More agricultural intensification, more deforestation? Recognising the risk of profitability–driven expansion of cropland in the Ethiopian highlands

Sustainable, climate-smart intensification of agriculture to increase agricultural production and productivity is a central strategy of Ethiopia's National Agricultural Investment Plan (NAIP) – but will it prevent further deforestation? This briefing explores the risks it could bring about the opposite.

Ethiopia's remaining natural forests are shrinking

Agricultural expansion in Ethiopia has resulted in significant loss of natural habitats, including forests, over time. Ethiopia lost 448kha of tree cover between 2001 and 2021, nearly 40% of which occurred in key biodiversity areas.[1] Most remaining primary forest is in Oromia and Southern Nations, Nationalities, and People's (SNPP) regions, which together had 71% of all tree cover in Ethiopia in 2010.[2] The regions are home to several protected areas of global importance, include the Bale Mountains National Park in Oromia and the Kaffa Biosphere Reserve in SNPP. But within these areas and in the vicinities of these protected areas, land use changes are happening, with land cleared for farming or livestock grazing in the forest, contributing to land degradation and biodiversity loss.[3]

Agriculture as a major driver of deforestation

Agricultural expansion in the Ethiopian highlands is driven by the ever-increasing demand for commodities, in particular cereals (barley, maize, teff) and meat for the domestic market, as well as coffee for export. The remaining forests and other natural habitats are under severe pressure from agricultural expansion, even within protected areas. Whether or not farmers choose to expand their farms depends on a range of factors,[4] including the effectiveness of local governance mechanisms, the presence or absence of alternative income generating opportunities, and the productivity and profitability of agriculture.

Key lessons

Agricultural intensification programmes operating near remaining forests need to carefully monitor changes in agricultural land use to identify and address intensification-driven expansion.

Alternative investment opportunities are needed for both poorer and better-off farmers to avoid profitability-driven expansion of farmland.

Inclusive and effective forest governance is necessary to prevent agricultural expansion into forests with a high ecosystem value.

Background

With Ethiopia's population expected to nearly double between 2020 and 2050, significant increases in the production of staple food crops are needed. So far, much of the increase in production has come from expanding the area under cultivation, at the expense of natural forests. Agricultural intensification could enable Ethiopia to achieve future food self-sufficiency without area expansion, but this depends on farmers' decisions to intensify and/or expand.
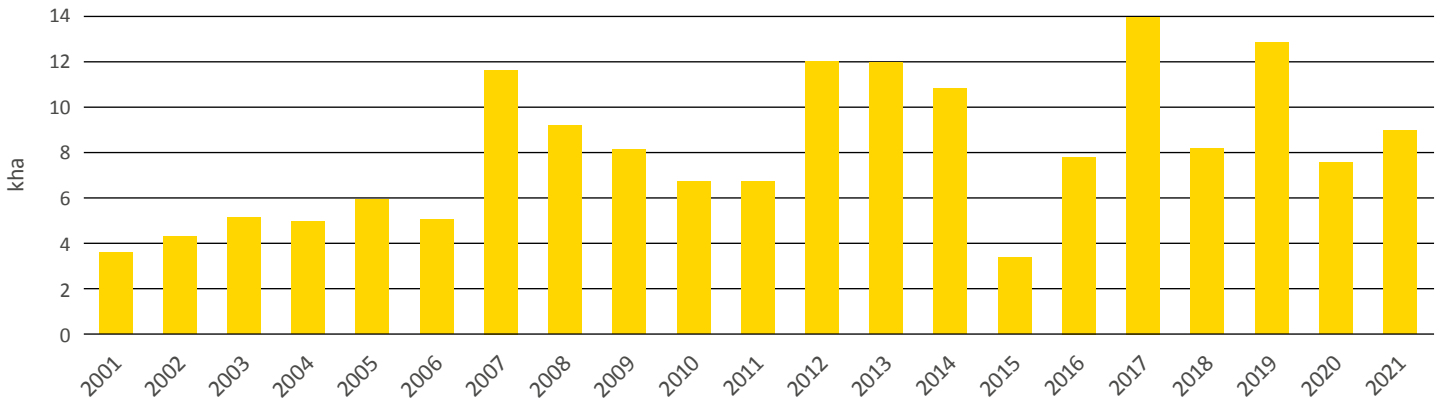
Figure 1. Tree cover loss in key biodiversity areas (kha)

Source of data: Global Forest Watch, www.globalforestwatch.org/dashboards/country/ETH

Reducing agricultural expansion through agricultural intensification – the answer?

