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Review

Linking Land Tenure and Integrated Watershed Management—A Review

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Abstract: Land tenure is given attention in the general discussions on conservation and management of natural resources, but the necessary holistic approach to understand the linkages is less considered. Thus, we considered a watershed as a unit of reference and Integrated Watershed Management as a holistic land and water resources management approach with various roles and touchpoints with land tenure issues. To examine the role of land tenure on the management of natural resources in watersheds, we reviewed and compiled literature that captures watershed issues, integrating aspects of land tenure, and aiming to identify the key land tenure roles, dynamics, and its influences on integrated watershed management. Land tenure is observed playing various roles in watersheds and, thus, also on integrated watershed management as an approach—as a driver of change, influence for investment decisions, an incentive for adoption of practices, and leading to sustainability. Land tenure dynamics range from land tenure security, land tenure forms, land access and acquisition modalities, and how these aspects of land tenure relate with integrated watershed management.

Keywords: land resources; conservation; holistic approach

1. Introduction

The United Nations Agenda 21 for sustainable development recommends the integrated management of land resources. The agenda broadly includes soils, minerals, water, and biota in subsection 10, while subsection 13 acknowledges mountain watersheds protection [1]. The recommendation enhances the watershed approach from the initial focus on forestry and forestry hydrology to include the complex actions, resources, and stakeholders in a proposed hydrological system area [2]. Consequently, applying the watershed approach for land resources management uses the watershed as a spatial unit of analysis and as an evolving practice for the management of land, water, biota, humans, and other resources in a defined area for ecological, social, and economic purposes [3].

Land resources immensely promote rural livelihoods, especially in developing countries. In Africa, an estimated 70% of the population directly depends on the land and natural resources for food security and sustainable development [4]. The relationship, whether legally or customarily defined, among people, as individuals or groups, concerning land refers to land tenure. Therefore, as a determinant of ownership, use, influence, and decision making, land tenure is a key factor in resources management and resource degradation [5]. Land tenure significance is also demonstrated by research exploring household land-use decisions at micro-levels that indicate the need for physical capital to span economic growth and land governance systems [6]. Land uses can both harm or enhance the environment as determined by existing rules of land acquisition and access [5]. Possible land ownership insecurity issues frequently lead to poor use of resources because it influences practices, abilities, and choices in line with adoption, sustainability, effectiveness, and efficiency among others [5]. In this way, land tenure insecurity also affects the effectivity of integrated watershed management [7].

Multiple empirical studies available about land tenure and resources management in watersheds, mostly focus on fragmented research problems, watershed components, geographical locations and methodologies. In this review paper, we compile information related to land tenure and resources management in the watershed in a multi-perspective approach. The focus of the review is on (a) to examine the role of land tenure in integrated watershed management, (b) to identify key land tenure dynamics (issues), and (c) to identify areas for further research about land tenure and integrated watershed management.

1.1. Integrated Watershed Management Concept

The approach of integrated watershed management has evolved in terms of definition, scope, and application in water and land resources management since at least 200 BC and gained increasing attention in the late 20th century [3,8–10]. Integrated watershed management is defined as the process of formulating and implementing a course of action involving natural and human resources in a drainage basin, taking into account the social, political, economic, and institutional factors operating within the drainage basin, the superordinate river basin, and other relevant regions to achieve specific social objectives [11]. Because land resources and other resources systems interconnect in a drainage basin, the need for joint actions and responses between the various stakeholders through integrated management is emphasized [12]. The linkages between upstream, midstream and downstream drainage basin areas fulfil the idea of trans-media environmental management, using the "ecosystem" as the concept, born out of the experience that single–medium or sectoral management was less successful [13]. Applying the holistic approach of integrated watershed management enables different actors to protect and restore the physical, chemical, and biological integrity of ecosystems and human health and to preserve the base for sustainable economic growth [14]. Watershed interventions include land use planning; controlling erosion and sedimentation potential; managing streamflow patterns; ensuring soil, water, and forest conservation; and enhancing food production, security, and livelihoods [15]. The indicators relating to the quality and quantity of water resources, land cover, ecosystem health, legislations, livelihood improvement, knowledge generation, and research apply when measuring the effectiveness of integrated watershed management and interventions. [3,13].

1.2. Land Tenure Concept

Land tenure is normally categorized into four different types [16]:

- Nationalized tenure, where the state has full ownership rights;
- Freehold tenure, where individuals envisage absolute rights;
- Leasehold tenure, where land is held based on contract or agreement for a specific time;
- Customary tenure, with land administered through and by indigenous customs.

