

## Winners and losers: Exploring the differential impacts of agricultural expansion in Ethiopia and Ghana

Nugun P. Jellason<sup>a,h,\*</sup>, Elizabeth J.Z. Robinson<sup>b</sup>, Pamela Katic<sup>c</sup>, Joanne E. Davies<sup>a</sup>, Adam J.M. Devenish<sup>d</sup>, June Y.T. Po<sup>c</sup>, Adrienne Martin<sup>c</sup>, Selase K. Adanu<sup>e</sup>, Tagel Gebrehiwot<sup>f</sup>, Hailemariam Teklewold<sup>f</sup>, Phil Franks<sup>g</sup>, Barbara Adolph<sup>g</sup>

<sup>a</sup> School of Agriculture, Policy and Development, University of Reading, Earley Gate, Whiteknights, RG6 6EU, UK

<sup>b</sup> Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science (LSE), Houghton Street, London, WC2A 2AE, UK

<sup>c</sup> Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime, Kent ME4 4TB, UK

<sup>d</sup> Department of Life Sciences, Imperial College London, South Kensington Campus, London SW7 2AZ, UK

<sup>e</sup> Department of Environmental Science, Ho Technical University, Ghana

<sup>f</sup> Environment & Climate Research Center (ECRC)/Policy Studies Institute (PSI), P.O.Box 2479, Addis Ababa, Ethiopia

<sup>g</sup> International Institute for Environment and Development, 235 High Holborn, Holborn, London WC1V 7LE, UK

<sup>h</sup> Teesside University, International Business School, Clarendon Building, Tees Valley, Middlesbrough, TS1 3BX, UK

### ARTICLE INFO

#### Keywords:

Trade-offs  
Smallholder farmers  
Sustainable livelihoods  
Agricultural expansion

### ABSTRACT

This paper examines how smallholder farmers are differentially affected by agricultural expansion in their communities and landscapes. Contributing to the debate on intensification versus expansion, and implications for sustainability, we employ mixed methods research with smallholders in four communities in Ghana and Ethiopia to explore the impact of agricultural expansion among different social groups (men, women, the young, older, the poor and rich community members) across different timescales. Surveys were conducted with 200 households per community on livelihoods, land management practices and involvement in agricultural expansion. Focus group discussions were conducted with different categories of farming households to support the initial surveys.

Results indicate that agricultural expansion may have both negative and positive effects on livelihood outcomes depending on timescale, participation in expansion, choices of other households, and individual roles in the household. Short-term wins are likely to result in losses in the long-term due to changing conditions. Households that have not expanded may lose benefits such as food and income from nature, due to the externalities resulting from the activities of expanders.

### 1. Introduction

Smallholder farming households in Sub-Saharan Africa (SSA) operate in complex landscapes, with multiple challenges such as poverty, malnutrition, food insecurity (Foley et al., 2005; Godfray et al., 2010; FAO, 2018a; Jiren et al., 2020), poor soil fertility, and land access constraints (Jayne et al., 2012). The area of land cultivated in lower-income countries is estimated to increase by over 47% by 2050 (Barbier, 2005), with about two-thirds of this new farm coming from forest conversion (Barbier, 2004). Indeed, between 2001 and 2015, 92% of

deforestation in Africa was due to agricultural expansion by smallholders (Curtis et al., 2018; Ngoma et al., 2021). The demand for cultivable land, and the pressures this puts on broader landscapes, is a challenge that is occurring amidst population growth pressures, and natural disasters (Jiren et al., 2020) as recognised in the United Nations' Sustainable Development Goals (SDGs) (UN, 2015).

Smallholder rural households often rely on a combination of agriculture, non-farm activities, and forest products for food and income. Reconciling food security needs and environmental damage tends to be difficult in real landscapes (Fischer et al., 2017) in part because

\* Teesside University International Business School, Clarendon Building, Teesside University, Middlesbrough, Tees Valley, TS1 3BX, UK.

E-mail addresses: [n.jellason@tees.ac.uk](mailto:n.jellason@tees.ac.uk) (N.P. Jellason), [E.J.Z.Robinson@lse.ac.uk](mailto:E.J.Z.Robinson@lse.ac.uk) (E.J.Z. Robinson), [P.G.Katic@greenwich.ac.uk](mailto:P.G.Katic@greenwich.ac.uk) (P. Katic), [joanne.davies@reading.ac.uk](mailto:joanne.davies@reading.ac.uk) (J.E. Davies), [a.devenish@imperial.ac.uk](mailto:a.devenish@imperial.ac.uk) (A.J.M. Devenish), [J.Y.T.Po@greenwich.ac.uk](mailto:J.Y.T.Po@greenwich.ac.uk) (J.Y.T. Po), [A.M.Martin@greenwich.ac.uk](mailto:A.M.Martin@greenwich.ac.uk) (A. Martin), [phil.franks@iied.org](mailto:phil.franks@iied.org) (P. Franks), [barbara.adolph@iied.org](mailto:barbara.adolph@iied.org) (B. Adolph).

<https://doi.org/10.1016/j.crsust.2022.100176>

Received 25 November 2021; Received in revised form 26 June 2022; Accepted 6 July 2022

Available online 14 July 2022

2666-0490/© 2022 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

biodiversity conservation and food security are intricately linked through livelihoods, governance arrangements and land use practices (Chappell and LaValle, 2011, Sunderland, 2011). Natural habitats such as forests, scrub, and grasslands can be conceptualised as common pool resources that contribute to livelihoods through the provision of diverse products and services (Newton et al., 2016; FAO, 2018). Forests in low- and middle-income countries provide income, medicine, fuel, and food for over one billion people (FAO, 2018; IPBES, 2019).

Smallholder households often do not have the opportunity or ability to purchase or rent additional agricultural land to increase their agricultural production (Jack, 2013). Therefore, they are left with choosing between intensification on existing land to increase productivity and yields, or expanding into uncultivated land (Potapov et al., 2022). Both options have implications for environmental sustainability, as is explored in the land sparing-land sharing literature (Phalan et al., 2011). This choice is likely to be constrained, for example, some farmers may not have access to savings or credit that is needed to intensify agricultural production and so their only option is to expand, if land is available and the household has sufficient labour to clear that land.

Smallholder households' decision-making processes are influenced in part by their perceptions of the consequences of agricultural expansion, on their wellbeing and others in the short and long term. Whilst the decision of one farmer to expand into uncultivated land might have little impact on the landscape and livelihoods of other farmers, the collective decisions of many farmers to expand can result in a complex pattern of "winners" and "losers" that can evolve over space and time.

Despite considerable attention in the literature to wellbeing, income, and gender inequality in rural landscapes, the distribution of social benefits generated by change in land-use at local level among stakeholders and its impacts on equity have seen little to no consideration in landscape planning projects (Vallejos et al., 2020) and ecosystem services governance literature (Lehmann et al., 2018). There is therefore considerable scope to address the trade-offs between agricultural expansion for food, income, and environmental conservation. By understanding how farmers perceive the short- and longer-term livelihood impacts of agricultural expansion, it is possible to better inform agricultural practices and policies, thereby affecting progress towards achieving the Sustainable Development Goals (SDGs), in particular SDG 2 zero hunger, SDG 10 reduced inequalities, and SDG 15 life on land (Byron and Arnold, 1999; Daw et al., 2011; Newton et al., 2016; IPBES, 2019).

This study sets out to understand how rural people perceive the impacts of agricultural expansion on their wellbeing and the wellbeing of the community, taking into account their and others' actions on individual and collective benefits from the broader landscape. We take a case study approach to investigate the perceived positive and negative impacts of agricultural expansion on smallholder rural livelihoods, comparing experiences in Ethiopia and Ghana. The design, communication and outcomes of agricultural and economic policies can be enhanced if they are informed by the needs and perceived risks of smallholder households in relation to their decision-making on agricultural area expansion.

The next section contextualises our work within the literature. Section 3 describes the data and methods; section 4 presents the results; section 5 discusses the implication of the findings and then concludes.

## 2. Literature

Evidence suggests that, to date, increases in agricultural production in Africa have been primarily a result of area expansion rather than land intensification (Udonian and Robinson, 2018; Franks et al., 2020). Area expansion, also known as agricultural expansion, refers to the change in land use from natural vegetation to agriculture (Arvor et al., 2012), typically resulting in loss of natural habitats that are rich in biodiversity (Laurance et al., 2014) that provide a broad range of ecosystem benefits. However, the loss of these uncultivated lands may

also bring benefits to households, for example, if it results in less crop damage by wild animals (Mfunda and Røskaft, 2011). The area covered by both planted and natural forest in sub-Saharan Africa (SSA) has declined by about 8 million hectares (ha) between 2000 and 2015 (Fenta et al., 2020), and is likely to continue to decline, due to population pressure and the associated demand for arable land for food and nutrition security. As such, resource scarcity, habitat loss and associated trade-offs will continue to rise.

