UN environment programme

FINANCING SUSTAINABLE LAND USE

Addressing smallholder resilience in coffee production in the Central Highlands, Viet Nam

The business case for intercropped coffee production

Summary

UN-REDD PROGRAMME

Food and Agriculture Organization of the United Nations

UNDP Empowered lives. Resilient nations.

UN environment programme

George Scott and Jonathan Gheyssens
Climate Finance Unit
United Nations Environment Programme

Disclaimer

April 2020

Executive summary

Coffee production in the Central Highlands faces a multitude of challenges; decades of intensive cultivation and expansion onto marginal land has degraded the soil quality and left smallholders less resilient to both climate change and vulnerable to fluctuations in the price of coffee. As a result, many smallholders are in a negative spiral of declining yields leading to the increasing application of inputs to compensate, which is further reducing their already limited margins.

This analysis presents the business case for sustainable Robusta coffee cultivation in the Central Highlands region of Vietnam. In recent years, intercropping models involving coffee interspersed with shade or fruit trees have demonstrated their potential to generate multiple benefits to smallholders and the environment. This analysis focuses on the economic benefits of transitioning from an intensive coffee cultivation model to three different intercropping models: avocado, durian and cassia siamea and pepper, and makes recommendations concerning the transition pathway that will be most accessible to smallholders.

Even in poor market conditions, the analysis finds that diversifying a smallholding through the addition of another productive crop will generate economic benefits for the producer. Furthermore, the revenue generated through the addition of a crop can help to reduce the impact of periods of low coffee price on a smallholder's livelihood. However, while this will provide a degree of economic resilience to a smallholder, if the coffee price remains consistently subdued, it cannot be said that the smallholder will or should not make the economically rational decision to replace their coffee plantation with what they perceive to be a more lucrative or less volatile crop.

In addition to economic benefits, diversifying a smallholding can bring potential environmental benefits: leading to increased biodiversity and improved soil structure, that may further contribute to the economic profitability of the model by reducing the requirement for irrigation or agricultural inputs and increasing resilience to climate driven drought or flooding.

The initial capital expenditure for converting to intercropping with durian, avocado, cassia siamea and pepper varies between VND 5.7 million for Avocado and VND 10.8 million for cassia siamea and pepper. While the additional operational expenditure varies between VND 628 thousand for durian and VND 12.24 million for cassia siamea and pepper.

Due to the added capital and operational expenditure requirements and the delay in revenue until the intercropping plant becomes productive, transitioning to a diversified production model may be inaccessible for poorer households without access to additional financing.

The analysis demonstrates ways in which converting to intercropping can be made more accessible to poorer households, by (i) initiating the transition earlier in the lifecycle for the coffee plantation, when the coffee plants are more productive and therefore generate a higher revenue and by (ii) staggering the transition over a number of years, thereby reducing the annual capital expenditure.

Further work is required to fully understand each model's resilience to the changing environmental and economic conditions. For example, irrigation is presently free for smallholders across the Central Highlands, but in the near future, due to water shortages, irrigation could be restricted or provided at cost, adding an additional operational cost to production. Similarly, recent socio-economic trends have seen a decline in the availability of labour, which will also likely impact the economics of smallholder production as labour costs increase.

1. Background: Coffee production in Vietnam

Vietnam is the second largest exporter of coffee globally (behind Brazil), and the largest for the Robusta variety. Between the mid-1980s and 2000, Vietnam's harvested coffee area expanded from 15,000 to nearly 500,000 hectares,[1] driven in part by the economic reform that was being undertaken in the country.[2] The same programme of reform also provided support for internal migration from more land-constrained regions, as well as investments in rural infrastructure. It was during this period that much of the most suitable land was converted for coffee cultivation.[3]

The Central or Western Highlands is the main growing area for Robusta coffee in Vietnam. It is a highland region in Central Vietnam comprised of five provinces: Dak Lak, Dak Nong, Gia Lia, Lam Dong and Kon Tum. Robusta coffee production from these five provinces together accounts for 92% of the total national production, which is currently grown on roughly 577,000 ha.[4]