The different land tenure systems and formations occur globally due to historical and social controlled parameters including legislation, cultural traditions, global trends, political situations, and social classes [16]. In Sub-Saharan Africa for example, next to freehold; leasehold; state, public, and cases of crown land; land tenure systems; and arrangements, customary and native land tenure systems predominate [4,16]. Customary land tenure is found to differ in the degree of individualization (the extent of rights held by families as opposed to the state or communal authorities), exclusivity, and property inheritance patterns [17,18].

Land tenure is argued to be a derivative of the concept of natural resources tenure, though "tenure" is largely a social construct [4,19]. Tenure is a possible instrument for conservation since tenure defines the relationships and rules between people, land, and related resources. The rules define property rights of use, transfer, and control through statutory or non-statutory laws [16].

2. Role of Land Tenure in Integrated Watershed Management

Land tenure plays various roles in watersheds and related management, including

- Land tenure as a driver of land use and land cover changes but also subsequently affecting hydrological, climatological, geomorphological, infrastructural, and developmental changes in watersheds [17,18,20–26];
- Land tenure as an influencer of (human) actions and decisions [8,27–31]
- Land tenure as a determinant for land use, plans, and arrangements [17,21,22,24,32,33];
- Land tenure as a tool for controlling access, ownership, and disposal of land resources [5–7,16,21];
- Land tenure as a basis for other resources tenures such as forest and tree tenures [32,34–37].

Land tenure drives land-use and land-cover change in watersheds. Pieces of evidence recorded include the changes in vegetation cover and the spatial distribution of species measured against population, land tenure, and climatic factors pointing to the effects of long-term human activities, with differences in land management practices that vary with land-tenure systems as the main controlling factor [20]. Land tenure is also cited in land cover conversions and changes as a means by which people and companies acquire and own land informally, strengthen tenure security, and alternate land use, as observed in the Mara River basin in East Africa [21]. Land tenure underlies some of the gradual land use and covers change processes by farmers converting forests to areas first used for annual crops and thereafter used for perennial crops [32].

Land tenure–driven land cover changes manifest variably, responding to spatial diversity and patterns according to a study done in Oregon state watersheds in the US. These patterns exhibited by distinguishable forest cover corresponded to the diverse state, federal, and private land ownership types, where private lands carried few forests and low forest diversity [22,33]. Tenure diversity is also observed in customary land tenure systems, resulting in varying effects on watersheds and management practices such as tree cover and community tree management according to case studies from Uganda and Malawi [17] and riparian vegetation and stream bank erosion according to a case study in South Africa [20].

The effects of land tenure on land-use changes in drainage basins have globally resulted in hydrological changes and increased soil erosion risks [25,26]. At a local watershed scale, soil erosion costs can be economically estimated, as a case study from Malawi shows, indicating 20% maize yield loss and 8% long-term soil productivity loss [38]. Consolidating land tenure mitigates some economic losses and costs due to land degradation [39]. Soil erosion risks and patterns have been linked to land use and related land tenure practices such as land fragmentation, especially in agrarian communities. A case study from Nicaragua documents increased soil erosion rates at farming units of less than four hectares in size, characterized by high land-use intensity and land fragmentation among smallholders [18]. Land fragmentation mostly results from land-use policies and reforms that promote individualization rather than communal land ownership arrangements, as observed in Cambodia [24]. Other risks associated with land fragmentation include the intensive use of land resources, increased costs of extension services to individuals, the complexity of large scale planning, and land use and land cover patchiness [18,24,40]. Despite the likely negative outcomes from land fragmentation, arguments to support fragmented and mixed land tenure systems advance the likely benefits of land fragmentation to an ecosystem and biodiversity in landscapes [33].

The role of land tenure is both indirect and complementary to other factors driving changes in watersheds. These factors, for instance, include demographic factors (population, gender, migration, employment), agricultural expansion, infrastructural development, climate conditions, and watershed resources management approaches [17,20–23]. For instance, gender, marriage, and migration differently influence environmental actions under matrilocal and patrilocal land ownership and inheritance systems among the Chewa and Yao community in Malawi. The Yao patrilocal communities were less affected by migration, norm changes and less destructive environmental practices than the Chewa matrilocal communities [17]. Unemployment among the local population results in unsustainable watershed use and livelihood options like fuelwood trading. Poverty and unemployment persisted with the lack of land or possession of small plots of land in some Zambian communities. Therefore, there is a link between unemployment, unsustainable livelihood options, and land ownership. The smaller the piece of land owned, the higher the probability that the smallholder and his family participate in fuelwood collection and marketing and, thus, trigger local deforestation as pointed out in a case study from Zambia [41].

