Report

Incentive design for **agroforestry in developing countries**

World Agroforestry

Report on

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I. Introduction

To achieve the United Nations' Sustainable Development Goals, we see the importance of agroforestry in terms of both its potential environmental benefit and its development benefit, especially in developing countries where the dominant economic activity is agricultural production. On one hand, agricultural and environmental scientists have been investigating the ecological effect of trees on farms and answering questions including what, where and how to plant. On the other hand, non-governmental organizations (NGOs) are putting in effort to secure funding from both public and private sectors for agroforestry-related projects. However, one crucial missing piece is an incentive mechanism that connects funding and the goal of agroforestry. Incentive mechanisms for agroforestry are often overlooked by policy makers and practitioners and are not well understood. In this report, we demonstrate the importance of designing effective incentive mechanisms, present the challenges, and dissect the problem to discuss how we can address incentive design for agroforestry.

We discuss incentive design in the agroforestry space with a focus on afforestation. Simply by protecting the primary forest remaining on Earth is not sufficient to combat climate change and environmental degradation. Instead, we need to take more immediate actions for restoration, mitigation and adaption. Afforestation, naturally, is part of restoration, mitigation and adaption. However, afforestation in agroforestry, or 'trees on farms', presents a set of challenges. In countries like Uganda, farmers use trees as their 'safety net' because trees are their source of firewood and cash. If children are sick or need to go to school, farmers cut trees in exchange for money. For this reason, we rarely see trees on farms. Afforestation on farms can only take place with systematic changes, where practical and well-designed incentive schemes must be put in place to encourage behavioural change on the farmers' side.

In Section I and II, we start with introducing what incentive design is and is not from an academic perspective. Then in Section III and IV, we discuss how the contexts of developing countries and afforestation processes have an impact on incentive design because this is an intersectional problem where sustainability and development go hand in hand. In Section V, we discuss two cases of currently-running incentive programs in Uganda; in Section VI, we give general recommendations and managerial insights backed by theoretical analysis.

II. What incentive design is to an economist

A concept like 'incentive design' might mean very different things depending on which community we talk to. We first address what this term means to an economist. There is a subfield in economics, operations research and computer science called, 'Market Design'. We think about how to design markets to achieve certain goals. 'Market' can be synonymous with 'rules' and 'institutions'. Given a set of market rules, market participants are free to take any actions that please them. Market designers think about how to design the rules prior to the establishment of a market so that desirable outcomes will likely occur. Sometimes, this field is also called 'economic engineering' because building a market is like an engineer's job except the market engineer uses the economics of market forces.

It is important to note that this research happens at the 'designing' stage. Often, in the public or non-profit sector, we care a lot about program outcomes and evaluations. However, evaluations can only happen after a program ends. The performance of any program is dependent on its design but the design stage usually takes place when we don't have much information and data about the system that we are working with. Thus, we utilize the power of applied mathematics and theoretical economics to build a theoretical model and analyse which are the alternative and complementary methods to collecting specific data and running trial programs.

That being said, many market designers also work with practitioners to improve or to redesign existing systems. Some prominent examples of successful market design are redesigning the US kidney exchange market and designing the Federal Communications Commissions' spectrum auction. We use the language of 'incentive design' in the agroforestry context because often programs created by NGOs or governments are not self-contained markets (thus, not 'market' design in a strict sense). In the end, whichever market mechanism we adopt, it will be individual incentives that the mechanism is having an impact on.

III. What incentive design is not

It is important to note that 'incentive' is not synonymous with 'payment' or 'reward'. In this report we will address how these concepts differ. An easy example to differentiate these terms is the following: the government pays a farmer USD 10 in exchange for their effort in growing trees but the cash payment is only paid after the tree is mature. The payment could also be a subsidy for the farmer's children's school fees. But neither the cash payment nor the subsidy is the full incentive. The incentive to the farmer has to be adjusted by the cost of tree-growing activities and the benefit (or cost) of having mature trees on their farm. If having mature trees is costly to the farm (because they are taking land away from a cash crop) and this opportunity cost is much more than USD 10, then the farmer may no longer want to take grow trees.

Incentive design is also not just payment design. It is about understanding and using the dynamics between farmers and trees. It is about using funding effectively to encourage behavioural changes.