The impact of agricultural expansion on livelihoods is likely to be mixed (Pellikka et al., 2013). In many cases, individual households may experience both positive and negative impacts of agriculture expansion, and their expansion choices are likely to take into account such trade-offs (Pellikka et al., 2013, Takasaki et al., 2001, Illukpitiya and Yanagida, 2010, Hirons et al., 2018, Beyene et al., 2019). When a household expands their agricultural land into uncultivated land, they are likely to benefit economically or in terms of food security from increased crop production, whereas the lost benefits from not conserving uncultivated areas such as forests and other natural habitats affect the broader community. However, ecosystem services, such as pollination and regulation of micro-climates, are important for agricultural production, and so if many households expand their farming into natural habitats, they might all start to experience a loss of such services. This is a classic example of a situation where households that expand into uncultivated land do not internalise the externality they impose on other households. As such, even where smallholder farmers are cognizant of the importance of natural habitats, those farmers may still choose to expand their landholdings, especially if they are not able to intensify their agricultural production, such as due to credit constraints. Even though some farmers are able to intensify, some may expand at the same time because it is profitable. A knowledge gap remains in understanding how smallholder farmers perceive the impacts of agricultural expansion for themselves, for others and for the broader landscape across multiple time horizons.

Conceptually, this paper draws on the work of Ostrom, who observes that the use of common pool resources can result in gains and losses across a broad landscape (Ostrom, 1990). Winners and losers are likely to emerge where the use of a common pool resource by one stakeholder reduces its availability for the other stakeholders (Daw et al., 2011; Gusenbauer and Franks, 2019), or reduces the ecosystem services that are provided across the landscape. For example, expansion of land into common areas could lead to de facto conversion and privatisation of the common resources by expanders thereby excluding the other community members both from the benefits previously extracted from the common areas and from the option to themselves expand their agricultural landholdings in the future.

Trade-offs exist in part due to competing needs and objectives (Daw et al., 2015; Hou-Jones et al., 2019). For example, from a socio-ecological perspective, ecosystem services trade-offs could exist either among the availability of provisioning ecosystem services (e.g., timber or wild edible plants) or between the availability of provisioning or regulating ecosystem services (e.g., timber or erosion control) (Gusenbauer and Franks, 2019). Trade-offs are often value laden, yet without understanding the values and perspectives from stakeholders across social strata, these values would likely be opaque to decision-makers. The trade-offs impact various stakeholders differently based on their competing needs, as use of one service or product could make other services or products unavailable. Beyond material needs, trade-offs could also be differentially perceived by different stakeholders due to their beliefs, values, knowledge and livelihood capacities (Gusenbauer and Franks, 2019).

Wellbeing trade-offs are likely to be ignored if losers are not carried along in decision-making due to political marginalisation or poverty (Daw et al., 2015). A shift in ecosystem services value from local to global value could further worsen existing inequalities (McDermott et al., 2013). In a study linking ecosystem services and inequality in Brazil, L terra et al. (2019) reported that the wellbeing of the poor is

more dependent on ecosystem services while affluent people can afford substitutes of ecosystem services. Similarly, [Beyene et al. \(2019\)](#), in a study on the contribution of non-timber forest products (NTFP) to livelihoods of coffee farmers in Ethiopia, found that poorer households depend more on forest resources as a share of total income than richer households. When vital ecosystem services and forest resources are threatened, households that depend on forests are disproportionately more vulnerable to negative impacts.

Beyond households that are highly dependent on ecosystem services, social groups across gender, age, and wealth are also vulnerable to negative impacts of agricultural expansion. Inequality across gender, age and socio-economic status can contribute to resource management failures and irreversible ecosystem change. Categorising the beneficiaries of an ecosystem service can enable scholars to understand the differentiated wellbeing impacts and address issues of more equitable resource distribution ([Gusenbauer and Franks, 2019](#)). Therefore, an analysis based on social groupings (e.g., age, gender, and wealth) is necessary to determine who derives which benefits from the ecosystem, and how the benefits contribute to their wellbeing.

### 3. Methods

To guide our fieldwork and analysis, we use a simple conceptual framework that focuses on a landscape of cultivated and uncultivated land; households of different socio-economic status and livelihood patterns that differ in households' preferences and abilities to expand their own area of cultivated land; and short- and long-term impacts of any land use changes. We used participatory approaches to explore local understanding of differences in household assets and characteristics and the ways in which these influence the different impacts people experience from land expansion.

#### 3.1. Characteristics of the study sites

This research is part of a research project titled, "SENTINEL: Social and Environmental Trade-offs in African Agriculture". Ethiopia and Ghana were selected to study the perceived trade-offs of agricultural expansion. Ethiopia is currently the second most populous country in Africa ([World Bank, 2022](#)) with an estimated 80% of the population residing in rural areas. It is undergoing ecosystem degradation with reported forest depletion of 3.6% between 2001 and 2020 ([Tadesse et al., 2014](#); [Global Forest Watch, 2022](#)). Similarly, Ghana has one of the highest reported rates of forest depletion in Africa, estimated at 3% per year ([Forestry Commission And National REDD+ Secretariat, 2017](#)).

Two research sites were selected per country: Asgede Tsimbila and Adiyo in Ethiopia and Dompem and Walembelle in Ghana for the quantitative survey. The research sites were selected based on 8 criteria. The site: i) has recently undergone agricultural expansion into natural vegetation, ii) has a mix of arable and natural habitat and not currently nominally under high level of protection, iii) has agricultural expansion that is partially driven by the production of food crops for consumption and sale, iv) has agricultural expansion that is largely practised by smallholder farmers, v) is accessible by road, vi) is deemed safe for field work, vii) is of high relevance to agricultural or conservation policy interests, viii) has communities that are willing to participate in research activities. Asgede Tsimbila is an administrative district, also called "woreda" that is located in the Tigray region, with a population density of 48 per square kilometre and a population of 135,621 based on the 2007 Census of Ethiopia ([Haftu and Sathishkumar, 2020](#)). Adiyo woreda is located in the Southern Nations, Nationality and Peoples (SNNP) region bordering the Kafa Biosphere Reserve in the Kafa Zone and covers an area of about 1748 km<sup>2</sup> ([Teshoma, 2019](#)). Crops grown in the two districts include barley, wheat, tef and maize. Due to the crises in Ethiopia, a follow-up qualitative data collection was carried out in Adaba and not Asgede Tsimbila as Adaba was one of the communities selected for an initial reconnaissance survey of six communities and later

dropped to select only two communities for in-depth quantitative survey.

In Ghana, Dompem is in the Western region and Walembelle is in the north, in the Upper West region ([Fig. 1](#)). The Western region covers 23,921 km<sup>2</sup> and is home to about two million people with a population density of 148.6 while the Upper West region covers 18,476 km<sup>2</sup> and is home to about nine hundred thousand people ([GSS, 2010, 2021](#)) with a population density of 49 people. Dompem falls within the Guinean forests of West Africa with rich biodiversity, and one of the 36 world's most important biodiversity areas ([Forestry Commission, 2016](#)). Crops grown in the two research sites in Ghana include cassava, maize, yam, and cocoa. The choice of sites and country was informed by the increasing focus of policy on food self-sufficiency at the expense of the forest and other natural habitats such as grasslands.

#### 3.2. Sampling approach, data collection and analysis

A mixed methods approach was employed for quantitative survey followed by a qualitative data collection between September 2020 and August 2021. For the quantitative survey in Ethiopia and Ghana, four villages were selected in each research site and fifty households were sampled using a random sampling technique from each village. A total of 200 households were administered quantitative surveys in each site per country covering topics about source of livelihoods, social protection, household and farm assets, food consumption, land characteristics, environmental challenges, farm management practices and production activities. Other themes include farmer perception of land-use change and involvement in agricultural expansion. Survey instruments were adapted to country context based on the means of livelihoods, land management practices and household involvement in agricultural expansion. Surveys were conducted in Twi and Dagaare languages for Dompem and Walembelle in Ghana, respectively, and in Amharic language for Asgede Tsimbila and Adiyo in Ethiopia. The surveys lasted between one hour to one hour forty minutes. Statistical Packages for the Social Sciences (IBM-SPSS) version 26 and Stata version 16.0 (STATA-CORP, College Station, Texas) were used to analyse the quantitative data.

For the qualitative data collection on social groups and their experience of the impacts of agricultural expansion, a rapid participatory analysis of social difference was carried out in each community. A simplified form of wealth ranking ([Grandin, 1988](#)) was carried out with community leaders and representatives. They described the characteristics of different wealth groups generating context specific indicators to differentiate households in terms of wealth and well-being.

The generated profiles of three to four wealth groups per community - the wealthy, those of medium wealth, the poorer and in some locations, the very poor/destitute. Participants for focus group discussions (FGDs) were selected from households in the wealth categories identified (wealthy, medium and poor groups of mixed gender), and from youth, women and men separately - a total of six FGDs per community except Adaba which did not have a need for a separate youth FGD as the youth constituted the 'mixed wealth group' (See Appendix). Farmers' perceptions of the impact of agricultural expansion and who gains, or losses were explored in the different groups and farmers indicated which were the most important impacts and whether impact was short- medium-or long-term. Impacts were regrouped by the facilitator and participants to harmonise before voting and ranking. Ranking was carried out by various groups in order of importance (see appendix). Consensus was reached on the importance of the impact through ranking of impacts by each FGD participant based on allocation of two coins for high importance and one coin for low importance. Votes were aggregated by the facilitator for each impact listed and ranks allocated. Nvivo qualitative data analysis software was used for thematic analysis.

