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Why put that Seedling in the Ground?

- A Case Study of the TIST Tree Planting Program in Tamil Nadu, India -

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Abstract

This study examines a reforestation program, TIST (The International Small Group and Tree Planting Program), and its effects on farmer's tree planting behavior. TIST is funded by selling carbon credits on the Voluntary Carbon Market and derive the carbon credits from farmers who plant trees in their own lands. In return TIST provides them with education on tree planting, free seedlings, a portion of the sales and organize farmers into small groups for enabling knowledge exchange. The study looks at what factors influenced the farmers into planting trees and what role the TIST program played in this decision. The main finding is that among the TIST benefits free seedlings, carbon payments and assistance in watering were determining factors. Other influential Non-TIST factors were increased labor costs and decreased rainfall, which affected agricultural profitability.

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1. Introduction

Few scientist today dispute that climate change is most likely caused by man and will have detrimental impacts on human society. Increased frequency of extreme weather with storms, drought, the spread of disease to temporal regions and a higher ocean level will all become our future reality. A leading cause of climate change today is the changes in land-use patterns where forests are converted for agricultural use or removed to make way for urban- and infrastructional expansion. 17% of anthropological greenhouse gas emissions are caused by deforestation (Stern, 2006) and between 2000-2005 12.9 million hectares was deforested (IPCC, 2007). But, the net loss of forest cover was only 7,3 million hectares because of forest regrowth. Deforestation was most severe in South America, Africa and Asia but was partly compensated through added tree cover in the rest of the world. The potential of carbon sequestration through afforestation and reforestation (A/R) has been estimated to 1GtCo2/year, 8GtCo2/year being the current net emissions (Stern, 2006).

Mitigation through forest activities has been shown to be highly cost-effective and also generates other benefits in the form of fuel wood and timber (Thomas, 2010). Although preventing deforestation is a more cost-effective approach for mitigating carbon emissions, tree planting is also a relatively cost-effective method (Sedjo et al, 1995). Although forest regrowth today is mainly taking place in the temporal zone the possibilities to sequester large quantities of carbon are greater in the tropics due to faster growth rates, available land and demand for biomass (Schlamadinger et al, 2007).

The cost of capturing the carbon dioxide has been estimated to be between 5-15 dollars/tC globally (Benitez, 2005). This is in line with the results in a study on carbon mitigation in India estimating a cost of 3,3-7,3 $/tC (Ravindranath et al, 1995). The same study estimated the Indian mitigation potential through A/R-activities to be between 23-175*10^6 Mg C. Hooda (2007) points to the fact that suitable land for A/R projects in India is not hard to find and consists of degraded lands, under stocked forests and farmland, pointing to the possibilities of Indian land to work as a carbon sink.

Funding of A/R-programs has historically been a task for national governments and government agencies. Now alternative sources of funding are emerging in the form of actors seeking to carbon compensate their carbon dioxide emissions. In newly established markets, such as the voluntary carbon markets and the Clean Development Mechanism (CDM), nations, companies and even individuals can

transact carbon credits. This additional inflow of capital makes way for new actors to enter the field of reforestation. As of 2011, 24% of the carbon credits bought and sold on the voluntary carbon markets were forest related project of which 10% were A/R projects. The CDM market has been slow to fund forest programs due to a long registration process and high transaction costs but nonetheless had 36 registered projects as of 2011 (Peters-Stanley et. Al, 2012; Thomas, 2010). As these new forms of investment appear, the question arises of how to manage them in the most cost-effective manner so as to create maximal carbon dioxide reductions and thereby generate sellable carbon credits. Privately funded A/R projects have small possibilities to change government policies, secure land tenure and provide better access to markets and must instead focus on other incentives to encourage tree planting. One of these programs is "The international small group and tree planting program" (TIST) and is the case studied in this thesis. On a small budget they encourage small scale farmers in Tamil Nadu, India, to plant trees on their land by providing multiple benefits and incentives for engaging in tree planting.

