frontiers | Frontiers in Environmental Science

TYPE Policy and Practice Reviews
PUBLISHED 24 July 2023
DOI 10.3389/fenvs.2023.1193242

Challenges in conserving forest ecosystems through coffee certification: a case study from southwestern Ethiopia

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RECEIVED 24 March 2023
ACCEPTED 14 July 2023
PUBLISHED 24 July 2023

CITATION
Arai Y, Hundera K and Yoshikura T (2023), Challenges in conserving forest ecosystems through coffee certification: a case study from southwestern Ethiopia. *Front. Environ. Sci.* 11:1193242.
doi: 10.3389/fenvs.2023.1193242

Certification schemes, aimed at simultaneously promoting ecologically sustainable agriculture and improving livelihood, are being utilized at a global scale. Among such certification schemes, the Rainforest Alliance is known as one of the most widely used environmental certification programs throughout the world. Previous studies have compared the ecological impacts of certified and non-certified farmlands, or evaluated the economic outcomes of certification. However, few studies have assessed the long-term impacts of the certification scheme. This paper attempts to analyze the long-term outcomes of the Rainforest Alliance certification program through a case study of coffee farming practices in southwestern Ethiopia. We conducted in-depth qualitative interviews with key informants who were deeply involved in the certification program, together with field observations and secondary data collection. The results of the assessment indicated that some areas of the certified coffee forests have been deforested or ecologically degraded and that the Rainforest Alliance program requirements were not uniformly applied. The possible causes include rapid population increase, government policies promoting intensive coffee production, presence of members who did not participate in the certification program, a lack of conservation incentives, and loopholes in the auditing process. To determine the overall success of the Rainforest Alliance certification program would require: monitoring of population growth rates and providing alternative livelihood opportunities, promoting collaboration between environmental and agricultural government authorities, conducting a more stringent on-site inspection, and to provide direct incentives for environmental conservation to all farmers living in or near the certified areas.

KEYWORDS

certification, forest ecosystem conservation, Rainforest Alliance, southwestern Ethiopia, arabica coffee, third-party auditing

Abbreviations: FC, Forest coffee; FCCP, Forest Coffee Certification Program, FFS; Farmer Field School, FMA; Forest Management Association, JICA; Japan International Cooperation Agency, OFWE; Oromia Forest and Wildlife Enterprise, RA; Rainforest Alliance.

10.3389/fenvs.2023.1193242

1 Introduction

Climate change and ecosystem degradation have caused large-scale and rapid changes to the environment over the past century. These changes threaten the integrity of natural ecosystems and perturb the dynamics of several functional groups that are vital to agriculture, including decomposers and pollinators, which ultimately compromises food security (IUCN, 2008). The conversion of tropical forests by agricultural intensification is considered a major cause of tropical biodiversity loss (Laurence et al., 2014; Milder et al., 2015), while conserving these natural ecosystems can promote food security and buffer the effects of natural disasters and disease outbreaks (IUCN, 2008). The certification of agricultural products can be an extremely useful tool to promote ecologically sustainable food production.

The basic concept of the agricultural certification system can be described as follows: 1) a third-party auditor evaluates whether a product meets the standards set by a certification agency and a certification label is linked to products that pass the audit, 2) the certification label allows consumers to choose environmentally friendly products, and 3) conservation is indirectly promoted by incentivizing ecologically friendly farming practices (Fujimoto and Urashima, 2012). In addition, since certified products can enhance traceability, they are considered safe and reliable, and these consumer perceptions increase their market value (Fujimoto and Urashima, 2012).

Several environmental non-governmental organizations, including the Rainforest Alliance (RA), have developed third-party certification programs to promote the conservation of shade-providing trees on coffee farms (Perfecto et al., 2005). The RA, founded in 1987, is an international non-profit organization that aims to conserve biodiversity and promote sustainable livelihoods in agriculture. The RA certifies agricultural products by evaluating the impacts of production, mainly according to: 1) forests and ecosystems, 2) soil and water resources, and 3) conditions of the work environment and job creation. The RA certification program provides farmers with the opportunity to sell products at premium prices, given that their practices conform to various socio-economic and environmental standards (Alliance, 2020). Products made from ingredients sourced from RA-certified farms are allowed to carry the RA logo. The RA Sustainable Agriculture Standard Farm Requirements 2020 consist of a wide variety of standards that involve aspects of management, traceability, farming, social, and the environment (Alliance, 2020). The environmental standards are comprised of requirements in conservation of forests, biodiversity, riparian buffers, water and other natural ecosystems, as well as waste and wastewater management, energy efficiency, and greenhouse gas reduction (Alliance, 2020). RA is one of the most widely used environmental certification programs, and audits 5.4% of the world's coffee producers (Sustainable Agriculture Network, 2015; Bose et al., 2016). Moreover, in a comparison of forestry, agriculture, and biofuel sustainability standards, Englund and Berndes (2015) concluded that the RA is one of the most stringent certification programs in terms of biodiversity conservation.

A number of studies have assessed the effectiveness of agricultural certification in ecosystem conservation by comparing ecological status between certified and non-certified forests. Haggar et al. (2015) found that certified organic coffee farms in Costa Rica, Guatemala, and Nicaragua had higher levels of tree species richness, shade, and stratification than conventional coffee farms. Higher survival rates have been confirmed for migratory birds in RA-certified coffee farms in El Salvador (Komar, 2012; Tscharntke et al., 2015). Hughell and Newsom (2013) found higher species richness of arthropods and aquatic invertebrates in RA-certified coffee farms in Colombia (Tscharntke et al., 2015). Takahashi and Todo (2013) showed that the RA coffee certification program alleviated the conversion of forestland into agricultural lands in Ethiopia. Pico-Mendoza et al. (2020) found that certified agroforestry systems in Costa Rica provide more ecosystem services (i.e., habitat maintenance, water quality, erosion control, and carbon stocks) than non-certified systems. RA-certified coffee farms in Colombia appear to have a significantly larger area of tree cover than non-certified ones (Rueda et al., 2015). Furthermore, organic certification reduced the overall use of chemicals on Costa Rican coffee farms (Blackman and Naranjo, 2012), and promoted better environmental management practices on certified farms in Colombia (Rueda and Lambin, 2013) and Mexico (Martínez-Torres, 2008). Thus, the majority of the literature suggests that certified farms are better for conservation than non-certified farmlands, and a few studies have reported the negative impacts of certification (Tscharntke et al., 2015). One study of Costa Rican banana farms found that RA-certified farms had less insect diversity than non-certified farms. This is one of the few studies indicating that certification may not always benefit biodiversity.

