

Reverting woodlots to crop fields in the Southern Highlands of Tanzania

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Abstract

For some decades, woodlots have been a salient feature of the agricultural landscapes of Mount Rungwe and Uporoto Highlands in the Southern Highlands of Tanzania. Their proliferation amidst socioeconomic conditions and innovation in farming practices influence production choices, and consequently, land use changes. Recently, farmers are reverting prevailing woodlots into crop fields, particularly, Irish potatoes. We investigate this process in order to examine the determinants of the reversion and the implications to agricultural development and people's livelihoods. The findings come from a survey of smallholders of woodlots in four villages around Mount Rungwe and Uporoto Highlands. Data were collected through structured and in-depth interviews, discussions with focused groups at village levels, review of documents and direct field observation. Time lag for woodlots, safeguarding households' food security, lack of agricultural support services, high rental market, and emergence of other fruit trees are determinants of the reversion. The reversion has implications for farmers' decreased access to reliable source of fuelwood as well as opportunity for livelihood diversification.

Keywords: woodlots, reversion, crop production, determinants, livelihood diversification, Tanzania

Introduction

In developing countries, planted woodlots have increased (Kimambo, et al., 2020; Ahimbisibwe et al., 2019; Miller, et al., 2016; Msalilwa, et al., 2016). Miller et al. (2016), report that a third of smallholders in five sub-Saharan Africa countries nurture woodlots on their land. Similarly, Lurasi et al. (2019) indicate an increase in woodlots on private farmland in Tanzania, as part of the rush for timber. Kimambo et al. (2020) note an increase in woodlots in the Southern Highlands of Tanzania between 2012 and 2015. Furthermore, Jumanne (2022), Tilumanywa (2022), and Kalinga et al. (2019, 2021) reveal an increase in areas planted with woodlots. The reported increase in woodlots farming is an indication that smallholders have been diversifying their agricultural produce to woodlots.

Woodlots are known for supporting livelihoods of the local communities, for example, by providing fuelwood, food and medicinal products (Ali et al. 2020), reducing distance travelled in search of firewood (Tilumanywa, 2022); reducing pressure on natural forests (Lokina, 2020);

and enhancing forest regeneration (Kimambo & Naughton-Javes, 2019). Woodlots play a vital role as safety nets to increase the resilience of the poor to major disasters and climate change (Mbow et al., 2014; Soka & Ritchie, 2016). Compared to other agricultural systems, woodlots are more diverse and create more stability (Wunder et al., 2018; de Leeuw et al., 2014) by creating diversified livelihoods. Ellis (2000) indicates that smallholders often face a number of household's demands that must be satisfied via a complex set of livelihood strategies including farm diversification. A study in Kitelewasi and Kasanga villages notes that smallholders are diversifying away from maize towards exotic timber and horticulture (Anderson, 2022).

In the Mount Rungwe and Uporoto Highlands, areas that are suitable for food production are also suitable for woodlots (Jumane, 2022; Sokoni & Tilumanywa, 2021). Studies have indicated that from the 1970s to the 2010s woodlots replaced crop fields in these areas (Sokoni & Tilumanywa, 2021 P. 304). Our frequent visits and observations in early 2020s in these areas indicate that some of the smallholders are reverting woodlots into crop fields. Crop fields replacing woodlots reflect a substantial change in land use that may have socioeconomic and environmental implications. While the reversion is taking place, scholarly insights on the determinants and implications of this shift are scanty.

It is important to understand this land use transition as the reverse might have implications on conservation of forests, provision of wood products, agricultural and non-farm occupations. This paper examines the determinants and implications of reversion from woodlots to crop fields, paying particular attention to livelihood dynamics and agricultural productivity. This analytical research seeks to explain the reasons why some smallholders are currently removing woodlots despite the fact that at one point in time they replaced food crops with woodlots. The paper contributes to knowledge on the determinants of the ongoing conversion, and is arranged into five sections: introduction, followed by the theoretical approach, a description of the study context and research methods, results and discussion, and then a conclusion.