Ethiopia's 2021 National Agricultural Investment Plan (NAIP)[5] identified the "intensification of agriculture through adopting improved practices and technologies" as the only plausible option for increasing agricultural production in highland areas. This is meant to be achieved through the implementation of nine commodity-based flagship investment programmes, including for maize and coffee – two commodities contributing to agricultural expansion in Oromia and SNPP. Whilst the NAIP does not explicitly mention agricultural expansion, interviews with key informants in the Ministry of Agriculture (MoA) and affiliated agencies such as the Agricultural Transformation Agency (ATA) in late 2021, confirmed that intensification is expected to reduce expansion of farmland – an assumption shared by much of the international development community.[6,7] If only farmers were able to produce more on their existing land, they would not need to expand their farms, goes the saying. Hence, productivity enhancing technologies – using either agroecological or agro-industrial approaches, or a combination of both – are expected to reduce, or even halt agricultural expansion and help protect existing forests and natural habitat.[8] However, it is difficult to know whether this strategy would work as expected in a specific context, as farmers' decision-making processes are complex.

Understanding household level choices: Using 'serious gaming' to understand 'what–if?'

We wanted to know how increasing agricultural productivity would potentially influence land use decisions of smallholder farmers in the vicinity of Bale Mountains National Park and Kaffa Biosphere Reserve. Would the assumption that increased productivity will result in reduced expansion hold? When we asked this question during a socioeconomic survey in 2019, we found that conventional socioeconomic research methods such as questionnaire surveys or semi-structured interviews, which ask farmers directly about their past or potential future choices,

Box 1: The study sites

This research was carried out in two locations: (1) a community in Adiyo woreda in the SNNP region and located in the Kaffa biosphere reserve, and (2) in Adaba woreda of Oromia region, in the vicinity of the Bale Mountains National Park. In Adiyo, the main crops are maize, enset (Ethiopian banana) and coffee, often cultivated on steep slopes. Coffee is the main cash crop, but farmers also sell maize. In Adaba, barley is the main crop, and livestock production (cattle and sheep) is an important source of income. In both sites, development organisations have tried to reduce the pressure on forests through agricultural intensification and improved forest governance initiatives.
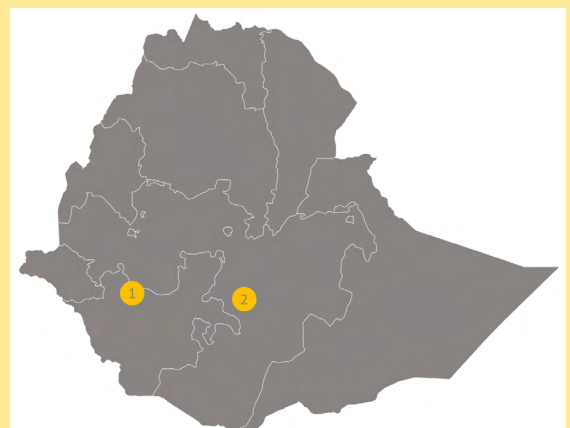
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have limitations. First, farmers were reluctant to discuss their own (or their household's) decisions related to agricultural expansion into forests or protected areas for fear of reprisals or sanctions – as farming in these areas is illegal (even though governance mechanisms are not very effective, and sanctions are not necessarily enforced). Second, the extent of agricultural intensification in these communities was very low, with most farmers using no or small quantities of external inputs (improved seed, fertiliser, or agrochemicals) or agroecological practices (compost, integrated pest management, integrated soil fertility management, agroforestry, etc.). It was therefore difficult for them to respond to a question such as "if you were able to increase your agricultural productivity and profitability, would you continue expanding your farmland"?