In recent years, coffee has demonstrated its potential to generate high revenues in the Central Highlands, making the crop very attractive for smallholder cultivation. Since the 1980s, coffee production in Vietnam has increased by nearly two orders of magnitude, from roughly 19,400 tonnes/year to 1.76 million tonnes in 2016.[5,6] This rapid growth in output has been a function of both increasing the area of land under cultivation and the adoption of intensive farming practices; Vietnamese farmers typically achieve yields of more than 3.5 tonnes per hectare, whereas Robusta yields per hectare average 0.8 tonnes in Thailand, 0.5 tonnes in Indonesia, and 0.4 tonnes in Laos.[7]

While this growth has made a significant contribution to the Vietnamese economy, it has not come without cost. Maintaining these high levels of productivity has created a series of environmental challenges, including deforestation and land degradation. As a result much of the expansion took places on marginal land unsuitable for coffee cultivation, and decades of excessive fertilizer and agrichemical application has contributed to the gradual deterioration of the soil, leading to issues with soil fertility, disease and nematode infestation.[8,9] These issues will be further compounded by the changing weather patterns that are expected as a result of climate change. They will lead to a significant reduction of land suitable for coffee cultivation and of water available for irrigation.[10]

2. Problem statement

Smallholder output in the Central Highlands is low quality, low volume and environmentally unsustainable

Smallholder production accounts for roughly 80-90% of Robusta coffee from the Central Highlands.[11,12] Smallholder cultivation practices are typically intensive and costly; characterized by the high application of pesticides, fertilizers and irrigation,[13] but, while Vietnam's coffee yields are above international norms, they have barely progressed over the past decade. Several factors account for this, including the aging of the tree stock, the spread of coffee planting onto less suitable or unsuitable land, and various episodes of drought (1999, 2005, 2013).[14] As a result, maintaining high yields has become a function of the heavy application of fertilizer and pesticides.[15] Soil testing in Vietnam is rare and subsequently, farmers often do not apply fertilizer of the optimal composition or at the optimal time. For a smallholder, the risk of a reduced yield due to under-application of fertilizer is considered less than the risk of the over-application of fertilizer.

Excessive fertilizer use, together with weak water management practices, has led to a large proportion of fertilizer running off into streams and groundwater, and emissions into the atmosphere as nitrous oxide, a potent greenhouse gas. Consequently, between one-half and two-thirds of fertilizer nutrients are not taken up by crops.[16] The long-term impacts of excessive application of fertilizer and other agricultural inputs has been shown to increase soil acidification and soil hospitability to nematodes and plant diseases, which in turn reduces soil and fertility, requiring increasing levels of fertilizer to compensate for reduced productivity.[17] This leads to increasing capital requirements for the purchase of fertilizer and other agrichemical input. For poor farming households, it is often difficult to generate cashflow to support these working capital requirements, but without sufficient investment in agrichemical input, the overall productivity, and quality and quantity of the coffee beans is likely to be lower and generate lower levels of income for farmers, which leads to a vicious circle where smallholders cannot generate future working capital for input and labour, and so on. For example, the International Fund for Agricultural Development (IFAD) has shown that productivity could be as low as 1.2 tonnes/ ha for farmers who are unable to invest in sufficient levels of key input, while farmers with higher capacity to invest productivity it could be as much as 3.5 tonnes /ha of coffee beans.[18]

Compounding these issues, smallholders are also the most economically disadvantaged participants in the coffee value chain: due to their relatively low output they face higher transaction costs in order to sell to distant markets. Typically, they also have limited access to finance and legal recourse, and as a result are almost entirely dependent on decisions made by downstream participants.[19]

Smallholder livelihoods are vulnerable to changes in the price of coffee

Intensive monocrop coffee cultivation leaves farmers vulnerable to changes in the market price of Robusta.[20,21,22] This is compounded by relatively low levels of domestic consumption and exposure to an international market that is clustered around the production of a small group of countries - Vietnam, Brazil, and Indonesia - which together account for roughly 75% of global production.[23] In consequence, global price is highly responsive to changes in the weather and growing conditions in those countries, leading to increased market volatility.

Significantly, low price expectations deter producers from making investments to improve their production capacity or increase resilience, which contributes to greater producer insecurity; investments in substantial cultivation improvements increase both capital and operational expenditure. At times when margins are depressed due to low market prices, this impacts the economic rationale for such an investment.

This can lead to a vicious cycle for producers; lower levels of investment lead to the production of lower quality coffee and lower yields. This reduces earning expectations and increases exposure to emerging or unforeseen risks such as climate change. For smallholders this risks their livelihoods, and for global supply chains, it increases the risk of destabilizing the supplier base.