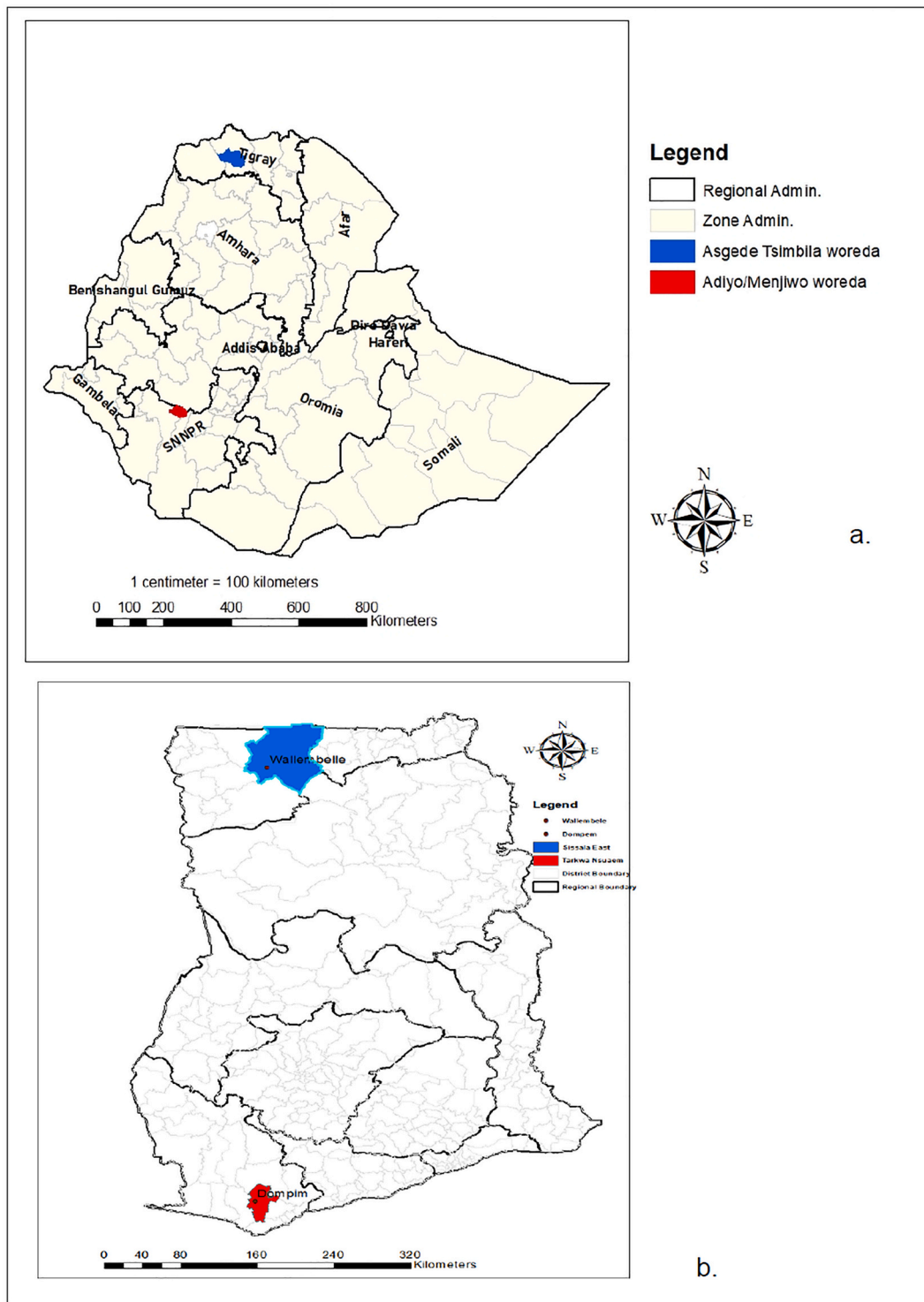


Fig. 1. Maps of the study sites in Ethiopia (a) and Ghana (b).

#### 4. Findings

This section presents the perceived differential impacts of agricultural expansion by smallholder households across social groups and timescales in Ethiopia and Ghana. We first consider the extent to which households rely on common pool resources sourced from uncultivated lands. We then examine the different groups benefitting or harmed by agricultural expansion.

Across all four study areas, wealth differences were perceived as

linked to the scale of ownership or access to natural assets in the form of land and livestock. In Dompem for example, wealthy farmers have large family lands, around 35 acres of farmland, and 30–50 acres of cocoa or rubber, compared to 10–20 acres and 20 acres of cocoa /rubber in the medium wealth group and 2 acres, and 1 to 5 acres of cocoa/ rubber in the poorer group. Similar contrasts in land ownership were found in Walembelle and Adiyu. However, other factors of social difference, particularly gender and age, are also important as associated social norms and practices influence access to land and resources and ability to

utilise them. Gender and age intersect with wealth status – it was found that women and youth were proportionately more represented in the poorer wealth groups, while older men predominated the highest wealth category.

Closely linked to differences in assets are differences in the ability to access a broad range of further benefits, in terms of crop production and income, food security, investment in farm inputs, children’s education, housing, business and transport etc. Social factors such as the ability to support poorer households and hold social celebrations were also mentioned by FGD participants. Agricultural expansion is influenced by the capacities and assets of different social groups and will result in different impacts. Similarly, the negative impacts of agricultural expansion are linked to the resources on which people mostly depend for their livelihoods.

4.1. Extractive benefits from common uncultivated lands

Respondents mentioned a broad range of extractive activities that households undertake in uncultivated lands. These activities include, food and cash crop production, hunting of wild animals, recreation, collection of construction materials such as thatch, timber, and more broadly non-timber forest products (NTFPs) such as medicinal plant, honey, and spices (Table 1).

Whilst quantitative survey respondents in Adiyo and Asgede Tsimbila reported low to moderate prevalence of crop farming in uncultivated land, reflecting patterns of shifting cultivation (Table 1), they also reported a wide variety of livelihood activities that are dependent on forest resources. Fuel wood collection, charcoal production, timber logging, and livestock grazing were the three most frequently reported activities, followed by collection of animal fodder, thatch roof material, medicinal plants, honey, and spices.

Respondents from Walembelle, Ghana, indicated crop farming in forests (24%), with 65% of respondents in Walembelle reported collecting NTFPs to support their livelihoods. However, reported crop farming in forests of Dompem remained below 10%. Livelihood activities such as timber logging, fuel wood collection, and charcoal

**Table 1**  
Frequency (%) of forest resource dependent livelihoods’ activities engaged by research participants for communities in Ethiopia (n = 200/site) and Ghana (n = 200/site).

Livelihoods’ activity	Ethiopia		Ghana	
	Adiyo Frequency (%) <sup>a</sup>	Adgede Tsimbila Frequency (%)	Dompem Frequency (%)	Walembelle Frequency (%)
Timber logging (Bamboo, craft, and construction materials)	91 (45.5)	62 (31)	5 (2.50)	33 (16.50)
Fuelwood/ charcoal production	107 (53.50)	79 (39.50)	7 (3.50)	43 (21.50)
Collection of fodder/grass	23 (11.50)	34 (17.00)	31 (15.50)	41 (20.50)
Collection of non-timber forest products (medicinal plant, honey, spices)	10 (5.00)	15 (7.50)	31 (15.50)	135 (65.50)
Crop farming in the forest	37 (18.50)	96 (48.00)	8 (4.00)	48 (24.00)
Livestock grazing in the forest	34 (17.00)	70 (35.00)	20 (10.00)	12 (6.00)

<sup>a</sup> Percentage does not equal 100 as participants are engaged in more than one livelihood activity.

production were reported to remain at low prevalence (Table 1).

4.2. Perceptions of land-use change

Our survey indicated that there has been considerable increase in agricultural land expansion by smallholder farmers in the study areas. Some expansion has been into areas previously cultivated by other households, some expansion has been into uncultivated areas (e.g., forests and grasslands).

Expansion into previously uncultivated land enables households to continue food crop cultivation on newly expanded fertile lands. With increased food production, households can store some food for later consumption and additional income from sales of surplus food helps families to cater for their children’s needs, especially health, education, and training.

To explore how farmers have perceived environmental changes in their communities, we asked whether they found there was a change in land use and land cover change in their communities (Fig. 2).

In Dompem, Ghana, about 85% of respondents reported they increased the area of land they cultivate; mainly by sharecropping (53.6%) borrowing land (10.3%); and expanding into nearby forest (14.4%). Respondents in Walembelle reported expanding their farmland into uncultivated areas and about 75% of the respondents perceived that expansion into previously uncultivated areas is generally happening in the community, specifically into nearby forest (32.1%), borrowed land (23.2%) or common grazing areas (19.6%) under use. Overall, the respondents perceived there has been various land-use/ land cover change in their communities.

4.3. Perceived positive impacts among different social groups

4.3.1. Different social groups

Focus group discussion participants reported that well-off men are often the main beneficiaries of agricultural expansion, because they have the land and the capital to invest in cultivating large areas for food and commercial farming. However, low and medium wealth farmers also identified very clear tangible benefits from expanding their agricultural landholdings. For example, a FGD participant stated that:

*‘Our income increased when we expanded our farms, some of us were able to build our own houses and acquire some personal properties.’* (Poor FGD, Dompem).