On the other hand, researchers have also evaluated the effectiveness of certification programs in terms of welfare and livelihood improvements (Barham and Weber, 2012). Certification schemes provide economic incentives by allowing farmers to sell their products at premium prices (Ferraro et al., 2005) and access foreign markets (Tscharntke et al., 2015). Mitiku et al. (2018) showed that RA-certified semi-forest coffee generates higher returns compared to non-certified semi-forest and garden coffee, owing to increased demand. In contrast, Barham and Weber (2012), in a study of fair trade/organic and RA-certified coffee farms, found that yield was more important than price in determining profits. Fenger et al. (2017) reported that RA-certified cocoa plantations showed greater sustainability and financial returns compared with conventional producers due to increased access to resources and skilled labor. Other studies have also suggested that certification promotes better agricultural management and crop quality (Clough et al., 2011; Rueda and Lamblin, 2013; Tscharntke et al., 2015). Generally, some major challenges related to certification schemes include limited market advantages, high costs, and complex administrative procedures (Englund and Berndes, 2015).

Below we review some of the few reports of monitoring or auditing systems of certified farmlands. In Ghana, Ansah et al. (2020) revealed that the frequency of inspections for cocoa certification programs (including RA and fair trade) was less than 50% of the level specified, which reduces accountability for certified farmers that do not follow standard practices (Ansah et al., 2020). Bose et al. (2016) highlighted that RA certification neither changed the farmer's awareness of sustainable production nor their behavior, casting doubt on the effectiveness of the certification scheme in contributing to conservation. Some of the most commonly found issues in reports of Forest Stewardship Council certified forests are the lack of monitoring for forest management indicators and the poor maintenance of high conservation value forests (Ehrenberg-Azcárate and Peña-Claros, 2020). Based on a review of corrective action requests for Forest Stewardship Council certified forests in Mexico, the majority of the requests focused on social, economic, or legal issues, and required small rather than fundamental changes (Blackman et al., 2017).

Traditional shaded coffee plantations are considered an ecologically sound approach to coffee production that can integrate and maintain local biodiversity (Perfecto et al., 2005). However, traditional shaded coffee systems are relatively inefficient in terms of yield and are vulnerable to pests and disease (Rappole et al., 2003). Intensive coffee production systems achieve high yields of coffee, though they require forest conversion and agrochemicals, resulting in forest degradation, soil erosion, and pollution (Rappole et al., 2003). An increasing number of coffee farmers are reducing canopy cover in intensive monocultures to increase yield and short-term profits (Tscharntke et al., 2011), which has an overall negative impact on biodiversity (Perfecto et al., 2003; Mas and Dietsch, 2004).

Environmental certification programs, including certification of shade coffee agroforestry systems, have been applied worldwide to promote ecologically sustainable agriculture; however, a general lack of consensus exists regarding their conservation success (Takahashi and Todo, 2013; Haggar et al., 2015; Bose et al., 2016). Very few studies have conducted long-term monitoring of biodiversity responses to certified land-use practices (Tscharntke et al., 2015). The socio-economic outcomes of these programs are also normally reported over a short period of time or soon after the program was initiated, with relatively little consideration of potential inadvertent impacts. Furthermore, few studies have analyzed the collective socioeconomic and ecological status of certified farms from a holistic perspective.

This paper assesses the long-term outcomes of the RA certification program through a case study of a RA-certified coffee forest in southwestern Ethiopia, established in 2007. The objective of this study was to identify potential obstacles in successfully implementing certification schemes and to suggest recommendations to further improve long-term practices in forest ecosystem conservation. Therefore, our research question is: Has the RA certification scheme been effective in preventing deforestation and conserving forest ecosystems in the long-run?

The following section describes the relevant background information, including the forest ecosystems and native coffee of southwestern Ethiopia and the donor-funded participatory forest and coffee management project implemented in the area. We then discuss the methodology and results of our assessment. The subsequent section interprets the study findings with reference to the RA standards, as well as the latest articles and official reports. Finally, we conclude by suggesting recommendations and policy implications.

2 Case description

2.1 Native forest and coffee of southwestern Ethiopia

Ethiopia boasts a diverse topography, ranging from high and rugged mountains, flat topped plateaus, rivers and valleys, and rolling plains (Teketay, 2001), which contributed to the formation of a variety of bioregions with high species richness (Gebre-Egziabher, 1991). Although the original estimates of forest cover are controversial (Pankhurst, 1995; McCann, 1997), some sources indicate that, a century ago, about 35% of Ethiopia was under high forest cover (FAO, 1981), which was reduced to about 2.7% by the 1980s (Bekele and Leykun, 2001). The total floral richness is estimated at approximately 6,500 species of vascular plants, of which 10% are endemic (Kelbessa and Demissew, 2014). The country has over 300 tree species, only a few of which are used for construction and industrial purposes.