Economic uncertainty can also increase the threat of further expansion into forests, as smallholders seek to increase their livelihood. Investments in substantial cultivation improvements in coffee supply chains increase both capital and operational expenditure. At times when margins are depressed due to low market prices, this affects both the economic rationale of such an investment and also the credit risk represented by smallholders borrowing in order to finance their own investment.

3. Proposed solution for analysis: Intercropping coffee with fruit trees

Intercropping models involving coffee interspersed with shade or fruit trees have demonstrated their potential to generate multiple benefits for intensive coffee cultivation models and smallholder livelihoods. These benefits can include:[24,25]

Enhancing functional biodiversity and improving soil fertility

Shade tree species can contribute to improving, preserving or restoring soil fertility and buffering seasonal variability of soil biological activity in intensively managed coffee farms.[26] Shade trees in agroforestry have also been found to increase functional biodiversity, carbon sequestration, and drought resistance, as well as weed and biological pest control.[27,28] This implies that shade trees could lead to reductions in the need for agricultural chemicals, pesticides, and herbicides, which could collectively lead to reduced soil and water pollution, as well as a potential reduction in costs for smallholder producers.

Improvements to soil health, leading to better soil water storage capacity

Decades of the excessive application of agrichemicals has led to a reduction in soil quality in coffee plantations in the Central Highlands, leading to issues with disease and nematode infestation.[29] Advances in soil biodiversity will improve soil structure and moisture retention, thus reducing the need for irrigation.[30]

Turning farms from carbon sources to carbon sinks

A recent study by IDH (the sustainable trade initiative) showed that while highly diversified farmers growing non-coffee trees on their farm had higher carbon dioxide equivalent (CO_2e) emissions, as a result of short-term increases in agricultural chemical application, transport, and so on, the higher rate of carbon dioxide (CO_2) sequestration from accumulated biomass, combined with improved fertilizer use could reduce the climate impact of farms, turning them from net sources to net sinks.[31]

Improvements to smallholder livelihoods

Finally, productive fruit and shade trees have the potential to provide an additional income for smallholders from the sale of timber, firewood or fruits, the revenue from which could improve smallholder livelihoods, as well as lessening the impact of a reduction in coffee yield or a reduction in coffee prices on smallholder livelihoods.[32,33]

Given the multiple potential benefits provided by shade and fruit trees, intercropping was selected as the model with the greatest potential to generate immediate improvements to the coffee landscape in the Central Highlands, while potentially improving livelihoods and stabilising incomes for smallholders.

4. Methodology of assessment

An analysis was carried out in separate stages to understand the suitability of intercropping as an alternative cultivation model in the Central Highlands: (I) assessment of the enabling environment, a market and value-chain assessment to understand the capacity for intercropping markets to absorb additional production; (II) an assessment of cost, and the benefits of conversion to diversified agriculture; and (III) an assessment of the resilience of models to changing market conditions.

I. Assessment of the enabling environment

Qualitative and quantitative assessment was undertaken to understand the capacity for intercropping commodity markets to provide a viable livelihood for smallholders. Potential markets were assessed according to their:(i) capacity to absorb additional supply, levels of domestic and global consumption, (ii) access to local and global markets for smallholders; and (iii) global market outlook.

Increasing the level of supply of goods into a market will typically lead to a reduction in the price of those goods. For smallholders, this could mean the difference between making a profit and making a loss. It is therefore necessary to have some insight into how the market will respond to a change in the quantity of goods supplied. The magnitude of that reduction is determined by a number of factors and is described by the price elasticity of demand.

To understand the price elasticity of demand, demand curves were first constructed for each commodity using data on individual trades, export values and volumes from the UN Comrade database.[34] A regression of the price and log of the net weight for each trade was carried out to determine the relationship between export price and weight for each commodity.

II. Assessment of the economic feasibility of the solutions

On the basis of the initial findings from the market assessment, three potential intercropping models were selected for analysis of the economic benefits and costs to smallholders. These were: coffee intercropped with durian, coffee intercropped with avocado and coffee intercropped with cassia and pepper.

An analytical tool was developed using Excel that modelled future cash flows for smallholders under a range of different scenarios. The tool predicts the economic impact of certain on-farm decisions from the perspective of a smallholder who is currently farming coffee intensively. A list of the decisions modelled is shown in Table 1.