Theoretical approach

Smallholder farmers are viewed as consumers and producers of knowledge and information: producers and consumers of agricultural goods and services, and as bridging institutions between various components, and as value chain actors (Spielman & Birner, 2008). Smallholder farmers are agents of change who often encounter complex and difficult decisions at a production level. Smallholder farmers as enterprises, have their own reference point, insights and interests for developing their farms. Due to the influence of market demands and emerging technologies that provide room for varying positions, different dynamics in agricultural development emerge. In the study area, there are favourable conditions for agricultural production, while potentials for agricultural extensification are limited (Kalinga et al., 2019, 2021; Tilumanywa, 2022). Likewise, food crops such as Irish potatoes are commercialised, fast growing and lucrative (Ponte, 1998; Bakari, 2015; Tilumanywa, 2022). Woodlots also emerge as a source of income and improved livelihoods (Tilumanywa, 2022), which make farming as social construction more dynamic.

While woodlots are beneficial, they take long time to realize their benefits compared to annual crops. Franzel (1999) point out that there are few incentives for smallholders to incorporate woodlots into their farming systems as there is a long-time lag between planting and harvesting, while poor farmers are often liquidity constrained with a high discount rate. Although woodlots pay in future, they hold land for a long time hence farmers ought to make a decision on either optimizing the available space for fast crops or invest in long term returns. In each case, there is a choice of an action, and that some choices exclude others. Different theories explain smallholder farmers' decision with regard to land uses. In fact, there is no single theory to explain decisions of smallholders in relation to household production choices (Umar, 2013).

This paper draws on Land Use Transition Theory in order to understand the determinants of reverting woodlots into crop fields. The theory focuses on how and why land use changes occur over time in a given geographical area. It suggests that land use transitions are influenced by a combination of socioeconomic, environmental, and institutional factors operating at multiple scales. This theory advocates that land use transitions, such as the conversion of woodlots to crop fields, are not isolated events but rather part of broader processes of socio-economic development and innovation in farming. That means the decision to revert woodlots to crop fields is influenced by different factors, including changes in market demand for agricultural products, shifts in land tenure systems, technological advancements in farming practices, and demographic trends affecting rural communities. These interplay factors, singly or in combination, influence production choices and consequently, land use shifts. Land Use Transition theory is also relevant as it helps in exploring the status of rural transformation.

Spielman and Birner (2008) see smallholders' farmers as key players embedded in different situations in which a farmer is influenced not only for his decision and actions, but also of the other external players. Kirsten et al. (2012) note that growing population, urbanization and global interconnectedness, influence agricultural transformation by shifting production practices from long-term production towards fast cash crops demanded by the growing population. There is a growing body of literature explaining the transitions in land use through the lens of the different transitional processes and mechanisms (Lu et al., 2022; Long, 2022; Zhu et al., 2020; Ge et al., 2018).

Collectively, these studies shed light on the human-land relations in rural areas, and the understanding on how land use transitions are growing in importance. Land use shifts, however, are context specific. Given the multifaceted factors and implications of the reversion, it is important for building our understanding of this change for providing invaluable insights of the shifts taking place in the Mount Rungwe and Uporoto Highlands. Such understanding is important as it will ensure increased productivity and sustainability of woodlots in the area. This knowledge is also crucial for informed decision-making for sustainable land management and rural development strategies.

Study context and research methods

The emergence of woodlots growing in the study areas has been widely acknowledged (Jumane, 2022; Tilumanywa, 2022; Kalinga et al., 2021). In these areas, non-native woodlots are planted in a monoculture system on private agricultural land for timber and firewood. The

most common trees are pines (*Pinus patula*) and eucalyptus (*Eucalyptus maidenii*). Woodlots are often less than five acres in size. The increasing prominence of woodlots is praised for its contribution to the conservation by reducing pressure on natural forests, as a source of income and a means for poverty reduction. These areas, however, have high population density such that land for further agricultural expansion is limited (Sokoni & Tilumanywa, 2021). This means further increase of woodlots intensifies competition for land resources with crops production. In addition, agricultural development and innovations in these areas have led to adoption of improved varieties of food crops especially Irish potatoes whose cultivation has intensified (Bakari, 2015; Tilumanywa, 2022). There have recently been observations of deliberate reversion of woodlots into crop fields on Mount Rungwe and Uporoto Highlands. This phenomenon presents dynamics in both natural and agricultural ecosystems of the study areas. Examining the determinants influencing this process of reverting woodlots into crop fields is fundamental for developing better agricultural strategies.