The main driving forces behind the rapid disappearance of the forest landscape in Ethiopia include the expansion of agricultural land, unregulated exploitation of forest resources, overgrazing, and the establishment of new settlements as a response to increasing population pressure (Gole, 2003; Senbeta and Denich, 2006). Most of the remaining forest habitat are moist evergreen Afromontane forests confined to fragmented remnant patches in the southwestern regions (Ethiopia-, 1992).

Arabica coffee (*Coffea arabica*) originated in the Ethiopian moist evergreen Afromontane forests (Anthony et al., 2002; Schmitt et al., 2009), which are commonly known as "coffee forests" and still harbor wild populations of *Coffea* (Gole et al., 2009). Arabica coffee is a shrub or small tree occurring in forests between 1,000 and 2,000 m above sea level, with annual rainfall between 1,600 and 1,800 mm/year and average temperatures of 18–24°C (Senbeta and Denich, 2006; Schmitt et al., 2009). It is the only *Coffea* species that is native to Ethiopia (Silvestrini et al., 2007). Coffee is an evergreen plant that requires consistent sub-soil water provisioning, making deep soils with good water-holding capacity ideal for growing Arabica coffee (Mamo, 1992; Schmitt, 2006).

Traditional forest management practices have been adopted by the local people who base their livelihoods on coffee production (Gole, 2003; Senbeta and Denich, 2006; Schmitt et al., 2009). Coffee production plays an important role in the Ethiopian economy; it supports approximately 15% of the population and represents a valuable commodity for foreign exchange with consistent levels of market demand (McMillan et al., 2003; Gebreselassie and Ludi, 2007).

The Belete-Gera forest, our study site, is designated as a national forest priority area (i.e., protected area) and covers approximately 97,000 ha at an altitude of 1,000–3,000 m (JICA, 2020) (Figure 1). It is located in Jimma, Oromia regional state, southwest Ethiopia. The average annual temperature and precipitation are approximately 20°C and 1,500 mm, respectively. The Belete-Gera forest is characterized by undulating hills and steep mountainous terrain.

Forest coffee production systems in southwestern Ethiopia can be categorized into forest coffee (FC), semi-forest coffee, and garden coffee based on the management level, vegetation, structural complexity, and agronomic practices (JICA, 2020). In areas of high population density, plantation coffee systems are used for intensive coffee berry production and generally show higher levels of degradation (Gole, 2003). Coffee production systems vary in their management levels. In FC systems, farmers simply collect wild coffee fruits with occasional removal of undergrowth to facilitate coffee collection. In semi-forest coffee systems, the canopy and undergrowth are systematically thinned to reduce shade and

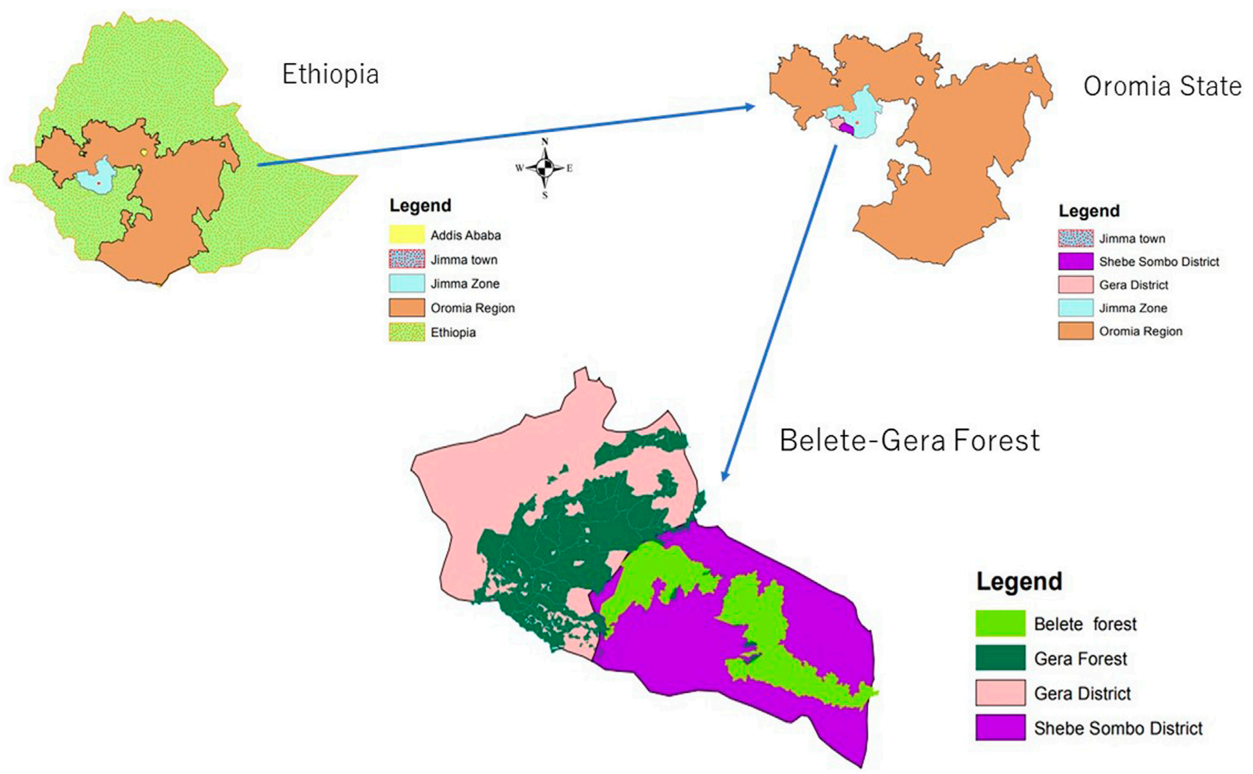

FIGURE 1
Map of the Study Site. (Created by authors).

competition, respectively (Gole, 2003; Schmitt et al., 2009). Garden coffee occurs in areas where coffee trees are cultivated outside the demarcated forest areas, usually around farmsteads among shade trees and other crops or fruit trees (JICA, 2020).