To overcome these challenges, we used a 'serious gaming' approach. A serious game is a method (computerised or not) that combines serious aspects (teaching, learning, communication, research, marketing, etc.) and playful aspects.[9] These methods have been used by social researchers to explore real-life problems in a playful manner, with an emphasis on experiential learning (learning by doing). We selected this approach to de-personalise the land use decisions, with farmers playing a fictional household role in a fictional (but plausible) future world. This enabled farmers to 'experience' (in the game) a scenario that they have not experienced before, and to react to it without fear of sanctions. The game involved a highly simplified simulation of the farming system to enable focusing on key decisions related to expansion.

Box 2 explains the game design, which was also used in a similar way in the Sentinel research sites in Ghana and Zambia. The insights gained from the game go beyond the actual choices made by farmers (such as expanding or not expanding, adopting certain intensification options or not), and include an understanding of

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Box 2: A game to understand farmers' agricultural expansion choices

The game was designed to simulate a situation whereby farmers were able to intensify their crop production, and if they did, to see whether they would continue expanding their farms. Participating farmers played several rounds of the game by allocating resources on a fictional farm. Each game round was equivalent to one main cropping season. The game focused on the main cereal crop grown by all farmers in the area (maize in Adiyo and barley in Adaba). The declared aim of the game was for a farm household to feed all its family members and meet basic household cash needs. Maximising household income was not a declared game objective, as the facilitators did not want to explicitly incentivise market-driven expansion.

There were twelve participants (farmers) participating in each game, working in pairs of two, resulting in six pairs. Each pair of participants formed one fictional farm households (a 'player' in the game). Each player was given a specific amount of land and family labour (household members) at the start of the first round. Players sat around a large table, with each having a board in front of them with all game materials (see photo below). All game parameters (these include the amount of land per household for different types of household, household size, the

required food and cash per family member to ensure household food security and meeting of basic needs, types and size of farmland, the level of production per unit area on different types of land – both existing farmland and newly cultivated land in the forest – under low and high levels of intensification, the crop prices at the time of harvesting and later in the season, the costs of inputs (intensification 'packages', labour costs)) were kept as close as possible to the actual situation in the location. This process of 'calibration' was carried out with local key informants (agricultural extension workers, local government) before the game.

To ensure that different types of households (in terms of wealth category) were included in the game, the six players received different resources (number and types of plots, family members) at the start, with two each representing poor, medium and better-off households, respectively. Players were given names corresponding to the colour of their farm / household and these names were used throughout (eg below the farm of the 'blue farmer') to emphasise anonymisation.

Players were asked to allocate their land, labour, and financial resources (the latter obtained from crop sales or wage labour during previous rounds) during each round in the way they thought would best help them achieve their objectives. This included the option to expand their farms into the forest (an area in the middle of the table, accessible to all players), subject to certain risks or sanctions. The 'rules' for each round are outlined in Table 1.

During each round, farmers' choices and discussions were recorded. After the game, all players discussed the game outcome and insights with the facilitators. In addition, a separate debriefing was held with each player / pair of participants) to discuss their specific choices and the motivations behind them.

Labels: Land use options (cereal / livestock); Household members; Round 1; Game round; Tokens indicating input use; Different types of farmland

Table 1: Game rounds

Round	Narrative	Purpose
1	Everything is similar to the **current situation** in terms of production, yields, prices, forest protection, etc – but there are no options to intensify production.	This is the warm-up round – for everyone to familiarise themselves with the game and for final calibration of parameters.
2	**Intensification:** Introduction of an attractive 'intensification package' that requires additional capital and labour (as compared to traditional management) but increases yields significantly. In Adaba, where livestock is a significant component of the farming system, we included in the intensification package a livestock fattening component. Farmers could choose to adopt both crop and livestock intensification, or only one component, on all or parts of their land / livestock.	This is designed to enable / incentivise farmers to intensify and increase the profitability of their farming activities.
3	(Adiyo only): "Forest protection is reduced": In Adiyo, the extent of forest protection was high, so it would have been difficult to see any expansion at all. So, we introduced a story that said that forest protection has been reduced as the government prioritises food production.	This was meant to generate the possibility of expansion.
4	"Jump to the future": It is now five years later, and family sizes have increased, but the farm size has remained the same. Both crop and input prices have increased (but in a way that is advantageous for farmers), and marketing has become easier, with good access to markets for farmers.	This is intended to generate a situation whereby farmers need to decide whether to invest income from intensified agriculture in expansion or in other activities.

their motivations and influencing factors. We were able to observe and record these conversations between players from the same fictional household during the game.