IV. Developing country contexts

In this section, we isolate how developing country contexts present a different set of constraints to the problem of incentive design. As previously mentioned, we have seen more cases of market design research in developed countries. Doing market design in a developing country is much more challenging. But we don't use the language of 'challenges' but rather 'constraints' because we take the developing context as given and try to optimize within this context.

We discuss three major constraints when doing incentive design in a developing context: 1) weak institutions; 2) voluntary participation; 3) missing financial markets. The first two constraints are from both the perspective of the market designer (government/NGO/program administrator) and the third is from the perspective of market participants (farmers). We believe that all of the assumed constraints above are reasonable for a country context like Uganda's.

Weak institutions

We assume that the market designer cannot punish participants for not complying. Developing countries often don't have strict laws or regulations in the environmental space. Even when regulations exist, enforcement is often limited. If an incentive program is created, the government or an NGO cannot use rules such as if farmers do not plant trees then they have to pay a fine.

Voluntary participation

We assume that farmers will only participate in an incentive scheme if participating provides more benefit than not participating. By participating, we mean not only at the enrolment stage but also the following stages where continued participation is needed. This constraint has a subtle difference from the weak institutions' constraint. Recall the scenario we described previously where the government pays a farmer USD 10 when the tree matures. There is a cash reward, which means that the weak institutions' constraint is satisfied but it does not mean that the farmer will necessarily voluntarily participate. If the farmer deems that growing trees will cost them more than USD 10 then they may decide not to participate in the program. To satisfy the voluntary participation constraint, we need to understand the cost and benefit not only of having trees on their farm but also of the tree-growing process itself. Only then, we would know when farmers will participate and when they will drop out.

Cash constraints/missing financial markets

Often in developing countries, farmers face cash constraints. Financial markets are missing and they cannot borrow against the future even if doing so will improve their livelihoods. Lack of access to financial instruments is intimately linked to farmers' use of forestry resources. They cut trees for firewood, charcoal or timber in exchange for personal use or cash. Their financial-decision-making process is tied to their management of natural resources.

V. Afforestation

Tree-growing is a slow and risky process, especially when the goal is to plant indigenous species that can enhance biodiversity on a farm. If a tree takes ten or twenty years to mature, the amount of time and effort required of the farmer should not to be ignored. The disincentives to growing trees on farms comes from several sources.

1) Tree-management costs

Tree management is the actions directly related to tree-growing that require effort and time from a farmer. This is not a one-time cost but is recurring. Farmers may also want to trim or thin the trees as they grow larger. However, this cost may decrease over time as the tree approaches maturity.

2) Opportunity costs

A farmer has fixed land size and fixed labour capacity. They choose an action to take among many other options. Instead of growing trees, farmers might prefer to grow cash crops because the return of value is faster. Given that market dynamics evolve over time, farmers might prefer the flexibility to switch to any crop that they anticipate will bring a higher return or a return with more certainty. Given cash constraints, farmers have a high discount rate into the future. If the benefit of trees does not deliver until the trees mature in many years, farmers will always choose to plant short-term crops for a faster return even though they know that growing trees may be a more rational decision for long-term benefits.

3) Income shocks

If farmers rely on forests as their safety net, frequent income shocks will have an impact on their tree-growing actions. Farmers might want to cut their trees before they are fully grown, simply because their need for cash is urgent. Even if they anticipate the environmental benefits of mature trees, owing to cash constraints they cannot make the 'strategic' and 'rational' choice even if they would like to. This shows how the context of developing countries at the intersection of afforestation creates unique challenges in incentive design.

Apart from costs, there are also external risks. Even when a farmer puts in effort to take care of a tree, natural events may occur which lead to the death of the tree. The program designer should not punish tree death from to natural occurrences, however, they should seek to discourage tree death owing to negligence. This is difficult to do in reality owing to high monitoring costs if the incentive program is implemented at a large scale. A well-designed incentive program should take this into account.

VI. Case studies

In this section, we present two case studies of incentive programs implemented with farming communities in Uganda, based on meetings that World Agroforestry (ICRAF) Uganda had with Ecotrust and with IUCN Uganda office, respectively.