2.2 Donor-funded project pursuing forest conservation and sustainable coffee production

From 2003 to 2020, the Oromia Forest and Wildlife Enterprise (OFWE), a public institution responsible for forest conservation in Oromia State, conducted a participatory forest management project with the support of the Japan International Cooperation Agency (JICA). The project aimed to establish a sustainable forest management mechanism in the Belete-Gera forest area through capacity development with OFWE staff and local farmers. It successfully established 125 participatory forest management associations (FMAs) by 2010 (Takahashi and Todo, 2013). With the support of government officers, each FMA delineated the boundaries between houses, farmlands, and protected forests; developed rules to conserve the local forests; and eventually agreed on a Forest Management Agreement with the local government (JICA, 2010). While this agreement regulated the removal of trees in protected areas, it allowed for specific resource utilization, such as the collection of branches for firewood (JICA, 2010).

With a Forest Coffee Certification Program (FCCP), the project also supported FMAs in obtaining shade coffee certification from the RA as an avenue for increasing household income. Local farmers were able to register and participate in the program if they were 1) a member of the FMA, 2) engaged in ecologically sustainable forest coffee harvesting, and 3) willing to comply with RA standards. Certified coffee forests were defined by tree species richness, tree height, tree density, number of canopy layers, and percentage of canopy cover (Philpott et al., 2007). By 2010, 58 of the 125 FMAs were RA-certified, which enabled them to sell coffee at 15%–20% premium prices in international markets (Takahashi and Todo, 2013). This has led to the production of 60 tons of RA-certified coffee, benefitting 3,050 FMAs (Takahashi and Todo, 2013).

The project also introduced a Farmer Field School (FFS): a group-based learning program developed by the FAO, in which farmers engage in experiential learning activities to improve their agricultural skills and knowledge (JICA, 2012). Producers gather at a local farm every week, assess their products, and discuss their findings. In this manner, farmers can improve their individual productivity by adopting knowledge that is immediately relevant. This approach differs from conventional extension programs, in which farmers are required to adopt techniques introduced by external experts (JICA, 2012). The FFS was also aimed at reducing agricultural land expansion—one of the major local drivers of deforestation.

Through an Internal Control System, Ethiopian government officials and farmers participating in the FCCP can continue to conduct ecologically sustainable forest coffee production and obtain RA certification through annual auditing processes. Since 2014, the Internal Control System 1) provided training to local inspectors (i.e., farmers selected among the members of each FMA), 2) conducted field inspections of the registered coffee forests, 3) provided technical support to the OFWE Jimma Office, 4) facilitated the analysis of field inspection data, and 5) applied for renewal of RA certification (JICA, 2020). The objective of the Internal Control System was to maintain certified coffee forests according to RA standards.

3 Method of assessment

The aim of the assessment was to examine whether the requirements (particularly related to forest ecosystem conservation) listed on the RA Sustainable Agriculture Standard Farm Requirements 2020 are fully satisfied or not, in the RA-certified coffee forest which was initially certified in 2007. The assessment combined field observations, qualitative interview surveys, and secondary data collection. Our study locale was an RA-certified coffee forest that extended 61,029 ha inside the Belete-Gera forest (97,332 ha) in Jimma, Oromia State, Ethiopia (JICA, 2020). Field observations were conducted in February 2019 at two study sites (one in the Gera district and another in the Shebe Sombo district). Both sites were FC systems that were certified with the FCCP since the initial stages of the project. We recorded forest conditions, with a particular emphasis on the levels of human disturbance.

In-depth semi-structured interviews were conducted in February 2019 with 10 key informants involved in the FCCP, including farmers, project coordinators, and JICA experts, all of whom played an important role in project functioning. Additional interviews were conducted in October 2021 with seven JICA experts and project staff members actively involved in the project. Informed consent was obtained from all the interviewees. The interviews considered the ecological conditions of the certified coffee forest, the recent status of FMAs, forest monitoring and management practices, auditing processes, and related changes in socio-economic circumstances. To verify our findings, secondary data were collected from recent official reports as well as academic publications related to coffee and forests in southwestern Ethiopia.

4 Results of assessment

4.1 Ecological conditions of the certified coffee forests

From field observations of certified coffee forests, we found that FC systems were gradually being converted into either semi-forest coffee or garden coffee, with an associated reduction in canopy cover and large-sized trees (Figure 2). These areas had larger quantities of coffee trees, whereas non-coffee trees were slashed and less frequently observed.

According to the interviews, coffee seedling plantations were encroaching into certified forest areas, with visible increases in expansion annually. A number of the FC areas were degraded and the level of shade resembled that of garden coffee systems. The clearance of non-coffee vegetation to maximize coffee yield was commonly observed. In addition, non-native coffee seedlings were being planted in some certified areas.

The scientific literature corroborated our interview results and observations. Hundera et al. (2013) studied the impacts of intensified coffee production (i.e., opening up the forest canopy and clearing of competing species in the undergrowth) in the Afromontane forests of the Belete-Gera region, which includes RA-certified areas. This study revealed that maximizing coffee production resulted in structural degradation of forests, changing the tree species composition into early successional plant communities (Hundera et al., 2013). By restricting the growth of late-successional or even pioneer tree species through continued thinning and slashing of understory vegetation, intensive coffee cultivation, including semi-forest coffee practices, had negative impacts on species diversity and regeneration potential (Hundera et al., 2013). Mengist et al. (2013) also found that human disturbances such as cutting of trees and new coffee plantation negatively affected biodiversity and regeneration in the coffee grown area of the Belete forest. Additionally, a study conducted in the Gera forest indicated that coffee production in this area threatened forest biodiversity by simplifying the forest structure (Hylander et al., 2013). Moreover, Gemmechis and Tura (2023) revealed that water bodies in the Belete-Gera forest decreased following the reduction of forest cover, which was mainly caused by increase of population and expansion of agricultural land areas.