*‘Through expansion, we increase the number of cash crops (e.g., cocoa and rubber) that we harvest yearly to increase our income from crop sales.’* (Medium wealth FGD, Dompem).

Considering perceptions of positive impacts from other groups:

*‘On a positive note, the expansion has resulted in the non-availability of animals such as monkeys and other rodents that used to destroy our crops.’* (Women’s FGD Walembelle).

Now because wild animals are disappearing, monkeys and other animals no longer destroy crops on a large scale as compared to the past, which at least one participant perceived as a positive benefit. A mixed group in Ethiopia also reported increased yield, and increased income. Other benefits recorded include reduction in cost of fertilisers as the land the lands are fertile in the first 2–3 years after clearing. There was a consensus about agricultural expansion leading to increased yield among all social groups in Adiyo, Ethiopia.

For some farmers, the social reputation from successful farm expansion is important:

*‘You get fame. With your small corner farm, you cannot be a best farmer in the district or the whole country but with expansion on your farm and taking good care of it, I think you can gain something out of it.’* (Men’s FGD Walembelle).

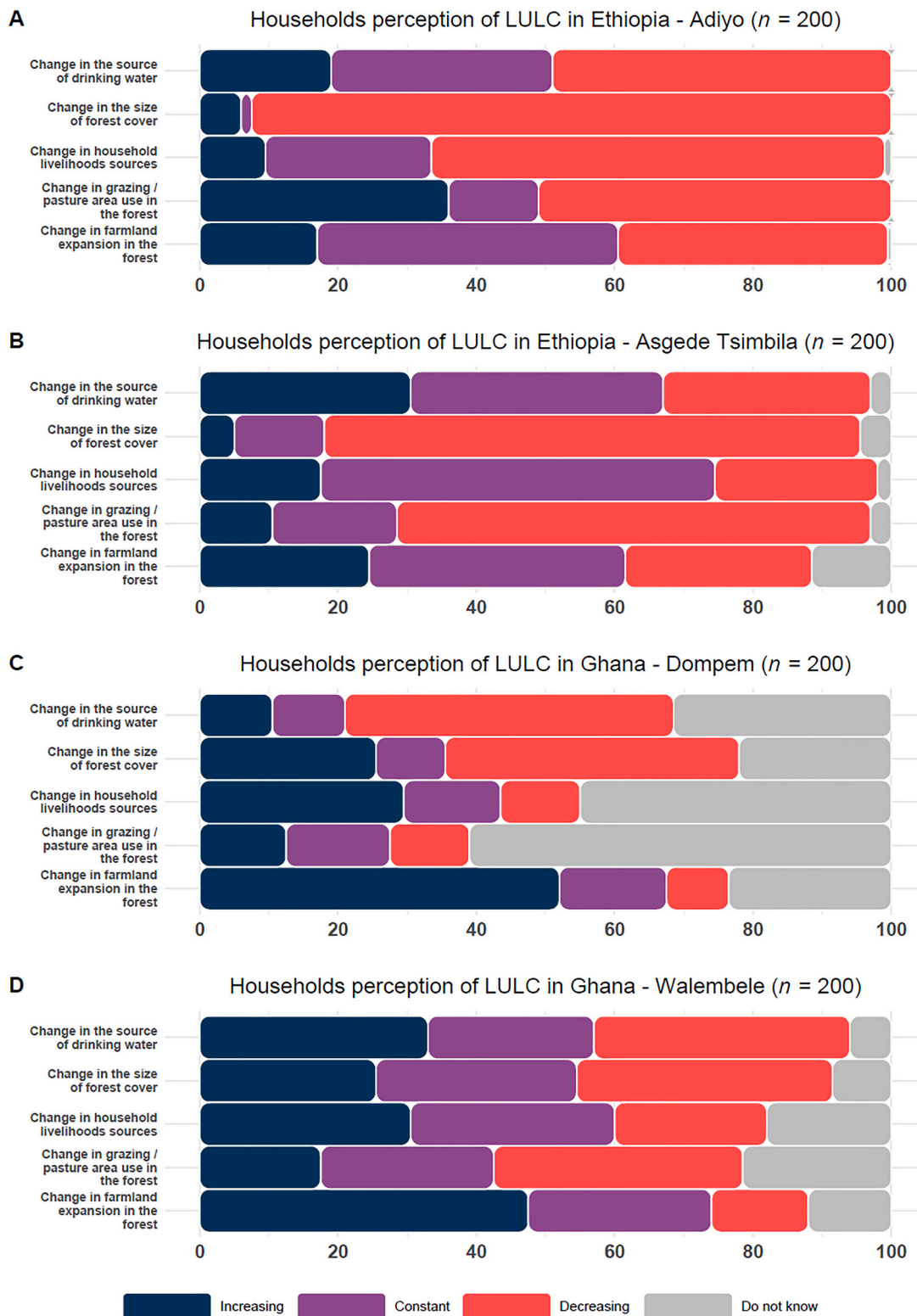


Fig. 2. Household perception of land use/ land cover change in Adiyo (A); Asgede Thembela (B); Dompem (C) and Walembelle in Ghana (D).

The benefits that farmers get over time from expansion evolve and change, due to the cyclical nature of cocoa and rubber farming.

*‘Although we expanded our farms, most of us plant cash crops and food crops for the first three years. However, after the third year, we cannot plant food crops again because of the canopies of cash crops such as cocoa or rubber plants. Due to this phenomenon, most of us have only cash crops*

*on our lands and we do not have any available lands to cultivate food crops. This therefore leads to the reduction in food crop production in our community.’ (Men’s FGD, Dompem).*

This illustrates how the cycles of food and cash crops are interwoven. Although pressure to expand cultivation to improve access to home grown food is alleviated in the early stages, as the tree crops mature, the

demand for food crops intensifies. In addition, the dynamic of cash and food crop farming are overlaid by family development cycles; for example, as households increase in size, so do their food demands.

*'[an] increase in family size comes with responsibilities, which requires you to expand the farm in order to get more yield to feed them.'*

(Men's FGD, Walembelle)

#### 4.4. Perceived negative impacts (losses) of agricultural expansion among different social groups

Although there is considerable common ground on the negative impacts among the different wealth and social groups, the importance of these are ranked differently and some are specific to a particular group (see appendix).

##### 4.4.1. Wealthy farmer group

The wealthy farmer groups (which were comprised mostly of men) identified the negative impacts of agricultural expansion as reduced rainfall, declining soil fertility, loss of firewood (with a particular impact on women who do the cooking), loss of natural manure, wild fruits and bushmeat; crop failure and lack of wood for building materials. They also mentioned the deterioration of land quality due to chemicals and the loss of medicinal plants due to herbicide use. These were mainly medium to long term impacts, although some, such as loss of firewood and building materials, can be immediate.

*'When we first settled here, farming wasn't very popular as compared to now and we had a good rainfall pattern. However, due to the clearing of forests and trees, I believe it has had an impact on rainfall in this community. It doesn't rain as previously and that has had an impact on farming in the form of poor crop growth and reduced yield.'*

*'Previously, bush animals such as deer, rats and antelope were commonly seen in our farmlands, however, the bush animals have become scarce, and I believe that is due to agricultural expansion.'* (Wealthier FGD Dompem).

These impacts identified were considered to affect men and women, richer and poorer farmers and the whole community. In Ethiopia, wealthier participants also identified the disappearance of medicinal plants (ranked highest of impacts), decrease in honey production and wild animals, rainfall fluctuation and disappearance of spring water.

*'Medicinal plants are vital for us as we have almost no access to drug stores or health facilities. We - both humans and livestock - are affected or become vulnerable to disease.'*

##### 4.4.2. Medium wealth farmer groups

In addition to impacts on land and forest resources, the medium wealth groups focused on the costs of agricultural expansion and the demands that maintaining an expanded cultivated area place on household budgets.

*'The point is, after starting the farm weeding becomes a problem, you need money to hire people. If you have an acre of land and want to expand to another acre, you have to sit down and budget for it. You have to ask yourself if you have money for the extra acre. So, your expenses will go up.'* (Medium wealth FGD, Dompem).

*'As we expand our farms, the amount of work that needs to be done on the farm also increases. This therefore increases our stress level. Some of the activities that lead to stress is weeding and spraying the farm. The more farmland you cultivate, the more stressful it is to maintain the farm'* (Medium wealth group Dompem).

The medium wealth group in Walembelle defined the main negative impacts of land expansion as the increased incidence of flooding and soil erosion when trees are removed, causing a reduction in soil fertility.

They also experienced increasing debt in managing land expansion. Community conflicts over disputed land boundaries were also ranked highly among negative impacts, followed by reduction in natural water sources especially for animals in the dry season, and the decline in availability of tree fruits and firewood. The group also mentioned the loss of grazing areas for livestock and the loss of medicinal plants.

In Ethiopia, the medium wealth group also mentioned the disappearances of communal grazing land which forced them to feed their livestock privately and buy supplemental feed. When feed is insufficient, the milk yield goes down. Similar concerns were voiced on the relationship between loss of forests and unpredictable rainfall -.

*'We believe that this uncertainty is due to [the] loss of forests, as forests are life, like water.'* (Medium Wealth FDG Adiyo).