Game outcomes

Farmers understood the game very quickly and played it enthusiastically – they told us at the end that they learnt a lot from it. Table 2 shows the main decisions and outcomes in terms of (a) whether farmers expanded or intensified their farms, and (b) what result they achieved in terms of income from crop / livestock sales or hiring out labour at the end of each round. Red numbers indicate deficits.

During the first 'Business-as-Usual' round, most players were struggling to meet their household's food needs, with most farmers in Adiyo ending up with a net deficit at the end of the round. Once the intensification option was introduced in round two, all farmers intensified production on at least part of their land.

Two of the poor or medium household players in each site expanded their farms. In Adaba, they expanded in the first round, before the intensification option was introduced, because they would not have been able to produce sufficient food for their families on the land allocated to them in the game (poverty-driven expansion). However, in Adiyo, two players expanded in the last round, after intensification, after they had increased their income through intensification. This enabled them to invest more in

farming by expanding their fields, in order to increase their income further. This is an indication that, besides the well-documented 'poverty-driven expansion', intensification (leading to increased profitability) can also incentivise expansion.

Farmers in both sites emphasised the need to balance the gains from expansion (increased food production contributing to household food security and increased incomes) and the costs (in the form of fines or even imprisonment when encroaching protected areas). They also showed awareness of the environmental impacts of expansion[10] and considered it a non-desirable strategy. But they admitted that expansion of farms is an ongoing phenomenon, in particular by larger, more influential

Table 2: Farmers' choices and outcomes

Game round	Decision / outcome	Better-off households		Medium households		Poor households	
		Player 1	Player 2	Player 3	Player 4	Player 5	Player 6
Adiyo / Kaffa							
1	Expand or intensify?	None	None	None	None	None	None
	Cash left	-27	23	-30	-5	-18	-16
2	Expand or intensify?	Intensify	Intensify	Intensify	Intensify	Intensify	Intensify
	Cash left	12	73	25	86	16	6
3	Expand or intensify?	Intensify	Intensify	Intensify	Intensify	Intensify	Intensify
	Cash left	6	98	29	93	16	-3
4	Expand or intensify?	Intensify	Intensify	Intensify	Both	Intensify	Both
	Cash left	168	227	96	93	7	35
Adaba / Bale							
1	Expand or intensify?	None	None	None	None	Expand	Expand
	Cash left	27	9	28	4	7	3
2	Expand or intensify?	Intensify	Intensify	Intensify	Intensify	Intensify	Intensify
	Cash left	258	95	138	48	77	76
3	Expand or intensify?	Intensify	Intensify	Intensify	Intensify	Intensify	Intensify
	Cash left	288	317	79	215	140	53

landowners who can afford to pay fines when caught farming in the forest, whilst also investing in intensifying their farm activities.

During the discussions, farmers also explained how the absence of alternative investment opportunities influences their decisions. Expanding agricultural operations (both by intensifying and expanding farms) is often the only viable economic activity in rural areas, whereas many farmers, in particular younger ones, would prefer to invest in off-farm businesses.

Discussion and way forward

The findings confirm that farmland expansion can happen when farmers are unable to meet their household food requirements from farming small plots of degraded land. However, the results show that increasing productivity and profitability of crop farming

through intensification can also incentivise some farmers to expand their farms - under certain conditions. These include poor forest governance without law enforcement by state institutions and/or communities and a lack of other income generation and investment opportunities.

Farmers in both sites considered the game to be a 'training exercise' that encouraged them to think through their resource allocation decisions in a more systematic way. For the researchers, the gaming methodology provided an entry point to discuss alternative scenarios with farmers, and how different factors (internal to the farm and external) affect farmers' decisions. The great strength of 'serious gaming' is that it creates a 'safe space', where researchers and farmers can discuss factors that influence the success or failure of interventions to reduce expansion, and their likely impacts on different types of households. It enables

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testing and discussing farmers' own assumptions, eg whether increasing fines for forest encroachment could help reduce expansion into forests.