We carried out household surveys in four villages, namely Idweli and Kabale on Mount Rungwe, Galijembe and Igoma on Uporoto Highlands (Figure 1). The selection of these villages considered the extent of woodlots planting and the observed deliberate removal of the woodlots. The selection of the villages was also informed by our discussion with informants at district and ward levels during reconnaissance.

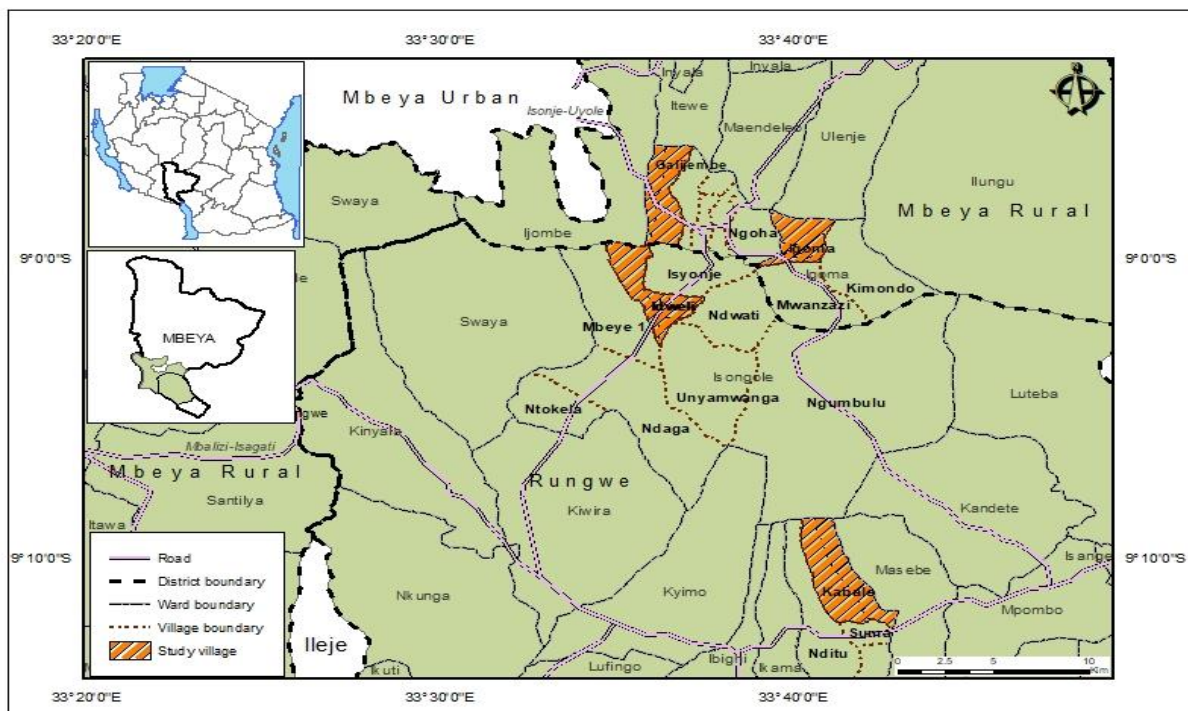


Figure 1: Location of the study villages

Source: Cartographic Unit, Geography Department-UDSM (2023)

In each of the selected villages, one focus group discussion comprised tree growers, farmers without woodlots and farmers who had cleared woodlots was conducted. In-depth interviews with key informants, including forest officers, agricultural extension officers, and ward and village executive officers, direct field observation and review of documents were conducted.

A sample of 166 smallholder farmers with woodlots provided information through completion of a questionnaire. Of the 166 respondents, 72 planted only pine trees, 21 grew eucalyptus only, 56 planted both pines and eucalyptus while only five planted avocado trees, and the remaining three planted other tree species. This suggests an apparent domination of pine trees in the woodlots on Mount Rungwe and Uporoto Highlands.