According to Landsat satellite image analysis, the entire area of the Belete-Gera forest has decreased from 108,823.77 ha in 2000 to 97,332 ha in 2019. While non-certified forest area decreased from 44,134.83 ha in 2000 to 36,303 ha in 2019, RA-certified coffee forest area has also decreased from 64,688.94 ha in 2000 to 61,029 ha in 2019 (JICA, 2020). (Table 1; Figure 3). This overall tendency was consistent with the recent study conducted by Gemmechis and Tura (2023) which disclosed that the area of the Belete-Gera forest largely decreased from 1980 to 2018, while agricultural land in the area drastically increased in the same period. Based on the annual rate of deforestation (2000–2019) calculated using the data from JICA (2020), we found that the rate in the RA-certified coffee forest area (=-0.31%) appeared to be lower than that of the non-certified forest area (=−1.03%) and the entire Belete-Gera forest area (=−0.59%) (Table 1). While the degree of deforestation and forest degradation may differ depending on the area, our interview results and field observations combined with the above-mentioned literature imply that forest ecosystems are gradually being converted and degraded inside RA-certified coffee forests.

4.2 Social factors behind the changing forest conditions

According to the interviews, the expansion of coffee plantations inside certified forests can mostly be attributed to young unemployed individuals. These individuals are often part of local FMA member households and, since they are not officially registered members of the FMA, they are not obliged to comply with forest management rules and RA standards. One interview respondent suggested that individuals with familial responsibilities would be

FIGURE 2
Native vegetation cleared and coffee seedlings planted in the certified area. (Photo: Toshihide Yoshikura, 2019).

TABLE 1 Change of Forest Area and Annual Rate of Deforestation in the Belete-Gera Forest, Oromia State, Ethiopia (2000–2019). (Created by authors, using the data from JICA (2020). The annual rate of deforestation (%) was calculated using the formula suggested by Puyravaud (2003): r= (1/(t2-t1))*ln (A2/A1)).

	2000	2010	2015	2019	Annual rate of deforestation (%)
Belete-Gera Forest Area (ha)	108,823.77	101,860.56	99,508.77	97,332.00	−0.59%
RA-Certified Coffee Forest Area (ha)	64,688.94	63,245.25	62,041.23	61,029.00	−0.31%
Non-Certified Forest Area (ha)	44,134.83	38,615.31	37,467.54	36,303.00	−1.03%

more likely to seek alternative income sources; though, due to increasing population pressure, job opportunities and land for cultivation are limited, leaving few attainable options other than producing coffee in the forests. Though the transgressing individuals might be aware of the RA standards, many of them pursue intensive coffee production to maximize yields and income in the short term and meet their household requirements.

One of the respondents indicated that increasing population pressure may have also led to deforestation and forest degradation. In fact, the total Ethiopian population increased from 82 million in 2007 to 120 million in 2021 (World Bank, 2023), while the population of Oromia State also increased from 27 million in 2007 to 40 million in 2022 (Brinkhoff, 2022). Agriculture remains to be the largest economic sector of Oromia State, and it is the main livelihood and income source for approximately 90% of its population (Ceseco International, 2016). In other words, the people of the state have very limited employment opportunities apart from agriculture (Schmidt and Bekele, 2016). While many farmers in the state traditionally inherit farmlands from their parents, the recent rapid population increase in southern Ethiopia has led to a severe scarcity of lands (Bezu and Holden, 2014). Young people who do not have enough access to farmlands face difficulties in sustaining their livelihoods (Bezu and Holden, 2014). When we turn our attention to education, over 40% of the country's population have only received primary education, and only around 10% have completed secondary or higher education (AfDB, 2018). Although highly educated elites may have opportunities to obtain jobs with better salaries in urban areas, it is difficult for the majority of youths who have received limited education (Bezu and Holden, 2014). Thus, due to the lack of employment opportunities other than agriculture, combined with limited availability of farmlands and limited chances for receiving higher education, it is likely that more people have had to expand agricultural lands to sustain their livelihoods.

Since coffee was known to offer good income generation opportunities in the Belete-Gera forest (Mengist et al., 2013), farmers may have been attracted to explore coffee production as an alternative source of income. In fact, the number of coffee producers has also increased from 4,217,961 in 2012 to 6,455,194 in 2017 (Degaga, 2020). In addition, the area allocated for coffee production in Ethiopia has expanded from 528,751 ha in 2012 to 700,474 ha in 2017 (Degaga, 2020). It is considered that the