The focus of much of earlier research on the determinants of tree planting behavior of farmers in developing countries has to a large extent been to identify the household- characteristics and farm characteristics of tree planting farmers - i.e. age and gender composition, on and off-farm income, farm size, farm tenure, attitudes towards risk (see: Mekonnen, 2011; Mekonnen, 2009; Alavalapati, 1995; Patel, 1995; Dewees, 1991) and so on. Research on farmers tree planting in situations with assisting forest programs follow the same focus and have tried to find what distinguish farmers who choose to participate in the program from those who do not (see: Thacher, 1997). By finding evidence for what characterize the farmers who join these programs future programs can be more effective by targeting the most receptible households. On the other hand, less research has looked at what particular incentives encourage farmers to adopt tree planting (Enters, 2004) and existing studies most often look at large scale government programs (see: Lamb, 2011; Nawir, 2007; Murray and Bannister, 2004, Nibbering, 1999). With a growing number of smaller reforestation programs funded through the carbon credits markets there is a need to look at how they, with their limited means, can encourage smallholder tree planting activities.

1.1 Aim of the study

The study aims to identify what parts of small-scale tree planting programs that have had a significant effect on smallholders' decision to plant trees. It also examines the contextual economic push-factors influencing this decision.

Research questions

In order to fulfil the aim stated above, the following research questions will be answered through this study:

- What factors made the farmers engage in planting trees?
- Which factors in the TIST program played a determining role?
- What characterize a farmer dependent on the TIST program to plant trees?

1.2 Thesis Outline

This thesis is outlined in the following way. Chapter 2 presents two theoretical models chosen due to their ability to predict the impact on the household decision to plant trees of the different benefits provided by TIST. Chapter 3 builds on the variables identified in the models and reviews earlier empirical evidence of their effect on tree planting. In chapter 4 the choice of research design and the method of data collection are presented and motivated. In chapter 5 the results on farmer perception of determining factors and observations on important farmer characteristics are reported. Chapter 6 contains the analysis and conclusions.

2. Theoretical Framework

In this section two models on tree planting adoption behavior will be examined. The selection of models was made based on the criteria of including the variables exemplified by the TIST organization. As mentioned previously, TIST provides multiple benefits intended to attract farmers to start planting trees. These include: providing free seedlings, annual carbon payments based on number of trees planted, technical assistance in the planting phase, organizing the farmers into small groups to enable exchange of knowledge and arrange large group meetings where tree growing related information is conveyed. The models were chosen based on their ability to predict how the provisioning of these incentives could affect the relative attractiveness of tree planting. In addition, the external push-factors identified by the farmers, increased labor costs and reduced rainfall are included in the framework.

2.1 Theoretical models

The decision to plant trees is determined by a myriad of factors (Fig 1). Among these, TIST provides only a fraction of the possible incentives. This limited set of influential factors will be the focus in the following models.