The dominance of pines in the study villages is fourfold: the influence of Kiwira Forest that provided free tree seedlings, ready markets and its marketability, rapid growth and quick returns compared to eucalyptus. Eucalyptus which is mainly for firewood, seems to be grown in response to urban demand for firewood from the nearby fast-growing city of Mbeya. Based on the household survey, there seems to be a general understanding among tree growers that conversion of farmland into woodlots was not a well thought decision. This is confirmed by the results from the household survey which show that 96 (59%) of woodlots growers were not in favour of encouraging woodlots on agricultural land. Similarly, out of the 166 woodlots growers, 130 were not intending to continue growing woodlots after harvesting prevailing woodlots. Likewise, 127 respondents indicated that the demand for tree seedlings in their villages is decreasing. Furthermore, informants revealed an emerging practice of removal of premature woodlots and instead planting Irish potatoes and other quick crops such as cabbage, carrot and beans.

Determinants of the reversion from woodlots to crop fields

The household survey probed on the determinants of the reversion from woodlots to crop fields. A number of determinants were revealed. These include time lag for woodlots and associated fluctuation of prices for wood products, technological advancement and market demand, safeguarding household food security, inadequate support services, emergence of high rental market and emergence of other profitable tree crops.

Time lag for woodlots and associated fluctuation of prices

The long time it takes to realize income from woodlots is one of the most crucial determinants for the reversion that was cited by 43 per cent of the heads of households surveyed. It takes about 10-18 years for the planted pines (*Pinus patula*) and eucalyptus (*Eucalyptus maidenii*) to mature and therefore for the smallholder to realise returns on investment. The majority of the smallholders are planting these woodlots for timber, poles and firewood. According to the URT (2021), woodlots for pulpwood, the optimal age for harvesting ranges from seven years (*Eucalyptus sp.*) to 11 years (*Pinus sp.*), while for utility and saw poles 18 years suits for both pines and eucalyptus. Irrespective of site class, pines can be harvested at the age of 18 years (Mugasha et al., 2021). Based on household survey data and from informants, the time taken for trees to mature, compared to annual crops such as maize, beans, bananas and Irish potatoes has of the recent years discouraged smallholder farmers from woodlot growing.

This view on the time lag and its effect on tree planting is supported by a retired forest officer who insisted that:

The recommended age for mature trees is 20-25 years, in government plantations standard variables such as diameter at breast height (DBH), age, tree heights are

observed before harvesting is done. For smallholders, some of them sell their trees even before this required time. Some sell trees at the age of five or even 10 years and hence they do not get the optimal benefits of tree farming. In any case, however, the long time it takes for trees to mature is discouraging smallholder farmers. For farming communities, meeting daily household requirements is a challenge as thus smallholder woodlot growers have decided to remove trees as they cannot wait for 18 or 20 years to realise the monetary benefits. The quick option is to clear trees for fast crops such as Irish potatoes and vegetables such as cabbage and carrots.

In fact, the time lag for woodlots to mature is often compounded with fluctuation of prices. About 26 per cent of woodlot growers associated time lag with falling prices for wood products. According to smallholder woodlot growers in the study areas, of the recent years, market and prices for timber have declined. Informants revealed some of the reasons for the declining market and prices include the fact that pines are currently grown in many parts of the Southern highlands especially in Iringa and Njombe Regions, where there are large individual, government and private farms as well as in nearby countries especially Malawi. Commenting on the decline of market and falling of prices informants uncovered that in the period from 2015 to 2019, prices of raw trees for timber were very high. This attracted many smallholders to plant trees on their agricultural land. During those years, the prices ranged from 50,000 to 100,000TZS per tree depending on their maturity. In the last two years (2020-2021) however, raw trees and timber prices have fallen down compared to those of other crops such as Irish potatoes. Thus, smallholders have switched to growing Irish potatoes rather than woodlots.

Remarking on the decline of prices, another informant at Idweli village indicated that:

Ten years ago, pine trees planting was one of the main economic activities in this village, but in the last 3-5 years, its price has fallen as compared to Irish potatoes. When farmers harvest trees at any age, they do not plant trees instead they plant Irish potatoes. Recently, smallholders remove immature pine trees either by selling or just by destroying them. Some are harvesting trees for sale while they are only 8 years. The planting of pine trees is declining as smallholders do not plant new trees. Even those selling seedlings have no customers. Some farmers are uprooting trees and replacing with Irish potatoes. Irish potatoes are paying more than trees as they take short time- only 3 months to mature. Also, the dominance of middlemen has continuously discouraged tree growers. Most of us also don't have market information and capital to make timber, we sell our raw trees to timber traders through middlemen. We don't have measurements like in Kiwira plantation, we sell through visual measurement and estimation only. Thus, the price depends on the bargaining power of the owner and the middleman. In fact, the middleman gets more than the owner of the woodlots.