Unlike in a standardised choice experiment, the actual game outcomes / farmers' choices cannot be used to make quantitative predictions, eg about the proportion of farmers who would expand after intensification. But there is great potential for using 'serious gaming' to inform and help better manage trade-offs between competing land use objectives and thereby enhance the coherence[11] and effectiveness of REDD+, forest conservation, land use planning and food and agriculture strategies. Gaming could be used by local and national government actors to test their own assumptions about the effects of different policies and strategies on farmers' land use choices.

There is clearly scope for improving the methodology, eg by playing it over several days to introduce more variations in subsequent rounds, or by introducing more game elements, such as different crop and livestock enterprises (and not only the main food crop). However, there are likely to be diminishing returns to farmers' and researchers' time investments.

Notes

1   This is according to Global Forest watch, which uses satellite image analysis to assess changes in tree cover – but which might not yet reflect recent trees planted over the past three years under Ethiopia's 'Green Legacy' programme (https://greenlegacy.et/). In 2015, Ethiopia changed its definition of forests (area with trees >2m, and canopy cover of >20%), diverting from the FAO definition (area with trees >5m and canopy cover of >10%) and increasing the nominal area under forests. Government of Ethiopia (2017) Ethiopia's Forest Reference Level Submission to the UNFCCC, https://redd.unfccc.int/files/ethiopia_frel_3.2_final_modified_submission.pdf.

2   Global Forest Watch - Ethiopia www.globalforestwatch.org/dashboards/country/ETH/.

3   See eg The Nature and Biodiversity Conservation Union (NABU) (*eds*) (2020) *NABU's Follow-up Biodiversity Assessment at the Kafa Biosphere Reserve, Ethiopia. Berlin, Addis Ababa.* https://en.nabu.de/imperia/md/nabu/images/international/afrika/aethiopien/kafa/2020_nabu_biodiversitaet_assessment_web.pdf

4   Gebrehiwot, T and Tekleworld, H (2022) Determinants of farmland expansion in the forest margins in Ethiopia. Sentinel Policy Briefing. www.sentinel-gcrf.org/determinants-farmland-expansion-forest-margins-ethiopia and Gebrehiwot, T, Teklewold, H, Devenish, A, Jellason, NP, Martin, A, Seifemichael, R and Barbara Adolph, B (2021) Unpicking the socioecological drivers and impacts of agricultural expansion in Ethiopia. Sentinel Policy Briefing. www.sentinel-gcrf.org/unpicking-socioecological-drivers-and-impacts-agricultural-expansion-ethiopia

5   MoA, Ministry of Agriculture (2021). Ethiopia's National Agricultural Investment Plan (NAIP), 2021-2030. Addis Ababa: MoA.

6   See eg Schut, AGT and Giller, KE (2020) Sustainable intensification of agriculture in Africa. Front. Agr. Sci. Eng., 2020, 7(4): 371–375 https://doi.org/10.15302/J-FASE-2020357.

7   Tesfaye, K, van Ittersum, MK, Wiebe, K, Boogaard, H, Radeny, M and Solomon, D (2018) Can Ethiopia feed itself by 2050? Estimating cereal self-sufficiency to 2050. CCAFS Policy Brief No. 12. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

8   The need for effective governance mechanisms for these forests and habitats is not normally explicitly acknowledged by agricultural development experts – who often operate in sectoral silos, with a limited understanding of and interest in forest protection.

9   After Daré, W, Hassenforder, E and Dray, A (2021) Observation manual for collective serious games. CIRAD, Montpellier, 68 p. https://doi.org/10.19182/agritrop/00144.

10 In both sites, NGOs have been working with farmers to develop sustainable forest management and governance mechanisms - in Kaffa with support from NABU (https://en.nabu.de/topics/regional-development/coffee-novation/kafa-project-area.html) and in Bale with support from FZS (https://fzs.org/en/projects/ethiopia/bale-mountains-national-park/).

11 See Jeary, K, & Franks, P (2022) Policy disconnects: trade-offs and synergies between Ethiopia's objectives to increase agricultural production and conserve nature. Sentinel/IIED, London for a discussion of disconnects between different Ethiopian policies related to agriculture, land use and forests.

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