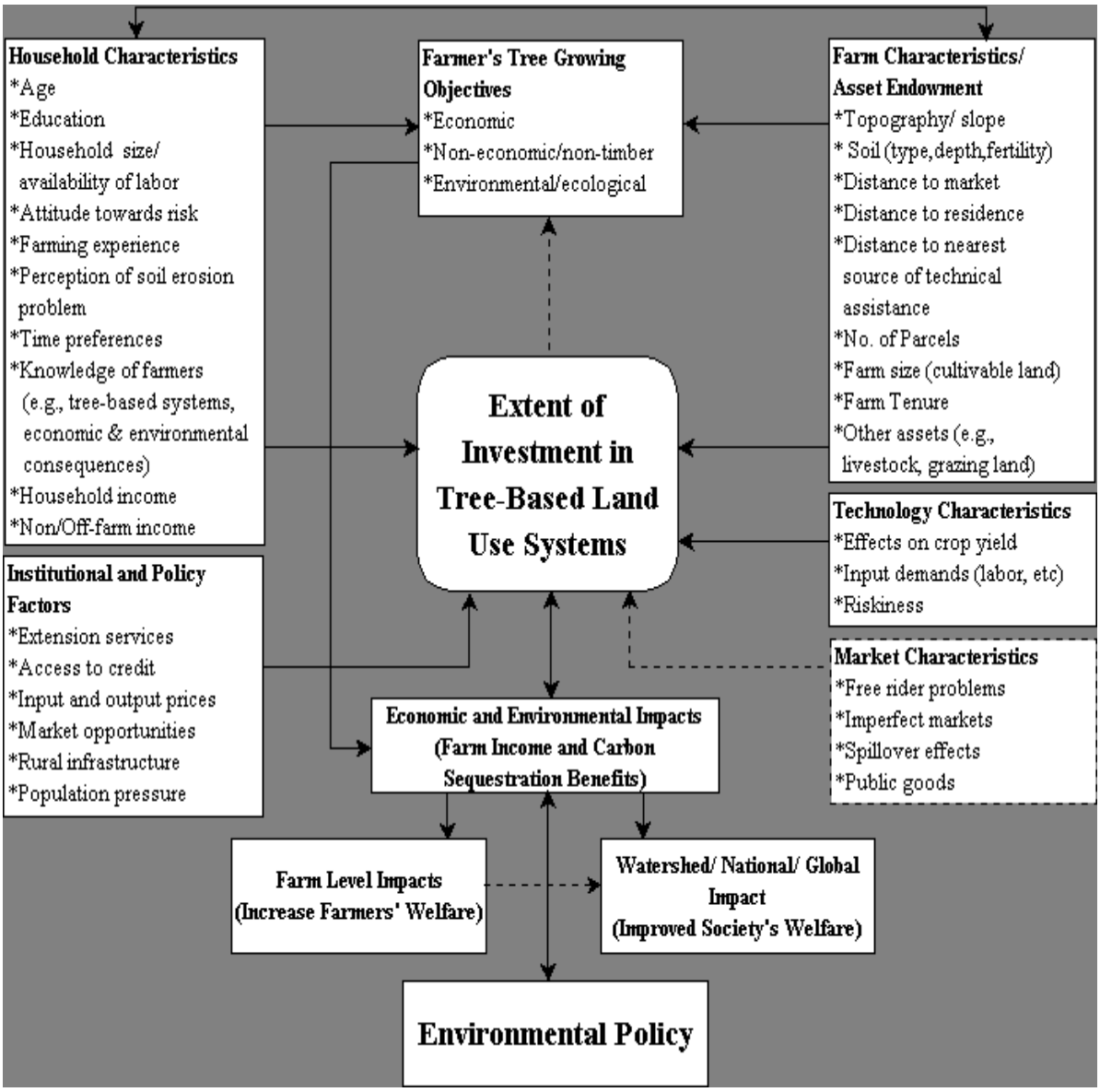
2.1.1 Model 1

Amacher et al. (1993) were among the first to model agroforestry adoption with the combination of expected utility theory and the household production framework under uncertainty. They construct a model to predict determinants of a household's willingness to adopt a new forest technology. A household is faced with two problems to maximize utility. Firstly they have a classical utility function where they need to chose an optimal bundle of goods to maximize utility from consumption. Secondly they need to optimize the use of inputs in farm production.

$$V(p , I ; C) = \max EU (Y_f , Y_o ; C), \qquad (1)$$

where Y_f is the consumption of forest-produced goods and Y_o is the consumption of other goods.

Illustration 1: Tree planting determinants *Source: Predo, 2003*



s.t. - sum (p_j*Y_j) + M + π = 0, (2)

where π is the return from forest activities, M other income, p_j prices and Y_j total consumption.

π in turn is explained by the following function:

$\pi = p_f*Q_f - rL$, (3)

where Q_f is forest production, r is cost of tree planting and L is a proxy for the combined use of land, capital and labor in tree production. Meaning returns of forest activities equals earnings minus costs. As we can see the budget constraint (2) is dependent on the income from forest products which in turn is dependent on Q_f, the production of forest products.

The household production function is:

$$Qf = f(\mu, L) = f(\mu * L) \qquad (4)$$

in which a higher L yields a higher Qf and μ is a random component.

The model is simplified by holding Y_o constant and assuming that the household consumes it's own produce of forest products, $Q_f = Y_f$. The household's decision is

$$\max_L E[U(I^*)],$$

I* being the household budget. By using the implicit function theorem they differentiate the L over I*, thereby finding which how the investments in L will change as income, or the components of income, change.

They find that increases in income, regardless of source, and endowments in capital, labor and land will increase the household's willingness to invest in trees, the explanation being that these increases will make the household more flexible in its production and consumption decisions and that risk averseness decreases with higher income. Following this, factors increasing the quality of labor will increase the likelihood of planting trees as this increases the factor endowment, meaning land, labor and capital can be utilized better. This includes education, information and technical assistance.

