al*., 2011; Oppong-Kusi, 2019). The conventional customary courts, on the other hand, are frequently criticized for their inability to handle the scope and complexity of contemporary property conflicts in the context of waning respect for traditional authorities (Agheyisi, 2019; Kalabamu, 2021).

Alternative Dispute Resolution (ADR) procedures are anticipated to offer a compromise between these two points of view in order to address the shortcomings of both approaches to the settlement of land disputes. Scholars (Kuusaana *et al*., 2013; Aiyedun and Ordor, 2016) argue that ADR mechanisms can help in the decongestion of the statutory courts overwhelmed with land cases, offer a cheaper, faster, and peaceful form of justice for the ordinary citizen, particularly the rural poor. Rural poor often do not have access to the state justice system either because of lack of resources or because of long physical distance to formal courts.

The conflicts between miners and farmers can be resolved through facilitation, a different approach to conflict resolution in which a third party is specially prepared, neutral, impartial, objective, and answers questions from group members to help the group achieve what it has proposed while taking into account the opinions of participants. The alternate approach of conflict resolution known as negotiation involves the parties directly engaging in a discourse to attempt and seek a resolution to their differences. In order to discuss and examine a wide range of issues, negotiation offers a framework that may be used for a variety of goals. By negotiating effectively, you can accomplish your objectives, win the support and participation of others, and create or enhance productive working relationships. In this instance, it has been noticed that conflicts generally result from artisanal mining's negative effects, such as pollution, land degradation, and societal issues, all of which may be discussed and accommodated by both parties. Zoning agreements involving the traditional leadership land use-tenure system could be used to resolve encroachment between these two livelihood strategies to prevent competitive clashes (Corbett, O'Faircheallaigh & Regan, 2017).

9. REDUCING BIODIVERSITY LOSSES

Zimbabwe's southern Matabeleland has historically been a cattle-producing region, with grain farming serving as a major source of income (Moyo, Ncube and Ndlovu, 2022). In response to the increasingly severe impacts of climate change on ecosystem-based livelihoods, diminishing grazing pastures, and rain-fed agriculture, agricultural communities in the same region have turned to artisanal small-scale gold mining (ASM) (Moyo et al., 2022). In what has been referred to as the tragedy of ecological services that unites incongruent livelihood options, ecosystem-based rural livelihoods such as irrigation-based communal farming, rain-fed agriculture, and artisanal mining now share common ground among vulnerable rural populations in drought-prone areas (Ncube, Moyo & Mamhute, 2021; Shackleton, 2020). However, inadequately controlled, ASM frequently encroaches and straddles beyond farming boundaries with detrimental effects on other land-use activities, which is detrimental to food security, sustainable livelihoods and the environment (Moyo et al., 2022; Shackleton, 2020).

Ecosystems known as agro-ecosystems are those in which the makeup of living things has been purposefully chosen by humans for agricultural purposes (MA, 2005). Agro-ecosystems are different from unmanaged ecosystems because they are deliberately changed, and frequently extensively managed, to provide food, fibre, and other products (Kremen and Miles, 2012). Resultantly, they have economic, environmental, and human community components by nature, which makes the maintenance of biodiversity within an agro-ecosystem necessary to ensure the continued supply of goods and services.

Sustainable agriculture has been more popular since the 1987 release of the Brundtland Report. However, the definition of sustainable agriculture is somewhat nebulous, making its application and utilization exceedingly challenging. For human survival and, by extension, for any human activity, an agriculture that can consistently supply food and other resources to an increasing global population is essential (Velten, Leventon, Jager & Newig, 2015; Rivera-Ferre, Ortega-Cerdà, & Baumgärtner, 20131). However, a number of issues, such as climate change, a high rate of biodiversity loss, land degradation due to compaction, erosion, pollution, and salinization, pollution of water resources, rising production costs, a declining number of farms and, consequently, poverty and a decline in the rural population, threaten agriculture's ability to meet human needs both now and in the future (Velten, Leventon, Jager & Newig, 2015; Rivera-Ferre, Ortega-Cerdà, & Baumgärtner, 20131). In addition to facing these challenges, agriculture's current practices during the past few decades have been a major contributor to all of these difficulties (Velten et al., 2015; Rivera-Ferre et al., 2013).

Climate change, energy, water, and land shortages are threatening agriculture production, leading to increased food insecurity and hunger in affected regions, particularly in Africa. Sustainable agriculture, an eco-system approach, is recommended to balance soil, water, plants, environment, and living organisms. Innovative technologies and research should be developed to ensure sustainable agriculture and productivity, while resource conservation and best management practices are used. Sustainable Agricultural Development presents successful experiences in sustainable farming, water and land resource management, and innovative livestock production, promoting resource conservation and tackling food security challenges.

Livestock contributes to nearly a fifth of global greenhouse gas emissions and may suffer from climate change effects. To address this, improved soil quality and resource conservation technologies are needed. However, selective breeding for higher productivity and yield can cause health and welfare stresses. A contraction and convergence model could help develop countries increase sustainable consumption (Behnassi, Shahid & D'silva, 2011).