They also suggested that the forest trees used to protect the soil from erosion and with forest clearing and cutting trees for individual benefit, they are losing topsoil in the area.

##### 4.4.3. Poor wealth group

One of the negative impacts of agricultural expansion mentioned by the poor wealth ranked groups was that it increases the workload necessary to maintain the farm:

*'if a farmer is managing farmland alone and extends to about 8 acres, an impact from this is that the workload on the farm will increase making it very difficult for the farmer to manage it, especially when the farmer lacks the financial capacity to hire labourers.'* (Poor FGD Dompem).

The next impact raised was the pollution of water bodies due to agricultural expansion and artisanal mining, resulting in loss of aquatic species. The loss of these resources which were previously free has led to increased household expenses:

*'It was much easier to catch fish and shrimps in our water bodies and this subsidized household cost for food. Because farm expansions have affected our water bodies, it has forced us to buy the fish and shrimps we got for free, and this has added to our living expenses. Also, it has become necessary to buy sachet drinking water when going to the farm and all these have added to the cost of farmers.'* (Poor FGD, Dompem).

Next ranked were the loss of wild animals and the incidence of pest attacks, especially army worm. Like the medium wealth group, the poorer group in Dompem mentioned land disputes which can arise over boundaries as land is extended. This particularly affects those involved in sharecropping who may be unfamiliar with the boundaries and risk eviction if they overstep. With limited land available, the expansion for cash crops has reduced the area and the quality of the land available for growing food crops, which risks creating food insecurity.

*'We have destroyed the land to the point where it is impossible to grow food crops without applying fertilizer even if you leave the land uncultivated for 3 years.'* (Poor FGD Dompem).

Additional impacts raised by this group were the destruction of trees as windbreaks to protect houses, health complications due to constant use of chemicals, and loss of locally available medicinal plants.

The group considered that these impacts affect everyone in the community. However, on specific areas, for example, the workload on the farm, there were divergent opinions, with some saying women were most affected, others saying both are equally impacted, noting that women do the cooking in addition to farm work, and others saying men were most affected as they do most of the physical work as well as the farm management. Expansion for this group is a gradual process so the impact on workload emerges in the longer term.

The poorer wealth group in Walembelle were affected by lower yields resulting from loss of soil fertility, siltation of water bodies, reduction of grazing and inter-family conflict. In Ethiopia, the poorer group emphasised the loss of resources associated with the forest - wild animals, fuelwood and quality timber trees. They also mentioned the

decline in the number of tourists which had affected the income of unemployed youths.

#### 4.4.4. Men only group

Among the important negative impacts identified by the men's group in Dompem was the destruction of water bodies through farm expansion and small-scale mining.

*'We used to have water sources on our farms where we could get water. When we go there, we can get water to drink, cook, and do other things. Because we have cut down the trees around the stream, there is water in it only during the rainy season. After a short period, it dries up because there is no shade to protect it.'* (Men's FGD Dompem).

This was followed by changes in rainfall patterns and scarcity of medicinal herbs linked with use of herbicides. Further negative impacts were reduction in cocoa harvest, scarcity of trees for building and charcoal making, reduction in food crops yield and scarcity of bushmeat and fish. People have switched to using gas for cooking or buying charcoal from elsewhere.

*'Our forefathers used to leave the younger trees on the farms, now we don't do that. You can see a 5 acres cocoa farm without trees. We cut down the trees because we want the cocoa to be free. We have to buy wood when we want to build. It's brought a lot of hardship to the town.'* (Men's FGD Dompem).

The men's group in Walembelle linked soil erosion and flooding to climate change, seeing it as a major issue in the community. They also identified an increase in workload, extinction of some animal species and scarcity of land. Several of the impacts cited by men in Ethiopia affected income generating activities, for example, the decline in honey production associated with the disappearance of bee foraging trees and the disappearance of wild coffee, both of which used to be good sources of income. They also highlighted the transition from communal to private grazing areas due to its conversion to farmland.

#### 4.4.5. Women only group

The women's groups highlighted impacts of agricultural expansion and the removal of trees, including changes in rainfall patterns which affect their farming, (ranked first in Dompem and Walembelle); the drying of water bodies, loss of fish and scarcity of water which affects their collection of water for the household. Other resources becoming scarce include medicinal plants, wood for firewood or building and bush meat. They also mentioned the increased workload on the farm with expansion. Like other groups they described the expansion of cash crops and the shortage of land for growing food crops which is a potential threat to food availability in the near future.

In this research, there were examples of women farming successfully, and it was evident that the sense of self-empowerment from this success was an important benefit to the women involved. An FGD participant in Walembelle indicated that she feels a sense of self-efficacy that comes with successful cultivation of a large portion of land, and that motivates her to expand. The participant reported that some farmers expand because they want to win the "best farmers' award" either within the District or the Region. The Best Farmer Award is associated with fame and financial benefits. Because it is mostly uncommon to see women farm large portions, male participants indicated that women feel a sense of accomplishment after successfully expanding their farm sizes, nurturing their crops, and increasing their yield. This is important as women rely on food crops for consumption and sale of surplus. The pressure on land is contributing to higher food prices which impacts on those that rely on the market for food supplies.

*'The land is finished so we don't get enough cassava and plantain .... We struggle to get food. .... so, if someone farms and they get food, they can give it to you at a price they want.'*

This is a particular problem for female migrants in Dompem who, as

they expand, they ultimately reach the limit of their allocated land and are unable to get any further space to farm.

Like the poorer farmers' group, the women emphasised the additional work involved in land expansion. Women are often less involved in agricultural expansion, because of the associated high physical demands of expansion and the increased amount of labour needed for a larger cultivated area.

*'We lack the physical strength to handle all the workload of a large farm as doubling one's farm doubles the farm workload'* (Women FGD Dompem).

The women's group at the Ethiopia site prioritised impacts which affected their specific roles and household responsibilities, for example the shortage of fuel wood which has meant travelling long distances for collection or incurring costs to purchase it; the increase in livestock diseases, affected by climate change and lack of medicinal plants for treatment has resulted in lower milk yield. The disappearance of communal grazing land with agricultural expansion has increased reliance on supplemental feed or fodder collection, which if not available also affects milk yield. They stated that, in the past, one cow used to produce more than seven litres of milk per day. However, this has fallen to three litres per day due to lack of grazing land and fodder in the area.

#### 4.4.6. Youth group

In addition to women, other less powerful groups within the community are relatively disadvantaged by agricultural expansion on unallocated land. Both migrants and youth within communities can lack the means to access or capitalise on the benefits of expansion. In the Dompem community, migrant farmers and the youth are unable to access farmland. Since people have expanded and used all family lands, unavailability of spare land reduces the opportunity for youths to become involved in farming. This adds to youth unemployment and pressures for youths to be involved in income generating activities such as illegal mining.

The youth group identified similar impacts to those of the lower wealth group and women's groups, for example, the importance of matching expansion to capacity in strength and finance. Other impacts reported were the drying up of streams, disappearance of aquatic life and wild animals which helped to maintain the fertility of the forest land, and lack of drinking water. Pest infestations on cocoa were also associated with the changes in the weather. The youth group in Walembelle reported that expansion limits the grazing area for animals, reduces the availability of wildlife, herbal plants and wood for building and sometimes creates conflict over rights to land. Land degradation was ranked the most important of the negative impacts of expansion, followed by the increased cost of acquiring herbal plants and building materials and then disappearance of wildlife, limited grazing and minor social conflict. A different point was raised by the youth group in Ethiopia who reported that agricultural expansion had encroached on areas where they used to play football.

There has been conflict between migrants and long-term residents over issues of land and expansion. In Dompem, some respondents noted how migrants are negatively impacted during the process of expansion. In some cases, a member of a family may give forested land to a migrant for sharecropping as highlighted here:

*'As the migrants worked and completely farmed the land allotted to them, a member of the family may claim that the migrants have encroached into his plot. Some such cases happened here where the family ended up in court as a result of land disputes. This situation sometimes makes migrants lose some of the plots on which they farm'* (Poor group FGD, Dompem).



#### 4.5. Winners and losers of loss of ecosystem services and products due to agricultural expansion in the short-, medium- to long-term

Farmers we interviewed generally depend on products and services from uncultivated areas such as the forest thereby leading to winners and losers at different timescales reported. These include loss of grazing areas, soil erosion, rainfall and water resources, timber and building materials, diversity of food sources, medicinal plants and fuelwood.

##### 4.5.1. Loss of grazing areas

The shortage of grazing areas has significantly reduced livestock production, primarily affecting the moderately wealthy and poor farmers. Poor farmers who are dependent on livestock are likely to be affected negatively.

In Ghana, it was reported that communal grazing land existed about ten years ago. However, as farmers expanded their farmlands, taking over most livestock grazing areas, it had become difficult for livestock herders to raise livestock in the dry and rainy seasons. The herdsman who graze livestock on common grazing areas in the forests in northern Ghana also indicated that they have limited land access for farming and no longer have areas for livestock grazing leading to conflicts between crop farmers and livestock owners in the dry season. In Ethiopia, participants stated that during the Derg regime (1980s), the communal grazing system was dominant as land was redistributed among the peasants with a communal grazing land allocated per community. The Derg is Amharic word for council or committee and the Derg regime refers to the armed forces Coordinating Committee that overthrew the Emperor Haile Selassie on 12th September 1974 as the Provisional Military Administrative Council (PMAC) (Kebede, 2011). However, none of the households currently practice communal grazing due to conversion of grazing areas to farmlands as a result of population growth.