The above narration indicates that smallholder woodlot growers in these villages are challenged in the timber market chain. Arvola et al. (2019) report that in the Southern Highlands of

Tanzania there are two distinct value chains: one, the larger saw-milling industries that source timber from mature industrial plantation and produce high quality sawn wood; and two is the smallholder-produced timber which is processed on-site with transferable machinery and produces lower quality sawn wood. Based on these two dominant value chains, smallholder woodlots in the study villages fetch low prices because of either the dominance of the middlemen or the quality of their wood which translate into falling prices in the market.

Lower prices in the timber value chain are also due to the fact that woodlots growers, often decide to harvest trees prematurely because of their needs to meet livelihood necessities. This has a double effect. First, it reduces their income as poor-quality wood products fetch low prices. Second, the demand for wood products shifts to alternative better building materials such as metal that replaces sawn timber in the construction industry. As a result of reduced income smallholders may be unable to reinvest in woodlots. The long time it takes to realise income and the market price fluctuations serve as crucial signals for woodlot growers in determining the economic viability of land use options. Henceforth, the interplay between product prices, price volatility, market access and the need to sustain daily household requirement compel smallholder woodlots growers to revert to crops for quick cash income as Ponte (1998) explains.

Technological advancement and market demand

In the study areas agricultural innovation has been taking place. The agricultural innovations referred to in this paper include agronomic changes associated with the selection and adoption of new Irish potato varieties and the use of chemical fertilizers. According to Anderson (1996), in Mount Rungwe and Uporoto highlands, there had been changes concerning the varieties of Irish potatoes since 1980s up to the present. Smallholder farmers in the areas have been increasingly adopting new varieties of Irish potatoes that are believed to have higher commercial value and the market is readily available (Tilumanywa, 2013). Due to use of improved crop varieties and fertilisers, crop cultivation efficiency and productivity has increased thus encouraging farmers to convert their woodlots to cropland. According to informants there is high income from selling Irish potatoes. Informants at Idweli village for example, narrated that in 2021, Irish potatoes' prices were high such that smallholders reverted woodlots to Irish potato fields. The informants added that in the 2020/2021 agricultural season, one could earn one million TZS for a quarter an acre of Irish potatoes (after waiting for almost three or four months). This is an indication that Irish potatoes, being a fast growing and lucrative crop, and the environment that favours its intensive production provide opportunities and encourage the reversion of woodlots to crop fields.

Although Irish potatoes are labour and fertilizer intensive, they are preferred over woodlots as they are lucrative and highly demanded in both local and external markets in growing urban cities in the country. According to the 2022 census some cities in Tanzania had a population of over 2 million people. These included Dar es Salaam (5.4m), Mwanza (3.7m), Morogoro (3.2m), Dodoma (3.0m), Arusha (2.4m), and Mbeya (2.3m). Apart from these cities regions such as Shinyanga, Pwani, Singida, Tabora and Mara had high population above one million each. The population of Tanzania is expected to reach 151.3m in 2050 as compared to 61.7

recorded in 2022 (URT, 2022). The growth of population in these cities and supermarkets acts as catalyst for the conversion of woodlots to Irish potatoes by creating market demand, facilitating market access and aligning with consumer preferences and trends in the country's food industry.

The demand for Irish potatoes in external markets such as of Zambia, Malawi, Kenya and D.R. Congo is also high. In 2022, the population of East Africa was 293,141,200 people of which Tanzania's share is 21.0 per cent (URT, 2022). The increasing population both within the country, neighbouring countries and East Africa in general creates a demand-supply chain of Irish potatoes especially in urban areas. Consequently, in such market-oriented dynamics smallholders need new strategies to meet the demand (Kirsten et al., 2012). Therefore, abandonment of woodlots could be one of such strategies. As thus, it is without doubt that the ongoing reversion from woodlots to Irish potatoes is both demand-driven (Pinstrup-Andersen et al., 1997; Delgado et al., 1999) and technology-driven (Pingali, 2010; Tilumanywa, 2013) as stipulated by Land Use Transition Theory.