Adequate knowledge about watershed issues and the capacity of resource users contribute to effective participation and decision making in watershed management [27,28,42,43]. However, a study conducted in the Philippines indicates land tenure arrangements rather than inadequate knowledge constrained farmers' engagement in soil erosion management [29]. Land tenure, therefore, also plays a complementary role in functionalizing community capacity and other resources use. Considering land tenure while practicing integrated watershed management is imperative because beneficiaries might be operating in a land tenure system that restricts their decision-making capacity and participation. Thus, in the past watershed planners frequently fixated on the infrastructural, economic and biophysical attributes of integrated watershed management while neglecting land tenure social elements risked-limiting local participation [34].

Integrated watershed management includes natural and societal components of human resource development, water and soil use, and the promotion of wise resource use with each type of land use in a drainage basin as competing interests [44]. However, several factors influence the effective integration, promotion and adoption of wise use practices, including land tenure [7,30,31,45]. Some communities have complex land tenure systems, characterized by both formal and informal rights on shared resources and fragmented land resources governance. In such cases, discrepancies exist between the "would-be right" technical solutions and socially or legally accepted interventions on various lands [7].

Globally, watersheds currently experience increased land and water demand for agricultural expansion and other uses [21,40,46]. Agricultural water use alone is estimated at 70% globally and 95% in developing countries and is expected to increase because of an increasing number of irrigation projects [46]. Large scale agricultural investments, and especially agricultural irrigation projects planning and design are rarely void of land tenure issues arising from access, people displacement and resettlement repeatedly [47]. Increased resources demand and competing interests in watersheds led to the need for incentive-based models in resources use. Incentive-based approaches, including Reducing Emissions from Deforestation and Degradation (REDD+) and other Payment for Ecosystem Services (PES), aim mainly at protecting and promoting sustainable use of shared natural goods and ecosystems services while engaging relevant stakeholders in beneficial partnerships [36,37]. These approaches slightly engage in defining resource use relationships, benefits, obligations, and property rights of forestry or tree tenures, use of water, carbon, mineral credits, and permits [35–37]. Thus, the requirement to understand prevailing property rights and land tenure as a prerequisite to participation in incentive-based projects. One of the aims is to avoid potential limitations from state incompetence, conflicts from competing and overlapping interests from indigenous dwellers and other users, land-tree tenure, and carbon rights [35,37].

3. Land Tenure Dynamics in Integrated Watershed Management

The term dynamics denotes a discourse marked with assertions, suppositions, questions, and sequences of statements in importance [48]. However, land tenure studies have interpreted dynamics in the direction of changes. For instance, the demonstration that land tenure in Africa evolved along with socio-economic and technological changes, and overtime getting simplified and individualized rights [49], and the account of land tenure changes in East Africa [50]. We employ both interpretations of dynamics as a change and as a discourse to offer a holistic discussion of key land tenure dynamics in the context of integrated watershed management. We categorized three key land tenure dynamics discussed in the following section.

3.1. Land Succession and Gender Dynamics

Land ownership changes with time, thus requiring a lifelong ritual of inter-generational access and acquisition through succession and inheriting for instance. Evidence from the literature indicates a positive association between secure land ownership with a succession plan and an emphasis on conservation because the reasons for ensuring environmental quality include the assured possibility of future productivity [34].

The land succession discourse includes a focus on gender disparities, where women and other marginalized groups miss out or rather access land rights mainly through their male kin [5,16,51]. Concerning gender and sustainable land-use practice decisions, studies have examined whether the gender of the head of the family influences pro-conservation land-use decisions [38]. One such case study from Malawi indicates that male decision makers are more likely to invest in soil conservation measures than the female decision makers in a patriarchal inheritance system. This finding did not hold for female decision makers in a matriarchy inheritance system; however, male decision makers preferred to invest in soil conservation measures in that second case [38].

3.2. Land Tenure System Dynamics

Land tenure systems, forms and classes refer to categorizations of land tenure practices, defined bundles of rights and means of administration (see Section 1.2), held by the state, other public institutions, and private entities or individuals. Public land tenures such as protected natural resources reserves show more land management and conservation results, biodiversity, species richness, land cover, and a conservation dividend than on private land tenures. Possible reasons for the variability include the land management and incentive measures that occur on the various land tenure arrangements [52,53]. Effects of differentiated resource management models captured in a case study on community tree cover on *Mailo* land tenure, a semi-customary land tenure system in central Uganda characterized by land custodianship because of absentee landlords and land squatters, crown landownership, and individual *Mailo* landowners [17]. Tree cover observed among resident *Mailo* owners was higher than on absentee *Mailo* owners land with squatters and on public lands including the commons. Additionally, possible reasons for the tree cover difference included the highly individualized rights among *Mailo* landowners for long-term land and trees conservation investments compared to public land [17].