##### 4.5.2. Soil erosion

FGD participants reported that the Adiyio community in Ethiopia is likely to be negatively affected by soil erosion, weather fluctuation and decline in crop productivity due to poor soils. In Adaba, Ethiopia, participants noted a decrease in tree cover, associated with changing rainfall. In Ethiopia, community members depend on farming for their household food security and the unavailability of fertile lands to support farming activities affects them negatively.

Farmers in Dompem, Ghana attributed loss of soil fertility to a decrease in the number of wildlife and the amount of animal dung they leave. At the same time, these impacts on soil fertility can also exacerbate existing inequalities as some farmers cannot afford to purchase fertiliser, meaning that they cannot mitigate the loss of manure as a source of fertiliser for their crops. Participants in Walembelle unanimously agreed that soil erosion is the number one impact of agricultural expansion. Also, forest clearing for agricultural production led to frequent occurrence of floods with impact on the communities living in the area.

##### 4.5.3. Rainfall and water resources

Several groups in Ethiopia associated climate change and variability with deforestation, including late onset of rain and increased temperatures. The participants in Ghana stated that farmers perceive a change in rainfall patterns compared to ten years ago. A medium wealth group participant argued that:

*'Currently, due to the clearing of the secondary forest to expand our farmland, many trees have been cut down. Which likely affects the pattern of our rainfall. Unlike the past when we had a stable and predictable rainfall season, currently, the pattern of rainfall has changed (Medium wealth FGD, Dompem).*

Some participants in Walembelle reported that the change in rainfall pattern affects production because farmers do not know when the rains

will start and end, hence affecting their planting decisions. However, agricultural expansion resulted in many trees being felled. Water bodies in the Dompem community in Ghana, such as the Soakodi, Aboabo and Nwururu, dry up in the dry season reducing access to water for drinking and livestock watering.

##### 4.5.4. Timber and building materials

Timber is said to be a major source of income particularly for the poor and youths in Ethiopia. This constitutes 45.5% and 31% as a source of livelihood in Adiyio and Asgede Tsimbila respectively (Table 1). Trees commonly used for timber are dokima (*Syzygium guineense*), tikur enchet (*Prunus africana*), and *Juniperus procera* and *Podocarpus falcatus* which are dominant in the Guta and Kaferesha protected forest areas in Ethiopia. Some participants in a community in Ghana explained unavailability of fallow lands has reduced timber availability:

*'Since most forest is cleared during farmland expansion, we no longer have access to wood to build our houses. In the past, however, we had access to such woods from fallow land.'* (Medium wealth FGD Dompem).

The entire community is also affected negatively because the price of building materials has increased, thereby increasing household expenditure in the community. Increase in workload for men as they must travel longer distances to collect construction materials.

##### 4.5.5. Diversity of food sources

Agricultural expansion has led to the disappearance of wild fruits in Ghana such as shea nut, which was previously in abundance. According to the participants in Walembelle, shea is now found in the forest reserve area only and entry to collect wild fruits is prohibited. Shea fruits are an important source of food for farmers while working in their fields. Hence, a decline means farmers would be affected in the medium-term. Women also depend on these wild edible fruits from the forest for income during the rainy season. In Adaba, Ethiopia, participants noted that a wild plant, Doobbii (*Urtica simensis*), commonly grows in fertilised land where cattle are kept.

It was reported that ten years ago, honey was produced in the forest with a good yield. However, honey production is now substantially reduced due to forest clearance. Dokima (*Syzygium guineense*) tree was said to be declining rapidly due to expansion in Adiyio; this tree is primarily used as forage for honeybees. Other trees such as Kosso (*Hagenia abyssinica*) are fast declining as agricultural expansion occurs.

##### 4.5.6. Medicinal plants

Agricultural expansion into forest land is also affecting the availability and range of plants used for medicinal purposes within the communities. Kosso is used as a medicinal plant. According to the female FGD participants in Ethiopia:

*'We used to collect a variety of medicinal plants whenever our children get sick. But now almost all are gone due to deforestation. Medicinal plants are vital for both people and livestock as we have almost no access to health facilities. Thus, both human and livestock are affected by the decline.'* (Female group FGD Adiyio).

In the Dompem community in Ghana, it was reported that it is very difficult to find some previously common medicinal herbs and trees. The herbalist in this area hires labourers to go into the forests in search of some medicinal plants, which were previously common around the community. A participant stated that:

*'Through the expansion of farmlands, we end up clearing all herbal plants that our forefathers used for medicinal purposes. As a result, we do not currently have such herbal plants in our community such as acheamong, Ntumrum, abekempon, sumpi, nkwadaankwadaa borode, yennyia and tuantini.'* (Men only FGD, Dompem).

In Dompem, participants reported they need to travel very far to

collect some of the known medicinal plants compared to prior to agricultural expansion.

#### 4.5.7. Fuelwood

A female FGD participant in Ethiopia indicated that it is difficult to get fuelwood around their homesteads as places where they used to collect fuelwood have been cleared for farming, and people are prohibited from collecting fuelwood from the forest reserve. This has had a negative effect particularly on women because they are responsible for collecting fuelwood and cooking for the households:

*'We used to collect fuelwood from the forest which is falling from the branch of forest trees for household cooking purposes and to sell some for income.'* (Medium wealth group FGD Adaba).

This broad range of both provisioning and regulating ecosystem services demonstrates what is at stake for all members of these communities in Ethiopia and Ghana. In the next section we discuss the implications of our findings and then conclude.

## 5. Discussion and conclusion

Agricultural expansion had diverse impacts on different social groups in the communities in Ghana and Ethiopia based on the perception of the different groups represented in the FGDs and surveys. In the short run, those who can expand benefit; but respondents tended to agree that in the long run the community as a whole was harmed through changes to weather patterns, soils, and access to common pool resources. As such, communities may be open to coordinated efforts to prevent expansion (carrots and sticks), but support might be needed to increase food security/productivity on existing land.

With significant rises in population predicted, food security in both Ghana and Ethiopia will pose an increasing challenge. Current evidence indicates that this challenge is likely to be addressed by increasing agricultural production through area expansion rather than by land intensification (Udondian and Robinson, 2018; Franks et al., 2020). We have aimed, in this paper, to highlight the importance of understanding this expansion through the differentiated impacts the expansion will have throughout the community. The significance of this approach is twofold.

Firstly, through our qualitative research, we have demonstrated that only certain sections of the community are in a position to undertake expansion of their agricultural land. These tend to be the wealthier, male farmers who have the resources and the labour input needed to cultivate larger farms. Agricultural expansion was found to increase workload, especially of women, and lack of capital to invest in labour for land clearing could constrain expansion of additional land as supported by Jellason et al. (2021), who argued that cost of clearing new land was a constraint to agricultural expansion in sub-Saharan Africa. However, women are significantly disadvantaged by existing gender norms in communities that reduce women's access to means of building capital (Meinzen-Dick et al., 1997). Women can also lack the physical strength to benefit from an expansion of their agricultural land.

Secondly, we have demonstrated the wide variety of goods utilised, both in terms of provisioning ecosystem services (e.g., medicinal plants, building materials, diversity of food, honey, edible wild fruits) and regulating ecosystem services (e.g., prevention of soil erosion, habitat for pollinators, protection of water courses). Agricultural expansion reduces households' access to a wide range of both provisioning and regulating services, and this can affect households differentially. Unlike richer households, poorer households are unable to afford substitutes for forest products or services they are dependent on (Lattera et al., 2019; Beyene et al., 2019). This suggests that agricultural expansion into unallocated uncultivated land risks both embedding and exacerbating existing inequalities within the community. This is more so if higher-income households are also more likely to expand their area of cultivated land.

We have explored the differentially perceived impacts of agricultural expansion in communities in Ethiopia and Ghana. We aimed to understand how the use of common pool resources could result in gains and losses due to the de facto privatisation of these common resources by expanders to the detriment of non-expanders and other common resource users.

Beyond this, by framing analysis via short- and long-term impacts, we can see that expansion could ultimately result in negative impacts across the community. Expansion of land for cash and food intercrops in Ghana show that food crops are only grown for the first three years after which they are unable to produce good yield thereby likely affecting the food production of vulnerable tenant farmers in a sharecropping arrangement as the landlords are mostly in favour of cultivating cash crops.

Our analysis indicates that community members perceived that communal grazing and pasture areas were decreasing due to farmland expansion, thereby negatively affecting households depending on livestock production for livelihoods through the loss of grazing areas (Fig. 2). This loss of grazing area has implications for future livelihoods of the residents of Walembelle community as livestock raising is a key livelihoods strategy in the northern region of Ghana (Tanle, 2014). The micro-climate is also affected in the communities due to the loss of tree cover thereby resulting in the decrease of water for drinking and for livestock watering. The literature suggests that loss of tree cover in West Africa has led to a decline in rainfall (Duku and Hein, 2021).