Reverting of a particular system of production due to prices is not a new phenomenon. There are similar cases of reverting to previous systems of production in Tanzania. They include abandoning coffee in Arumeru in favour of vegetables and potatoes that have a stronger local market and prices that are more reliable (Noe et al., 2022). Ponte (1998) reports that farmers abandon slow growing crops in favour of fast cash earning crops taking advantage of prevailing economic opportunities. As Ponte suggests, the urge to get fast cash drives smallholders to opt for fast crops rather than slow cash crops. In this case, woodlots are slow earning products.

Safeguarding households' food security

The need to ensure household food availability requires smallholders to ensure that there is adequate land for food production and income. Twenty-two per cent of the respondents cited the need for ensuring food availability for their households as a reason for reverting woodlots to crops. Ahimbisibwe et al. (2019) report that adequate food consumption and yields are among the factors farmers consider before engaging in woodlot production. The importance of food availability cannot be overemphasized. It is among the determinants of the existence of humankind. There is a general opinion that ensuring food security at a household is an integrated task of agriculture and political will, combined with the logistics of product delivery (Lang & Barling, 2012). Having adequate land for food crop production means assurance of having adequate food and improved livelihoods. FAO (2007) suggests that to rural communities among the factors considered for livelihood improvement is enhanced access to sustainable food sources. As thus smallholder farmers may choose to cultivate crops over protecting woodlots due to worries about local or national food security, especially when such crops can help with nutritional demands or bridge gaps food supply chain. Supporting this view, Kallio et al. (2012), Kallio and Kanninen, (2013), Nigussie et al. (2017) observe that woodlots like any other emerging smallholder tree growing systems, with their limited financial resources they prioritize agricultural activities for food security over over woodlots.

During discussion, informants revealed that currently woodlots are available in areas where erosion is high and where the land is unproductive but on suitable land for agriculture, woodlots have been removed to allow the production of Irish potatoes. Informants at Galijembe village remarked that production of trees in good agricultural land is ceasing and what they see in the near future is that pine woodlots will completely disappear as they are replaced with Irish potatoes. Informants added that eucalyptus trees will remain for firewood and poles. They further added that most pine woodlots will remain at institutions especially schools that are mandated to have at least two acres of woodlots. As part of the implementation of this government requirement, informants reported that Galijembe Primary School in Galijembe village has two acres of pine trees at their school environment.

According to informants, pine woodlots will probably also remain in public lands for those villages that have village lands. Furthermore, informants at Galijembe reported that in future, pine woodlots may disappear as pyrethrum did in their village. They added that in the future few smallholders will retain woodlots on their farms, except those with many plots, the well-off and government institutions. The disappearance of woodlots in these villages might be true in the future as more than half of the 166 respondents, indicated that woodlot growing should not be encouraged in their villages. Similarly, of the four surveyed villages, only Kabale village has a village land of about four (4) acres of pine woodlots which may persist.

Inadequate support services

Support services including extension, credit, and marketing are important for the sustainability of woodlots. From household surveys, 11 per cent and two percent respectively, indicated lack of markets and capital as the reason for removing woodlots. Woodlots growing involves smallholders investing money with the expectation of getting more financial gain in future. The prevailing market conditions at the time of planting influences smallholders' decision to grow woodlots. Nonetheless, prevalence of such market conditions and their respective market prices in 10-18 years later is not certain. Such investment for future gain requires professional guidance. Unfortunately, woodlots management and marketing in the study areas lack such guidance. The systems of extension consider woodlots as neither forests nor crop farms. As the provision of extension services is sectoral based, woodlots, receive services neither from forest officers nor from agricultural extension officers. With time, this is a drawback on productivity and profitability of woodlots.