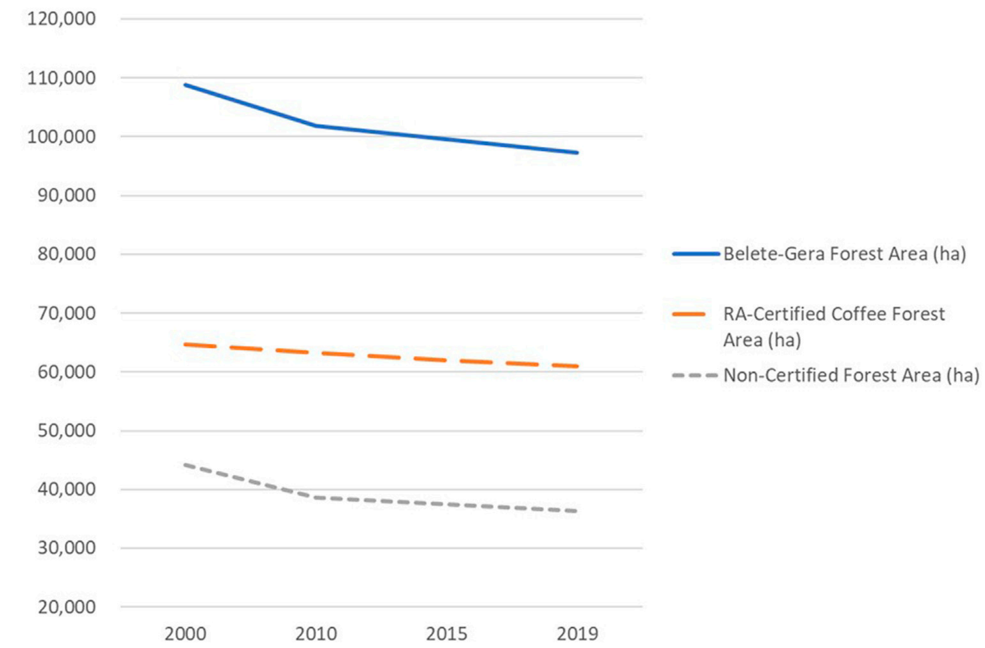

FIGURE 3
Change of Forest Area (ha) in the Belete-Gera Forest, Oromia State, Ethiopia (2000–2019). [Created by authors, using the data from JICA (2020)].

increase of coffee production in Ethiopia has been mostly due to land expansion rather than intensification (Wainaina et al., 2020). The interviewees noted that the boundaries between certified coffee forests and non-certified land were often unclear, which increased the risk of coffee plantations expanding into certified coffee forest areas. The project originally delineated the boundaries with a GPS-based map after a consensus was reached among FMA members. With increasing population pressure, it is likely that home gardens and farmlands gradually expanded toward the boundaries, making it difficult for farmers to recognize them.

Another social factor that seems to be lying behind the forest conditions is the Ethiopian government's policies that accelerated coffee production. The Agricultural Sector Policy and Investment Framework (2010–2020) aimed at increasing agricultural productivity and production, as well as accelerating agricultural commercialization and agro-industrial development (Ministry of Agriculture and Rural Development, 2010). It emphasized the importance of facilitating farmers to graduate from subsistence farming and start producing for markets and businesses. Under this strategy, the total amount of coffee production in Ethiopia rose from approximately 180 million tons in 1993 to about 471 million tons in 2017 (Wainaina et al., 2020). Furthermore, in 2017, the Ethiopian government established the Ethiopian Coffee and Tea Authority, which promotes intensive coffee production for exports (JICA, 2020). The goal of this authority is to make Ethiopia one of the world's largest producers and exporters of Arabica coffee by 1) accelerating research and development to increase productivity, 2) building a competitive and transparent marketing system, 3) increasing the production and export of value-added coffee, and 4) promoting sustainable coffee production through informed environmental management (JICA, 2020). In particular, they are promoting the development of improved coffee seedlings with higher productivity and distribution of seedlings to replace low-productivity coffee trees (JICA, 2020). With growing governmental interest in foreign markets, farmers are legally allowed to maximize coffee yields by thinning non-coffee trees and planting coffee seedlings (JICA, 2020). Interviewees noted that these governmental policies may have influenced the behavior of local farmers.

Another respondent explained that improvements in road accessibility and an increase in coffee processing facilities may have urged farmers to step away from the FCCP. Before industrialization, farmers would dry the coffee beans in the sun and transport their products over long distances by horse. While Ethiopia had only 19,000 km of roads in 1990 (CIOB, 2018), its length reached 144,024 km in 2020 as a result of the government's steady efforts to extend the road networks (U.S. Department of Commerce, 2022). Such rapid expansion of road networks provided opportunities for companies to build coffee processing facilities nearby the remote coffee forests, which allowed the farmers to easily sell the coffee beans at the facilities and directly earn their income by themselves. As one interviewee expressed his concern that the premium price was usually paid after a year from harvesting, this ease of access also seemed to have disincentivized farmers from participating in the FCCP.

4.3 Status of forest management and auditing

Some respondents explained that the FMAs are not equipped to enforce the appropriate forest management practices, especially with regards to individuals that are not registered as members of the association. Others noted that the perceived role and responsibility of FMAs in forest conservation based on the Forest Management Agreement deteriorated over time, even among the registered members. This may be partly due to members of the FMAs who are not involved in the FCCP neither having opportunities to obtain direct benefits from premium prices nor receiving inspections from the local inspectors or RA auditors. Some respondents expressed concern that FFS itself may not provide sufficient incentives for FMA members to conserve forests, since participation in FFS is not directly linked to forest conservation. Other interviewees also noted that the association's members, who initially produced forest coffee in an environmentally friendly manner, are becoming more intensive producers, similar to young non-members.

The respondents revealed that not all local inspectors (i.e., farmers who are responsible for monitoring the status of the certified coffee forest area) were committed to inspecting all the coffee forests/registered farmers or reporting issues to RA auditors. Some respondents expressed concerns that local inspectors reported unsubstantiated findings to RA auditors. Generally, RA auditors randomly select sites for on-site inspections and visit farmers and coffee forests without the involvement of local inspectors. However, one respondent noted that RA auditors cannot gain access to all of the sites, sometimes due to distance or impassable terrain. Since hosts have to bear the travel expenses of auditors, itineraries are often designed to minimize the number of days spent on inspections. In such cases, RA auditors only inspect easily accessible sites, which implies that the conditions in isolated forest areas are not comprehensively assessed during the auditing process. Based on our review of the documents made during the RA's auditing process between 2012–2017, although various comments were given toward lack of documentation for social and environmental management system, absence of wildlife inventory and integrated waste management program, insufficient soil erosion control, limited use of organic fertilizers, etc., we found no descriptions concerning deforestation and forest degradation or plantation of coffee trees inside the certified areas.