While studies associate higher losses of watershed resources like forests with private land ownerships [35,54], the contribution of private lands to landscape biodiversity and conservation is reported [52]. Private land ownership contribution to landscape biodiversity value suggests the need to integrate into national conservation frameworks, especially in the developing countries where degradation on both state and private land tenure systems is high [49,55]. However, in Ethiopia, government-financed watershed programs targeting private land for adoption and scale-up of soil and water conservation techniques document the potential challenges that result from mixing public interests and private land ownership. Observed challenges of integrating privately owned land for public resources conservation practices include limited adoption and scale-up possibly due to community members' unwillingness to invest private finances into shared resources conservation work, and costly technologies [56]. The example from Ethiopian is not isolated, other programs about public and private sustainable development financing have encountered related challenges with land tenure systems [57–60].

3.3. Land Tenure Security Dynamics

Land tenure security refers to the assurance that land-based property rights remain upheld by society or institutions. The rights may be held by individuals, governments, groups or communities [16,35]. Land tenure security characteristics include full land ownership rights, predictable and long-term occupancy, and proof of ownership. Land tenure insecurity relates to short term land tenancy contracts, unpredictable occupancy periods, unprotected or defined rights and lack of ownership evidence. Land tenure security, however, is also likely perceptional, attainable formally and informally, with the possibility of status change [16,32,49]. While land tenure security or insecurity is a status, either situation is possibly a result of social and economic processes and changes. Informally initiated land tenure security processes include the case of farmers converting natural forests to croplands and subsequently claiming ownership of the land [21]; farmers investing in long-term watershed measures like tree planting to mark ownership, boundaries, and secure the land [61]; and other processes of formal institutional measures like obtaining formal land documents such as land titles [55,62,63]. Land tenure reform processes in various African countries, for instance, have formalized land tenure systems and land tenure titling as a means to centrally secure land [49]. A study comparing the land tenure security situation among formal and informal land tenure systems landholders in the Prasea watershed in Thailand found cases where both formal and informal land tenure holders were reportedly secure. The confidence exhibited in either formal and informal land ownership security by the Prasea watershed communities was attributed to the likelihood of land tenure homogeneousness and occupation by indigenous owners with given land rights even without formal registration and land titles [32]. Still, land tenure security motivates most transitions from traditional undocumented to documented land tenure systems [35,64].

Land tenure security may have both positive and negative effects on watershed use and watershed management. The literature focusing on forestry protection mainly associates protected areas as a form of land tenure with positive conservation outcomes. In addition to the presumed land tenure security through protected areas, land tenure security is also associated with less deforestation regardless of land tenure form, accounting of potential variations in assessment approach, location, and other factors [64]. Land tenure security contributes to land conservation through influencing soil and water conservation actions in watersheds by enhancing household willingness to invest in high-cost and long-term conservation practices like stone bunds, as documented in a case study from Ethiopia [56]. Land tenure security additionally enhances the intensity of investments into watershed protection measures and the likelihood of the adoption of good watershed use practices compared to village institutions, market access, and population density development domains, as shown in a case study from Kenya [65].

Land titling is one of the mechanisms sought for land tenure security. Advocates of land titling argue that it spells out land rights, builds confidence into long-term conservation-friendly investment benefits, and the ability to exclude destructive users or competition [16,32,49,63,66]. Therefore, land titling is claimed to protect indigenous communities' forests in the Peruvian Amazon [63], a finding that is appreciated, but we must be cautious not to extrapolate without rigorous location and methodological consideration [67,68]. A case study from Ecuador comparing titled and untitled land tenure types impact on forestry and forest cover changes noted the statistically indistinguishable and insignificant impact of land titling to slow down the negative trends of deforestation [62].

Land tenure security exhibits time and space dynamics in watersheds as observed around Mount Elgon watershed in Uganda, where land tenure security varied spatially among communities [35]. Communities close to the Mount Elgon National Park and natural protected reserves reported very limited land rights of transferability, exclusivity, enforceability and alienability compared to those distant from the protected areas who claimed to be land tenure secure [69]. As a result, adoption of watershed conservation techniques was poor in the land insecure communities, while in contrast predominantly land secure communities invested in long-term soil conservation measures [69].