Lack of guidance in the value chain makes smallholders disadvantaged in the liberal wood products market. This is a major disincentive to smallholder woodlot growers, and therefore turn into fast growing and quick cash earning crops that have better chance of receiving services. Success of woodlot growing depends on adoption of appropriate technical nursery and tree management practices. These include proper choice of species, sources of seeds, method of regeneration, site preparation, initial spacing, planting, and tending and site management. Mwambusi et al. (2021) reported that inadequate technical knowledge on proper treatment is one of the biggest challenges to smallholder forestry in Tanzania. Support services are required in the marketing of wood products for farmers to realize sufficient profit. Limited extension and marketing support services are also reported as some of the major challenges to

smallholder tree growers in Tanzania (Juma et al., 2019). Such services to farmers may be provided where farmers are organised into some groups. However, there were no such organised groups of woodlot owners in the study villages.

Emergence of high rental market

Reversion of woodlots in the study villages relate to increasing demand for land arising from agricultural commercialization especially of Irish potatoes. Smallholder farmers earn income through leasing land to well-off local and in-migrant farmers who are in need of land for Irish potatoes production either on seasonal (three months) or yearly basis. At the household level about 47 per cent of the 166 respondents indicated to have leased out their land to needy farmers in the 2021/2022 agricultural year. Informants at Idweli village added that, leasing land for Irish potatoes cultivation is nowadays an economic opportunity for those who have no capital and those who want to increase Irish potatoes production. They further informed that although leasing land for Irish potatoes production started way back in 2000s but now it has intensified. Land leasing has the advantage that the landowner gets back the field after harvesting Irish potatoes. The land owner uses the land for planting maize that takes advantage of the fertility of the soil following the use of chemical fertiliser for Irish potatoes growing.

Commenting on the extent of leasing land for Irish potatoes production one of the informants at Idweli village said:

Of recent, villagers in Idweli are removing pines because there is a high demand of land for Irish potatoes production. It is a practice here that when the prices of fertilizers are high almost all fields are hired out for Irish potatoes production, but when fertilizer prices are low and manageable by the villagers, then hiring is slowed down.

Informants further revealed that the cost of leasing land differs from size and location of a farm. It was learnt that leasing a quarter of an acre the cost ranges between TZS 1,000,000 and 1,200,000 for a year, and TZS 600,000 and 800,000 for three months depending on how closer to the road the farm is. The role of road infrastructure in rural areas is well documented by Gina (2013), Wudad et al. (2021), Lokesha and Mahesha (2016), and Tunde and Adeniyi (2012). With improved roads and means of transport including use of motor cycles distant farms are reached easily, hence Irish potatoes are grown in different locations in the study area.

Due to high demand of land for Irish potatoes, by better-off farmers both from within and outside the villages, there is more commercialisation of land resources. Better-off farmers and those with the smallest land holdings hire land from other farmers. In some cases, potential Irish potato farmers capable of hiring fields are urban based farmers. These kinds of urban farmers have also been reported in the study area by Sokoni (2014). Rental market is not a new phenomenon in some parts of Tanzania. Anderson et al. (2021) view emergence of a rental market as a component in agricultural transformation in Tanzania that those households who rent land have the small holdings, which may indicate that households that are capable can expand their farms through the rental market. Similarly, leasing farms on season or yearly basis, has become an important economic opportunity that gives smallholder farmers an alternative

income rather than waiting for income from woodlots that take too long to generate monetary returns.

Emergence of other profitable tree crops

Smallholders have been growing traditional varieties of avocado fruit trees for a long time. Recently new avocado varieties have been introduced in the area and smallholder farmers are embracing them. Informants at Galijembe villages on one hand, reported that around 2000 to 2015 avocado fruits were not grown for commercial purposes. Most trees were pines and eucalyptus, but recently avocados are replacing pines. Informants at Kabale village revealed that, avocado production for commercial purposes started in 2018 in their village. Both villagers and in-migrants currently grow avocado fruit trees.