OFWE together with JICA have made certain efforts to address the above-mentioned issues. A joint forest monitoring and field survey was recently conducted to assess the latest ecological conditions of certified coffee forests, identify the risks, and develop measures to support the monitoring efforts of local inspectors. Local inspectors were provided with GPS-installed tablet devices. This allowed for subsequent visits to certified coffee forest plots to be recorded as photos with GPS locations, allowing for increased accountability along with the collection of useful data (JICA, 2020). OFWE and JICA also developed Forest Coffee Management Guidelines aimed at minimizing the impacts of coffee production on ecosystems and provided training to relevant governmental staff and farmers (JICA, 2020). This guideline also specifies monitoring priorities related to forest ecosystem conservation (e.g., abundance of large trees and species richness) (JICA, 2020). The project also conducted various awareness-raising campaigns to communicate the importance of certification in maintaining premium product prices. These efforts are expected to reduce the risk of deforestation and forest ecosystem degradation.

5 Discussion and recommendations

Combining in-depth interviews with field observations and secondary data, we found that RA-certified coffee forest areas in the Belete-Gera forest have been gradually deforested or degraded over 12 years after the initial certification approval. Interview respondents expressed concerns about the changing conditions of the coffee forests, where canopy cover and large trees were removed, and understory vegetation was cleared to promote the growth of coffee trees. Respondents also noted that farmers were planting non-native coffee seedlings inside certified coffee forest areas. Similarly, Castro-Tanzi et al. (2012) suggested that coffee farmers replace biodiverse shade coffee systems with more simplified and unshaded coffee farms to increase yields and meet market demands. As coffee yield is maximized between 35% and 65% shade cover, coffee producers have little incentive to maintain more than 70% shade tree cover, unless premium prices are sufficiently high (Perfecto et al., 2005).

Although we did not collect primary data to quantify the impacts of coffee production, various studies conducted in the coffee grown Belete-Gera forest area, namely, the RA-certified area, found that coffee production negatively impacted the forest biodiversity (Hundera et al., 2013; Hylander et al., 2013; Mengist et al., 2013), regeneration (Hundera et al., 2013; Mengist et al., 2013), and water bodies (Gemmechis and Tura, 2023). The studies indicated that cutting large trees and clearing understory vegetation reduced species diversity, simplified the forest structure and retarded the regeneration of late-successional species, which also caused a reduction of water bodies. Although our data analysis on the annual rate of deforestation imply that the RA certification played a role in reducing deforestation, it was not strong enough to stop them, and our field observations generally concurred with the changes observed by other researchers in many parts of the RA-certified area.

Below, we review the relevant standards stated under the RA certification scheme, based on the RA Sustainable Agriculture Standard Farm Requirements 2020. RA standards 6.1.1 "From 1 January 2014 onward, natural forests and other natural ecosystems have not been converted into agricultural production or other land uses" and 6.2.2 "Farms maintain all remnant forest trees, except when these pose hazards to people or infrastructure. Other native trees on the farm and their harvesting are sustainably managed in a way that the same quantity and quality of trees is maintained on the farm" are likely not being satisfied in some certified areas, as some interview respondents acknowledged the clearing of certified coffee forests by young and unemployed individuals aiming to maximize short-term coffee yields.

Based on our findings, we propose that the following four factors caused deforestation or degradation of the certified coffee forests. First, a rapid increase in population could facilitate and exacerbate the other emerging issues. Second, the government's agricultural development policies and the establishment of Ethiopian Coffee and Tea Authority incentivized farmers (including those who had previously practiced ecologically sustainable coffee farming) to maximize yield and shift their practices to intensive coffee production. Third, farmers who do not join the FCCP (including unemployed young farmers) may have little incentive to conserve forest ecosystems. Fourth, the RA's auditing system was not stringent enough to fully detect the social and ecological changes in a timely manner. Although OFWE and JICA have made enormous efforts to establish FMAs, develop forest conservation plans, designate boundaries, provide incentives through FFS and

FCCP, establish Internal Control System, and raise awareness, these efforts might have been overwhelmed by the above-mentioned societal circumstances.

In order to ensure successful implementation of certification schemes, we propose the following recommendations. First, population growth rates as well as industrial structure and educational opportunities in the targeted areas should be well considered when introducing certification schemes. The Oromia State had high population growth rate and less educational opportunities, while its industrial structure was highly dependent on agriculture. Due to the limited employment opportunities, scarcity of lands, and insufficient access to higher education, the increased number of local people had no choice but to expand agricultural lands to sustain their livelihoods. As the government accelerated coffee production, and since coffee provided good income generation opportunities for forest dwellers in the Belete-Gera forest (Mengist et al., 2013), we presume that more individuals were incentivized to practice coffee production to earn their living expenses. Farm/garden expansion may have also obscured the boundaries between certified and non-certified areas or protected forest and farmlands, thereby facilitating further expansion of human settlements.

Resilience is an important aspect to consider when pursuing to build sustainable communities. “Community resilience” is the capability of a community to prepare for, recover from, or adapt to adverse events (Cutter, 2022). It is often evaluated by measuring various capitals, including human capital (i.e., age, educational levels, shared beliefs), financial capital (i.e., employment, livelihood, wealth), natural capital (i.e., natural resources, environmental conditions), social capital (i.e., social networks and connectivity among individuals and groups), built environment capital (i.e., material assets, buildings, infrastructure), and political capital (i.e., access to the power to influence distribution of resources) (Cutter, 2022). Though the communities of Oromia State had relatively good access to forests (natural capital), they lacked opportunities for education (human capital) and employment (financial capital), which made them less resilient. Due to the lack of human and financial capitals, it appeared that the population increase directly expanded the pressure on the forest resources (natural capital), since their livelihood options were limited to agricultural land expansion or coffee production in the forest. Negative impacts on the natural capital may further reduce the levels of community resilience since degradation of forest ecosystems would deprive of their economic and livelihood opportunities (Kelly et al., 2015; Jarzebski et al., 2016). Therefore, when the government or other practitioners introduce certification schemes in areas experiencing high population growth rates, it is important for them to concurrently provide support to enhance opportunities for higher education and alternative employment without causing negative impact on natural capital. Previous study suggests that human capital, particularly learning ability and flexibility, play a significant role in strengthening community resilience, as it provides opportunities to seek for alternative income sources (Arai et al., 2022). Assisting vulnerable communities to enhance human capital and financial capital may eventually reduce the risks of negative impacts on the natural capital through provision of alternative livelihood options, while increasing the potentials for building ecologically sustainable and resilient communities.