These views are underscored by Muhie (2022) who suggests agrarian scientists and legislators around the world are irritated by the unsettling rate at which the world's population is growing and the amount of food required to feed this rapidly expanding human population. Scholars contend that today's population is stealing natural resources from the next generation, potentially jeopardizing their access to wholesome food and clean air (Umesha, Manukumar & Chandrasekhar, 2018Müller-Lindenlauf, 2009). The reasons behind this problem are numerous and can be stated, but one must stand out: the inadequate adoption of innovative techniques and strategies for sustainable agriculture. Climate smart agriculture (CSA), organic farming, biodynamic farming, sustainable intensification, and regenerative agriculture are few innovative techniques for adoption. Other cutting-edge sustainable agriculture methods include precision agriculture, integrated nutrient management (INM), integrated farming systems (IFS), and integrated pest management (IPM) (Muhie, 2022; Umesha et al., 2018). Sustainabke agricultural practices include the following:

Agroforestry

Agroforestry, which Mbow, Van Noordwijk, Luedeling, Neufeldt, Minang & Kowero (2014); Lasco, Delfino, Catacutan, Simelton & Wilson (2014) unpack as the practice of growing trees alongside crops to enhance ecological and economic systems and offers benefits like increased soil organic matter, agricultural yields, carbon sequestration, water storage, agrobiodiversity, and farmer income is a sustainable agricultural practice that is recommended. Variables like agroecosystem type, tree phylum, and management practices impact carbon sequestration (Mbow et al., 2014;

Lasco et al., 2014). Agroforestry is cost-effective and climate-smart, especially in drought conditions, as trees search for nutrients and water (Paul, Weber & Knoke, 2017; Zomer, Neufeldt, Xu, Ahrends, Bossio, Trabucco & Wang, 2016).

Another sustainable agricultural practice is the *Mixed Cropping* is an indigenous farming method that diversifies food supply, reduces risk of decline, pests, and illness, and promotes biodiversity preservation, thereby reducing global warming and promoting sustainable food production (Singh, 2023; Fraser, Frausin & Jarvis, 2015).

Crop Rotation

The other sustainable agricultural practice is *Crop Rotation* is a traditional method of growing plant species in succession on the same land, aiming to address agroecological issues like soil degradation and global warming caused by short rotation and mono-cropping. It is effective in sequestering carbon and reducing greenhouse gas emissions. Crop rotation alters soil structure, organic carbon concentration, nutrient cycling, and disease presence, improving crop health and production.

Cover Cropping

Additional to the above, there is *Cover Cropping,* which is a sustainable method for improving soil health, agroecosystem, and microbial biomass (Singh, 2023; Cooper, Hama-Aziz, Hiscock, Lovett, Dugdale, Sünnenberg & Hovesen, 2017). It involves growing non-cash crops to prevent soil erosion and nutrient loss while cover crops can be non-leguminous or leguminous, and can be grown alongside primary crops to provide living mulch (Cooper et al., 2017). Popular cover crop species include sun hemp, sorghum, velvet bean, rye, oat, pea, vetch, and clover (Cooper et al., 2017).

Intercropping

Sustainable agriculture also includes *Intercropping*, or growing multiple crop species simultaneously on the same area, is a useful application of fundamental ecological concepts like diversity, rivalry, and simplification. It is one of the farming methods that is very productive. Since various crops have varying degrees of climatic adaptability, intercropping decreases climate-driven crop failure. Intercrops improve the biodiversity, productivity, resilience, and stability of an agroecosystem by effectively using natural resources like soil, light, water, and nutrients (Ning, Qu, He, Yang, Chen, Luo & Cai, 2017). Intercropping grains and legumes improves the efficiency of cultivation in nutrient-restricted environments. Legumes collaborate symbiotically with rhizobium microbes to fix nitrogen in the soil. Leguminous crops decrease N2O emissions from agricultural regions while also increasing the release

and recycling of mineralizable nitrogen-containing compounds in soil (Singh, 2023; Scalise, Pappa, Gelsomino & Rees, 2017).

Integrated Crop-Animal Farming

Integrated Crop-Animal Farming is one of the many sustainable agricultural practices smallholder producers in Asia use, which benefits agrobiodiversity, food diversity, and land resource management. Rice-fish culture is a crucial farming technique that enhances food production's sustainability, intensification, output, and profitability. Fish and ducks consume weeds, plant hoppers, and insects, reducing the need for chemical fertilizers in conventional rice cultivation.

Soil Carbon Sequestration

Soil carbon sequestration, also known as carbon farming or regenerative agriculture, involves caring for land to increase soil carbon storage and absorption. This climatologically renewable resource is crucial for soil functionality and ecosystem services. Improving this resource involves positive eco-system and soil carbon expenditure.

10. LIMITATIONS OF THE STUDY

The study was limited only to secondary data reviewed from the preferred reporting items for systematic review and meta-analysis conducted. It did not involve primary data, which could have generated new insights and location specific context, hence the findings represent findings and sentiments obtained from secondary empirical studies reviewed.

11. FURTHER STUDY

Deriving from the limitation of the chapter, future studies may need to focus on a given geographic location to conduct a similar study that is informed by primary data collection to test the application of artisanal mining-farming conflict theory explained by Kamncube's SPCR **4Δs Conflict Model** and how the alternative dispute resolution could best address the biodiversity and land-use conflicts to attain sustainability of the livelihood strategies.

12. CONCLUSION

The intertwined nature-based livelihood strategies of artisanal mining and communal farming stand to be more effective operating as harmonised and synergised than stand-alone strategies due to the rampaging effects of climate change on environmental change. While biodiversity presents with good opportunities for both agricultural and mining activities, the ecosystem services driving from the same biodiversity has often generated conflicting outcomes pitting artisanal miners and local communal farming villagers. Current land-use conflicts can and should be resolved by deploying alternative dispute resolution mechanism (ADR) that would effectively conduct zoning of each land-use. This is possible through the involvement of the Traditional Leaders in collaboration with local districts offices in each area such that there is avoidance of itinerancy and maintenance of orderly activities, farming and mining alike by known and traceable locals or the use of a local permit system that allows one to conduct mining responsibly through traditional and legal policies as a collaborative framework.

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