The seedlings price is TZS 3000 per each tree plant. The first adopters of avocado trees in this village made their first harvest in 2021 and earned a lot of money. An avocado tree that has been well managed earned some farmers in the village up to TZS 200,000 from 200-300 kgs. Thus, smallholder farmers have been impressed and have now moved to planting of avocado trees as they have promising income. Informants further revealed that recently avocado trees have replaced pines and tea, due to their good price from both internal and external markets. Compared to non-fruit woodlots, smallholder farmers indicated that planting of avocado trees has been embraced because of a number of advantages. Firstly, they take a relatively shorter time of about three (3) years before the first harvest unlike 10-18 years for pines. Secondly, post-harvest loss is low. With the improved varieties, avocado fruits can stay for 2-3 weeks after harvesting and they have good price from both internal and external markets. Thirdly, unlike pine and eucalyptus woodlots, avocado tree growers receive extension services from ward agricultural officers.

While pines are being replaced by Irish potatoes in Igoma and Idweli villages, avocado trees are replacing pines and bananas in Kabale village. In-migrant farmers and better-off smallholder farmers who are capable of hiring or buying plots for avocado production, grow the tree crop solely, while other villagers interplant avocado trees with bananas. Informants at Kabale village indicated that due to limited land, most smallholder farmers interplant avocado with bananas and in some instances avocado trees standalone replacing crops such as maize, tea, coffee and bananas as well as pines. Those who practise intercropping of avocado trees with bananas is because of limited land.

Informants explaining the new development in avocado production informed that of the recent, villagers are interested in growing more avocado trees than pine and that some farmers have even stopped growing Irish potatoes in favour of avocado trees. Informants further indicated that in future, a good number of smallholders may plant more avocado trees than pines. The planting of avocado according to informants is expected to improve people's livelihoods. Avocado trees are also likely to be friendlier to food security in the study area if their productivity and generation of quick and high income to farmers will be sustained as this will enable them to buy food from other regions.

Conclusion

It is apparent that there is a reversion from woodlots to crop fields in some parts of Mount Rungwe and Uporoto Highlands. The observed reversion is influenced by socioeconomic changes that are fostered by macro-economic conditions. National policies and village bylaws do not limit smallholders' growing woodlots on their private land. Innovation has happened in farming in such a way that food crops are commercialised and the adopted technologies of improved varieties and use of fertilizers can ensure high yields enough for consumption and selling, and so enable more and faster cash returns. The occurrence of market opportunities and agricultural technologies have enabled smallholder farmers to consider replacing woodlots with fast and more lucrative crops such as Irish potatoes and avocados. Replacement of woodlots is an aspect of agricultural transformation where production focus is more in response to needs of domestic and external markets so as to meet the increasing demand for food, expand agricultural land, adapt to urbanization, intensify agricultural practices, respond to changes in dietary preferences, and address land scarcity issues. The ongoing reversion from woodlots to crop fields in the area also relates to increase in demand for land, following more commercialisation of Irish potatoes.

Reversion from woodlots to crop fields is, however, contrary to smallholders' diversification from crop production. Woodlots farming is perceived as means of farmers' diversification from crop production and as an insurance for farm households given the risky economic environment, the missing insurance market, fluctuations in food prices and unpredictable climate conditions. It signifies smallholders' adaptability to market signals, farmers' ability to reduce risk and vulnerability, progress of the farm economy towards self-reliance, and diversified farming systems. The on-going removal of woodlots may impair these diversification benefits.

The apparent reverse from woodlot growing is an abrupt change in the farming systems of Mount Rungwe and Uporoto Highlands. It is an indication that woodlots growing for economic gain may become yet another cash product production failure for smallholders in these areas as it was for pyrethrum. Whereas better-off farmers are likely to continue with the woodlots growing practice due to their relative advantage to accumulate land, poor smallholders are more likely to reverse woodlots into quick cash earning crops or fruit trees. While this is good news, to the agricultural production sector, it is a challenge to conservationists as pressure and demand for services from natural forests may increase. Before this reversion, local communities had developed strategies to ensure availability of energy resources since they could no longer gather firewood and timber from reserved forests.

For sustainable woodlots development in the study areas, support services are essential for enhancing their productivity and sustainability. With high productivity, avocado trees, can provide sufficient earnings suggesting that quantity of land should no longer be a problem since technology can ensure high yields. Furthermore, the woodlot growing system in the study areas has the potential for enhancing rural differentiation, as better-off smallholders are likely to accumulate assets of land and related investments while poor smallholders face challenges of losing land asset for agricultural production. Reversion of woodlots to crop fields may retard the process of rural differentiation.

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