Second, government policies should be made consistent with the objectives of the certification schemes. The Ethiopian government have enforced conflicting policies in the same forest area since 2010: Where the OFWE aimed to protect forest ecosystems, Ministry of Agriculture and Rural Development accelerated agricultural commercialization and agro-industrial development. Moreover, Ethiopian Coffee and Tea Authority promoted intensive coffee production to maximize yields for exports. These double-standard policies may have confused both agricultural extension officers and local farmers, and could have encouraged farmers to pursue intensive coffee production instead. Government authorities in charge of environmental conservation and agricultural development should collaborate and develop an integrated policy that can facilitate the simultaneous achievement of ecosystem conservation and sustainable livelihood development. Practitioners who plan to introduce certification schemes should always be aware of government policies in relevant sectors and should help coordinate to establish cooperating relations among the local and national government bodies to align the objectives of the relevant stakeholders.

Third, it is recommended that farmers residing in forest areas be provided with direct incentives for forest conservation. FFS was introduced as an incentive for all FMA members to participate in the project. Forest coffee certification was added as another incentive for FMA members who were already harvesting coffee beans. However, based on our findings, these efforts were insufficient to encourage all FMA members to conserve the forest resources. The FCCP incentivizes the participants to conserve forest ecosystems and gain access to premium prices. If the forests are degraded, the certification will be cancelled and farmers will not be able to sell coffee at a premium price. On the other hand, although FFS appeared to be attractive for farmers who wished to improve their agricultural skills and knowledge, it might not have encouraged conservation efforts, as FFS in itself is not a forest conservation practice. In other words, even if farmers do not make any efforts to conserve forests, they can still benefit from joining FFS. This is different from the FCCP, where farmers would not be able to obtain benefits if they deviate from environmentally sustainable practices. Although we can appreciate the goal of the FFS component (i.e., reducing agricultural land expansion by increasing productivity), our results imply that more direct incentives might have been necessary to keep all FMA members compliant with the Forest Management Agreement.

Finally, we would like to recommend the RA to oblige a more stringent on-site inspection that can comprehensively assess the ecological conditions of the certified area. As indicated by the respondents, some local inspectors may not be reliable. In addition, local hosts may attempt to minimize the duration of inspection to reduce the travel expenses of auditors. We suggest that the RA should bear the travel costs of auditors, and that the auditors should ensure that the selected sites for inspections appropriately represent the ecological and social conditions of the entire certified area.

6 Conclusion

While agricultural certification programs are being introduced around the globe, reports have mainly focused on the outcomes of a single aspect of certification (e.g., ecological or economic) within a short time frame, and few studies have paid sufficient attention to the long-term outcomes of certification programs. This case study attempted to explore the realities of an RA-certified coffee forest based on the perceptions of stakeholders who have been involved in the program for over 10 years. Combining in-depth qualitative interviews with key informants with field observations and secondary data collection, we recorded some possibilities of incompliance, particularly in terms of forest ecosystem conservation, and several social factors that may have led to deforestation and forest degradation inside the RA-certified coffee forest areas. Although our study findings cannot be generalized, they still highlight the following concerns.

1) Farming practices in certified coffee forests may not satisfy the core requirements of the RA Sustainable Agriculture Standard (2020), especially in terms of clearing large trees and understory vegetation and planting non-native coffee seedlings.
2) A rapid increase in population, government policies promoting intensive coffee production, farming practices by individuals who did not participate in the certification program, a lack of incentive to conserve the forest, and loopholes in the auditing process may have all contributed to the deforestation and degradation of the certified coffee forests.

Our findings suggest that practitioners who introduce certification schemes should consider population growth rates as well as employment and educational opportunities, since they may ultimately influence the effectiveness and sustainability of the certification program. Understanding the latest government policies and promoting collaboration among relevant government authorities is also important to avoid unnecessary confusion among stakeholders. Practitioners should also provide direct incentives for environmental conservation to all farmers living in or near the certified areas in order to ensure collective action. RA is also recommended to conduct a more stringent and comprehensive on-site inspection.

Further research is necessary to evaluate the long-term ecological impacts of certification programs compared to non-certified areas. Effective monitoring can be achieved by combining field data with satellite image analysis of species richness and canopy cover, respectively. Additionally, social surveys considering different certification programs in various socio-economic and ecological contexts can be used to determine the major barriers and enabling factors of conservation success. Needless to say, a combined analysis of relevant ecological and socioeconomic factors is necessary to obtain a more holistic understanding of the effectiveness of certification schemes and allow practitioners to establish a more adaptive conservation management approach.

Author contributions

This study was initiated and conceptualized by YA under the supervision of KH and TY. TY conducted the field observations and interviews and summarized the findings. The writing process was led by YA in collaboration with KH and TY. All authors contributed to the article and approved the submitted version.

Acknowledgments

We would like to express our sincere gratitude to Japan International Cooperation Agency (JICA) for providing financial assistance in conducting field observations and interviews. We would also like to thank Fumiaki Saso, Taichi Morinaga, who were the former JICA experts, and all the Ethiopian staff members of the project for their kind support and valuable comments.

Conflict of interest

Author TY is employed by the Appropriate Agriculture International Co., Ltd.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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