In Ethiopia, options for local livelihood sources are reducing as forest ecosystem services are mismanaged. This implies that the immediate benefits from agricultural expansion may not continue as the forest areas in most SSA countries such as Ethiopia continue to decline (Franks et al., 2020; Fenta et al., 2020). Resource management programmes targeted at reducing inequality will likely help in cushioning the effect of loss of livelihoods of the poorer households dependent on the forests as well.

While those expanding land are likely to benefit from the practice in the short- and medium-term, the changes to forest/ wood/ grasslands, drinking water, and grazing areas have implications for households who rely on these resources for their livelihoods. Our research highlights that the impacts are already being felt. Hence, understanding the characteristics of these households negatively impacted in terms of gender and wealth is important for policy makers to plan inclusive strategies to reduce the effect of such losses to the households or the affected members and reduce structural imbalances in the communities.

Our study indicates that this current expansion is an example of the need for common resource management policies. Policymakers should promote community-based land-use planning that explicitly takes into account the multiple benefits from forests and factors these into decisions, which could lead to more equitable outcomes. This could involve reviewing protected area status of forests that provide high levels of ecosystem services based on Ostrom's (1990) eight principles of managing the commons. The principles include the need to clearly define boundaries of the common resource and to specify who is entitled to what. It is important that the rules of management are not imposed as a one-size-fits-all, but that they are grounded in each local context. It is also important to involve all community groups in creating the rules and in designing the sanctions through which they are upheld. This participatory approach makes it more likely that the co-created rules will be adhered to. Reflecting on the outcomes of our study, we would argue that particular attention should be paid to groups that often lack influence in the community setting. Ostrom (1990) argues that any form of sanction should be graduated, with allowances made for the time needed to adapt behaviours, and that disputes can be settled via a form of mediation that is both easy to understand and affordable. Finally, it is important that the community rules are both recognised as legitimate by the relevant higher local authorities and that they are coordinated and synchronised with wider regional rules e.g., river management.

Despite the limitation of not conducting in-depth correlations between impact and social group, our study contributes to the literature on

understanding the winners and losers of agricultural expansion in the context of sub-Saharan Africa and implication for common resources management (Ostrom, 1990). Specifically, it found that socioeconomic factors such as gender, age and wealth and livelihood opportunities determine participation in specific livelihood activities in the forests. These socioeconomic factors can lead to differential outcomes between groups, depending on whether they support or limit participation in agricultural expansion. The evidence from this paper suggests that the impacts on diverse ecosystem services - food production, livelihoods, grazing and livestock, and on soil and water have differentiated effects on different groups within a community. These differential outcomes can also alter across time, as short-term winners may be losers in the medium- to long-term. For example, expanders may have more food or income in the short-term but suffer poor yields in the long term due to loss of soil fertility resulting from land degradation. Therefore, this paper serves to highlight the importance of disaggregating analysis of

the impacts of agricultural expansion to recognise and, hopefully, meet the SDG goals, prevent current inequalities within communities being both embedded and exacerbated.

### Funding

This research was funded by UK Research and Innovation through the Global Challenges Research Fund programme, "Growing research capability to meet the challenges faced by developing countries" ("Grow"), grant number ES/P011306/1.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Appendices

Focus Group Discussion composition per community for winners and losers of agricultural expansion with ranked impacts.

### A.1. Walembelle

Activity	Participants	Composition	Duration	Most important impact (ranked)
-Men group	13	13 men (4 under 30)	2 h 18 min	Scarcity of land
-Wealthy group	12	9 men, 3 women (2 men and 1 woman under 30 years old)	2 h, 22 min	Soil erosion
-Women group	9	9 women (1 under 30 years)	1 h 55 min	Climate change
-Moderate wealth group	9	6 men, 3 women (2men, 1 woman under 30 years)	1 h 57 mins	Loss of medicinal plants, flooding and loss of soil fertility (3)
-Mixed Youth group	8	6 men, 2 women (3 men and 1 woman under 30 years)	1 h 54 mins	Increased income
-Poor group	8	6 men, 2 women (1 man, 1 woman under 30)	1 h 39 min	Loss of yield leading to increased debt.

### A.2. Dompem

Activity	Participants	Composition	Duration	Most important impact (ranked)
-Men group	9	9 men (no under 30)	2 h 10 min	Pollution and increased income (3)
-Wealthy group	10	5 men, 5 women (no under 30)	2 h	Reduction in rainfall
-Women group	12	12 women (3 under 30)	2 h 15 min	Sense of pride, increased yield and increased income
-Moderate wealth group	10	8 men and 2 women (no under 30)	2 h, 10 min	Loss of medicinal plants
-Mixed Youth group	9	8 men and 1 woman (4 men and 1 woman under 30 years)	2 h, 10 min	Scarcity of farmland leading to hardship
-Poor group	10	7 men and 3 women (2 men under 30 years)	2 h 30 min	Increased income

### A.3. Adiyo Ethiopia

Activity	Participants	Composition	Duration	Most important impact (ranked)
-Men group	10	10 men (4 under 30)	1 h 25 min	Decrease in honey production
-Wealthy group	9	7 men, 2 women (3 men and 1 woman under 30)	2 h 5 min	Disappearance of medicinal trees
-Women group	8	4 under 30	1 h 45 min	Shortage of firewood and increase in livestock disease
-Moderate wealth group	11	8 men, 3 women (4 men, 1 woman under 30)	2 h 10 min	Decreased milk production
-Mixed Youth group	12	8 men, 4 women (8 men and 4 women under 30)	2 h 25 min	Decreased recreation area land
-Poor group	11	5 men, 6 women (2 men and 3 women under 30)	1 h 15 min	Loss of wild animals and shortage of fodder

### A.4. Adaba Ethiopia

Activity	Participants	Composition	Duration	Most important impact (ranked)
-Men group (grp 2)	9	6 men, 3 women (3 men under 30)	1 h, 35 min	Loss and disappearance of thatch
-Wealthy group	9	7 men, 2 women (all under 30)	1 h 40 min	Unavailability of thatch
-Women group	9	9 women (3 under 30)	1 h, 30 min	Loss in honey production
-Moderate wealth group	9	6 men and 3 women (3 men)	1 h, 50 min	Decreased fuelwood
-Mixed Youth group	-	-	-	-
-Poor group	8	8 men (2 under 30)	1 h	Change in land tenure from communal to private