The temporal aspect of land tenure security is reflected by changing practices and rights with time. These changes largely relate to social changes including gender perspectives or tenure reforms that form land tenure systems and ownership modalities. In the US, "full landowners" adopted conservation tillage practices more frequently than other "cash renters" and "share renters," documenting the immediate effect of the different land rights on land conservation behavior [70]. Land leaseholders hold land rights for a defined time [70]. A related case about land tenure systems and investment decisions in sustainable agricultural practices in Pakistan shows "full" landowners investing more into soil improvement measures than "lease contract" land ownership holders [71]. In contrast, findings from another study conducted in Iowa, USA show that land "leaseholders" were more likely to practice conservation tillage than "full landowners," indicating possible behavioral changes with time [72]. A case study from Ghana relates land tenure forms with productivity considering technical efficiency and effectiveness in the rice industry: rice production on "owned" land reduced productivity inefficiencies and thus, higher technical efficiency than on "rented" and "shared cropping with fixed rent" land [73].

To a large extent, recent research demonstrates a positive link between land tenure security and general land management improvement, consideration of long-term investments, land rights optimization, and improvement in socio-economic outcomes given the reduced uncertainty. Nevertheless, cases of land tenure security resulting in externalities and unpredictable effects on sustainable land management exist [61,74]. In case studies from Vietnam and Thailand, evidence shows long-term conservation investments occurring in land tenure insecure areas, though going along with the hope of attaining tenure security from the investments [61]. A related scenario in Ghana shows farmers who neither felt land tenure insecure nor fully participated in the conservation activities of forestry plantations [74]. Therefore, assessing the relationship between land tenure security and land conservation requires a multi-directional view while considering the value of alternative land uses. [55,61,74]. The land tenure security discourse includes probing the dependence of individuals and institutions on land titling as a mechanism to guarantee tenure security and facilitate good-land-use decisions. The probing connects with institutional limitations, resource competition, rent markets, tenure system reforms, customary gender-biased inheritance systems and modern land resources management approaches and governance issues. [38,67].

4. Conclusions

Integrated watershed management puts the "human–land–water" resources interactions in a central position, making the need to characterize the related land resources rights of land tenure significant. The approach ensures a coordinated process approach of managing all resources and interests in a drainage basin for socio-economic and environmental purposes. We, therefore, reviewed the available literature on land tenure and natural resource management in watersheds, integrating case studies from around the world, which are mostly focusing on developing countries. On this basis, we demonstrated the role of land tenure in watersheds and on the implementation of integrated watershed management, identifying and linking the key land tenure dynamics to offer a holistic view. We observe that empirical studies about land tenure and natural resources conservation issues are repeatedly component of studies, independent from the disciplinary focus of the review. However, a dependency between the diverse role of land tenure and land tenure dynamics in watersheds can be observed. Land tenure is mainly an indirect factor driving land management behavior. The watershed changes including land cover and land use changes result mainly from the need to own land, land ownership insecurity, land fragmentation, and land-use practices. We also point out how the different land tenure systems affect the physical, ecological, and socio-economic situation of a watershed and the possible differences in resources, biodiversity, species distribution and soil loss spatial distribution patterns, legislative, institutional, and resources management aspects of integrated watershed management. Prevailing land tenure conditions enhance integrated watershed management objectives through influencing resource users' decisions to participate, adopt and invest in conservation practices. Land tenure conclusively plays a significant role in planning the management of a watershed and conducting watershed management; however, awareness of other surrounding physical and ecological conditions, population parameters, cultures, and administrative practices factors is indispensable.

We further point out that land tenure security is positively considered for sustainable watershed practices and that land tenure insecurity is frequently associated with poor adoption of acceptable watershed protection measures and the eventual soil and land cover losses.

Concerns recorded include the possible negative impact of land tenure security, land fragmentation, and individualization of land rights in protecting natural capital, especially where shared ecosystems and resources occur and conflict with socio-economic interests [64]. The literature reviewed sufficiently informs certain decisions about natural resources management in watersheds and demonstrates the varied linkages of land tenure and integrated watershed management. However, it lacks the full capacity to inform the holistic principle of integrated watershed management approaches that can enable a direct measure and conclusion on the level of significance of the identified roles. Thus, more research is necessary. Additional questions for further research surround the understanding of watershed management changes along the historical continuum of land reforms and other major factors such as wars, land tenure insecurity and instabilities, new policies, technologies and climate change. Therefore, acknowledging the significant and dynamic role of land tenure in integrated watershed management requires continuous research.

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