1) Ecotrust

Ecotrust works with Western companies that provide funding for carbon offsets or allocate funds through their corporate social responsibility programs. Ecotrust uses the funding from the companies to give cash incentives to farmers who grow indigenous, slow-growing trees (farmers choose their preferred species). These trees take 10–25 years to mature. Each farmer is paid in years 0, 1, 3, 5 and 10 — 30%, 20%, 20%, 20% and 10% — respectively of the total payment per hectare (they plan for about 200 trees per hectare; the payment is adjusted accordingly). We were not told the exact total payment but this amount is equivalent to USD 6 per tonne of carbon. The payment as trees mature decreases over time because Ecotrust sees this payment as a reimbursement to a

farmer's tree management costs. Tree-management costs decrease over time because as trees mature less effort is required. However, Ecotrust admits that farmers may also abandon the tree-growing process owing to opportunity costs and income shocks (the other kinds of costs mentioned in the previous section).

Further, Ecotrust also encourages farmers to manage the trees by thinning them in years 7, 10 and 15. After thinning occurs, payment will again be adjusted by the number of trees that remain. Farmers can cut their trees at any point after Year 10 so that they can receive value from timber or charcoal if they wish. At any point, farmers are allowed to re-enter the program or choose to grow more trees. Ecotrust claimed that they always knew the reasons for tree death, whether it was deliberate abandoning of the tree-growing process or it a failure owing to natural circumstances. This was because of the close relationship Ecotrust formed with all of the participants. However, as the program expands to a larger or even national scale, the program administrators may not always have accurate and truthful information on tree death. Ecotrust has complete data records of tree-survival rates in their program for the past twenty years, which is a rare and large data source. Tree-survival rates can be used as an indicator of farmers' aggregate utility level for an afforestation program.

2) IUCN Uganda office

IUCN Uganda works with farming communities, using a landscape approach. The environmental landscape target goes hand in hand with funding that IUCN provides to each community. IUCN works with each village to help them set up long-term community-, household- and individual commitments for improving a landscape. As long as the targets are continuously being met, a fund is available from which any community member can obtain micro-loans at an interest rate of 5%. The use of the loans is not tied to any environmental activities, which provides flexibility and ensures that the money goes to the most urgent needs of the community. A community board is formed to administer the fund, including deciding who is approved for a loan and making sure loans are repaid. IUCN monitors the progress of achieving the environmental target. IUCN claims that the repayment rate is high and that the funds in most communities are growing. However, owing to the low interest rate, we wonder whether the fund is truly self-sustainable given inflation. In addition, this model may be difficult to expand in scale to a national level because environmental targets are tailored to each community.

VII. Managerial insights

In this section, we describe a set of general managerial insights. The recommendations come from theoretical and mathematical evidence. However, they overlap with the successful approaches of both Ecotrust and IUCN Uganda. The convergence between theory and field experience further validates these recommendations. They should be best practice for afforestation projects in developing countries.

1) Continuous incentives must be provided until trees are mature. Just pouring in budget at the tree-planting stage may not lead to long-term success. Cash constraints faced by individuals will cause them to cut trees early. It is always important to allocate budget for continuous incentives.

2) Design in terms of an individual's utility but not payment. Instead of deciding how much money to give to an individual each year, we should ask what individuals need when they have to put in tree-growing efforts every year. This is a change of perspective. If individuals use trees as their 'safety net' because of poverty then cash (or subsidies, for example, for school fees, medical bills) must be provided; if individuals do not have access to financial markets then loans should be given as long as environmental targets can serve as credit scores. It is crucial that individual utilities from growing trees and the financial mechanisms over time stay higher than not participating. Once we understand the dynamics of utilities then we can decide the details of financial mechanisms.

3) Different levels of incentives mean different environmental outcomes. To be clear, let's compare a loan mechanism to a direct-payment mechanism. With loans available, individuals will put in environmental effort as if they have access to a financial market. However, it is possible that this level of environmental effort is still not enough for the socially-desired environmental outcome. In this case, direct payment will be more effective because the amount of payment can be adjusted according to the desired environmental outcome.

VIII. Conclusion

In this report, we reviewed the set of unique challenges faced in incentive design at the intersection of afforestation in the context of developing countries. We highlighted two real-world examples of financial mechanisms run in Uganda where Ecotrust uses a direct-payment scheme for agroforestry and IUCN Uganda provides micro-financing funds for communities that meet their environmental targets. We provided a set of best practice for incentive design for practitioners to consider. We hope that the public sector and practitioners treat the process of incentive design with care.

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Trees on Farms for Biodiversity

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