## References

- Arvor, D., et al., 2012. Analyzing the agricultural transition in Mato Grosso, Brazil, using satellite-derived indices. *Appl. Geogr.* 32 (2), 702–713.
- Barbier, E.B., 2004. Agricultural expansion, resource booms and growth in Latin America: implications for long-run economic development. *World Dev.* 32 (1), 137–157.
- Barbier, E.B., 2005. Frontier expansion and economic development. *Contemp. Econ. Policy* 23, 286–303.
- Beyene, A.D., Mekonnen, A., Hirons, M., Robinson, E.J.Z., Gonfa, T., Gole, T.W., Demissie, S., 2019. Contribution of non-timber forest products to the livelihood of farmers in coffee growing areas: evidence from Yayu coffee Forest biosphere reserve. *J. Environ. Plan. Manag.* 1–22.
- Byron, N., Arnold, M., 1999. What futures for the people of the tropical forests? *World Dev.* 27, 789–805.
- Chappell, M.J., Laval, L.A., 2011. Food security and biodiversity: can we have both? An agroecological analysis. *Agric. Hum. Values* 28, 3–26. <https://doi.org/10.1007/s10460-009-9251-4>.
- Curtis, P.G., Slay, C.M., Harris, N.L., Tyukavina, A., Hansen, M.C., 2018. Classifying drivers of global forest loss. *Science* 361, 1108–1111.
- Daw, T.I.M., Brown, K., Rosendo, S., Pomeroy, R., 2011. Applying the ecosystem services concept to poverty alleviation: the need to disaggregate human well-being. *Environ. Conserv.* 38, 370–379.
- Daw, T.M., Coulthard, S., Cheung, W.W.L., Brown, K., Abunge, C., Galafassi, D., Peterson, G.D., Mcclanahan, T.R., Omukoto, J.O., Munyi, L., 2015. Evaluating taboo trade-offs in ecosystems services and human well-being. *Proc. Natl. Acad. Sci.* 112, 6949.
- Duku, C., Hein, L., 2021. The impact of deforestation on rainfall in Africa: a data-driven assessment. *Environ. Res. Lett.* 16.
- FAO, 2018. The State of the World's Forests 2018: Forest Pathways to Sustainable Development. Food and Agriculture Organisation of the United Nations, Rome.
- FAO, 2018a. The State of Food Security and Nutrition in the World. Building Climate Resilience for Food Security and Nutrition. FAO, Rome, Italy [online] URL: <http://www.fao.org/3/i9553en/i9553en.ipbespdf>.
- Fenta, A.A., Tsunekawa, A., Haregeweyn, N., Tsubo, M., Yasuda, H., Shimizu, K., Kawai, T., Ebabu, K., Berihun, M.L., Sultan, D., Belay, A.S., Sun, J., 2020. Cropland expansion outweighs the monetary effect of declining natural vegetation on ecosystem services in sub-Saharan Africa. *Ecosyst. Serv.* 45, 101154.
- Fischer, J., Abson, D.J., Bergsten, A., Collier, N.F., Dorrestein, I., Hanspach, J., Hylander, K., Schultner, J., Senbeta, F., 2017. Reframing the food-biodiversity challenge. *Trends Ecol. Evol.* 32 (5), 335–345. <https://doi.org/10.1016/j.tree.2017.02.009>.
- Foley, J.A., Defries, R., Asner, G.P., Barford, C., Bonan, G., Carpenter, S.R., Chapin, F.S., Coe, M.T., Daily, G.C., Gibbs, H.K., et al., 2005. Global consequences of land use. *Science* 309, 570–574. <https://doi.org/10.1126/science.1111772>.
- Forestry Commission, 2016. Ghana REDD+ Strategy 2016–2035. Republic of Ghana, Accra. <https://tinyurl.com/ydxxu8qj>.
- Forestry Commission and National REDD+ Secretariat, 2017. Ghana's National Forest Reference Level. Republic of Ghana, Accra. <https://bit.ly/34RZ2Rr>.
- Franks, P., Adolph, B., Neina, D., 2020. Food and Forests: Understanding Agriculture and Conservation Trade-offs in Ghana. International Institute for Environment and Development (IIED), London.
- Global Forest Watch, 2022. Ethiopia. Available at: <https://www.globalforestwatch.org/dashboards/country/ETH/?>. Accessed on 08/04/2022.
- Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M., Toulmin, C., 2010. Food security: the challenge of feeding 9 billion people. *Science* 327 (5967), 812–818. <https://doi.org/10.1126/science.1185383>.
- Grandin, B., 1988. Wealth Ranking in Smallholder Communities: A Field Manual. Practical Action Publishing.
- GSS, 2010. Population and Housing Census. Ghana Statistical Service, Accra.
- GSS, 2021. Population by Region Western. Ghana Statistical Services, Accra. Available at: Ghana Statistical Services. ([statsghana.gov.gh](http://statsghana.gov.gh)). Accessed 15/11/2021.
- Gusenbauer, D., Franks, P., 2019. Agriculture, Nature Conservation or Both? Managing Trade-offs and Synergies in Sub-Saharan Africa. International Institute for Environment and Development (IIED), London.
- Haftu, Z., Sathishkumar, P., 2020. Determination of physicochemical parameters and heavy metals concentration in drinking water at Asgede Tsimbila District, Tigray, Ethiopia. *Chem. Afr.* 3, 419–426.
- Hirons, M., Robinson, E., McDermott, C., Morel, A., Asare, R., Boyd, E., Gonfa, T., Gole, T.W., Malhi, Y., Mason, J., Norris, K., 2018. Understanding poverty in cash-crop agro-forestry systems: evidence from Ghana and Ethiopia. *Ecol. Econ.* 154, 31–41.
- Hou-Jones, X., Franks, P., Chung, J.-H., 2019. Creating Enabling Conditions for Managing Trade-offs Between Food Production and Forest Conservation in Africa: Case studies from Ethiopia and Zambia. International Institute for Environment and Development (IIED), London.
- Illukpitiya, P., Yanagida, J.F., 2010. Farming vs forests: trade-off between agriculture and the extraction of non-timber forest products. *Ecol. Econ.* 69, 1952–1963.
- IPBES, 2019. Global assessment report on biodiversity and ecosystem services. In: Brondizio, E.S., Settele, J., Díaz, S., Ngo, H.T. (Eds.), Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).
- Jack, B.K., 2013. Market Inefficiencies and the Adoption of Agricultural Technologies in Developing Countries.
- Jayne, T.S., Chamberlin, J., Muyanga, M., 2012, January. Emerging land issues in African agriculture: implications for food security and poverty reduction strategies. In: Paper Presented as Part of Stanford University's Global Food Policy and Food Security Symposium Series, sponsored by the Center for Food Security and the Environment and the Freeman Spogli Institute for International Studies, Stanford, California (Vol. 12).
- Jellason, N.P., Robinson, E.J.Z., Chapman, A.S.A., Neina, D., Devenish, A.J.M., Po, J.Y.T., Adolph, B., 2021. A systematic review of drivers and constraints on agricultural expansion in sub-Saharan Africa. *Land* 10.
- Jiren, T.S., Hanspach, J., Schultner, J., Fischer, J., Bergsten, A., Senbeta, F., Hylander, K., Dorrestein, I., 2020. Reconciling food security and biodiversity conservation: participatory scenario planning in southwestern Ethiopia. *Ecol. Soc.* 25 (3), 24. <https://doi.org/10.5751/ES-11681-250324>.
- Kebede, M., 2011. Ideology and Elite Conflicts: Autopsy of the Ethiopian Revolution. Accessed on 08/04/2022. Available at: <https://core.ac.uk/download/pdf/232827127.pdf>.
- Laterra, P., Nahuelhual, L., Vallejos, M., Berrouet, L., Arroyo Pérez, E., Enrico, L., Jiménez-Sierra, C., Mejía, K., Meli, P., Rincón-Ruiz, A., Salas, D., Špirić, J., Villegas, J.C., Villegas-Palacio, C., 2019. Linking inequalities and ecosystem services in Latin America. *Ecosyst. Serv.* 36, 100875.
- Laurance, W.F., Sayer, J., Cassman, K.G., 2014. Agricultural expansion and its impacts on tropical nature. *Trends Ecol. Evol.* 29, 107–116.
- Lehmann, I., Martin, A., Fisher, J.A., 2018. Why should ecosystem services be governed to support poverty alleviation? Philosophical perspectives on positions in the empirical literature. *Ecol. Econ.* 149, 265–273.
- McDermott, M., Mahanty, S., Schreckenberg, K., 2013. Examining equity: a multidimensional framework for assessing equity in payments for ecosystem services. *Environ. Sci. Pol.* 33, 416–427.
- Meinzen-Dick, R.S., Brown, L.R., Feldstein, H.S., Quisumbing, A.R., 1997. Gender, Property Rights, and Natural Resources. The International Food Policy Research Institute (IFPRI), Washington, DC.
- Mfunda, I.M., Roskaf, E., 2011. Wildlife or crop production: the dilemma of conservation and human livelihoods in Serengeti, Tanzania. *Int. J. Biodiv. Sci. Ecosyst. Serv. Manag.* 7, 39–49.
- Newton, P., Miller, D.C., Byenkya, M.A.A., Agrawal, A., 2016. Who are forest-dependent people? A taxonomy to aid livelihood and land use decision-making in forested regions. *Land Use Policy* 57, 388–395.
- Ngoma, H., Pelletier, J., Mulenga, B.P., Subakanya, M., 2021. Climate-smart agriculture, cropland expansion and deforestation in Zambia: linkages, processes and drivers. *Land Use Policy* 107, 105482.
- Ostrom, E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge.
- Pelikka, P.K., Clark, B.J., Gosa, A.G., Himberg, N., Hurskainen, P., Maeda, E., Mwang'ombe, J., Omoro, L.M., Siljander, M., 2013. Agricultural Expansion and its Consequences in the Taita Hills, Kenya. *Developments in Earth Surface Processes*. Elsevier.
- Phalan, B., Onial, M., Balmford, A., Green, R.E., 2011. Reconciling food production and biodiversity conservation: land sharing and land sparing compared. *Science* 333, 1289–1291.
- Potapov, P., Turubanova, S., Hansen, M.C., et al., 2022. Global maps of cropland extent and change show accelerated cropland expansion in the twenty-first century. *Nat. Food*, 3, 19–28. <https://doi.org/10.1038/s43016-021-00429-z>.
- Sunderland, T.C.H., 2011. Food security: Why is biodiversity important? *International Forestry Review* 13 (3), 265–274. <https://doi.org/10.1505/146554811798293908>.
- Tadesse, G., Zavaleta, E., Shennan, C., 2014. Coffee landscapes as refugia for native woody biodiversity as forest loss continues in Southwest Ethiopia. *Biol. Conserv.* 169, 384–391.
- Takasaki, Y., Barham, B.L., Coomes, O.T., 2001. Amazonian peasants, rain forest use, and income generation: the role of wealth and geographical factors. *Soc. Nat. Resour.* 14, 291–308.
- Tanle, A., 2014. Assessing livelihood status of migrants from northern Ghana resident in the Obuasi municipality. *Geo J.* 79, 577–590.
- Teshoma, U., 2019. Carbon storage potential of Ethiopian Highland bamboo (*Arundinaria alpina* (K. Schum)): a case study of Adiyu Woreda, Southwest Ethiopia. *Int. J. Environ. Sci. Nat. Resour.* 16.
- Udondian, N.S., Robinson, E.J., 2018. Exploring agricultural intensification: a case study of Nigerian government rice and cassava initiatives. *Int. J. Agric. Econ.* 3, 118–128.
- United Nations (UN), 2015. In: Transforming our world: the 2030 agenda for sustainable development. Resolution adopted by the General Assembly on 25 September 2015. UN, New York, New York, USA [online] URL: [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/70/1&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E).
- Vallejos, M., Faingerch, M., Blum, D., Mastrángelo, M., 2020. 'Winners' and 'losers' of the agricultural expansion in the Argentine dry Chaco. *Landsc. Res.* 1–12.
- World Bank, 2022. The World Bank in Ethiopia: Overview. Available at: <https://www.worldbank.org/en/country/ethiopia/overview#1>. Accessed on 04/04/2022.