2.1.2 Model 2

Shively (1998) compared the decision of how big share of agricultural land to divert to forest plantation to a portfolio choice problem and an investment problem under uncertainty. It is assumed that the

investment can be made only once and at any time. The investment-choice is also assumed to be irreversible and that the investment cost is non-recoverable. The choice is hence how much land to divert to tree planting to optimize

$$\text{Max } E \{\sum ßtU(\pi t)\} \quad (5)$$

Subject to the definition of income,

$$\pi t = \theta\ pt(tree)\ g(t) + (1- \theta)pt\ (food)y – \theta I \quad (6)$$

where θ is the share of land devoted to tree plantations, ß is a discount factor, πt is net income at time t, p is the price of noted crop, g(t) is growth in forest output over time, y is the yield in food crop, and I is the investment cost of investing in trees. In the investment cost include the opportunity cost of the land devoted to tree planting is included, meaning the lost income from food crops on the same piece of land.

The first year utility is constrained by:

$$\pi t = \theta\ pt(tree)\ g(t) + (1- \theta)pt\ (food)y\ -\ \theta I \quad (7)$$

and every year that follows:

$$\pi t = \theta\ pt(tree)\ g(t) + (1- \theta)pt\ (food)y \quad (8),$$

where cost of investment is no longer included.

The optimality condition of the model is:

$$u'(\pi t) = ßEt\ \{u'(\pi t+1)\ [pt+1(tree)\ g(t) – pt+1(food)y - I]\} \quad (7)$$

which shows that the farmer will chose land shares so that the expected marginal values for each crop is equal. The expression shows that the willingness of the farmer to invest in trees is affected by the

investment cost, expected prices of food and tree crops as well as the relative risk of planting trees and the importance of risk to the farmer.

2.2 Summary of expected determinants

Any addition to income or available labor, land or capital will increase the willingness to plant trees according to model 1. Any external influence increasing these endowments are likely to increase the likelihood of tree planting, *education* being one of these factors as the educated can made better use of his or her available productive factors. A *reduction in investment costs* according to model 2 will reduce the investment barrier, making it easier to plant. Shively (1998) includes in his definition of investment cost the opportunity cost of the land occupied by the young trees. Thus a decrease in returns from the best alternative land use will spur a transit to silviculture. For future reference, free seedlings and the carbon payments will be defined as a decrease in investment cost and increased labor costs and reduced rainfall as reductions in opportunity cost of tree planting.

The rest of this thesis will be structured around these categories, which are organized in the following way:

Increase in productive factor endowments

- Education and technical assistance (Provided by TIST)

Reduction in investment costs

- Free seedlings (Provided by TIST)
- Cash incentives (Provided by TIST)
- Reduced alternative cost to tree planting
    - Increased labor costs (External)
    - Reduced rainfall (External)

3. Empirical Evidence

This section contains a review of existing empirical evidence. The review will be structured following the above organization of identified influential factors. The evidence of the effect of education is followed by the reduction in investment costs, which include free seedlings and cash incentives, and reduced opportunity costs.

3.1 Increments in productive factors endowments through education

Not having the right knowledge can be a barrier for any endeavor, and so including tree planting. Being comfortable with a new type of farming method can decrease the perceived risks and uncertainties (Pattanayak, 2002). In a meta study on quantitative studies by Pattanayak et al. (2002) all studies examining "received training" and "extension services" were significant and had a positive impact on adopting tree planting in an agro forestry setting. Predo (2003) found similar results in the Philippines where farmers who were more familiar with the economic and ecological consequences of planting trees were more likely to engage in such land use.

In case studies on programs providing education to participating members these factors have been shown to be fairly effective. Baynes (2007, in Lamb 2011 p. 412) looked at a government program in the Philippines that tried to encourage farmers to adopt silviculture by providing education in the form of field trips to successful plantations where they could interact with the farmers. Most participant chose to plant trees after this and also knowing they would receive additional help in setting up nurseries, pruning and free seedlings. The farmers were self-selected and most had unused land on their farms, which presumably would make them more interested in a low intensive land use. Other schools of thought have looked at the effect of education as well, for example the Theory of Planned Behavior framework (Williams, 2012). The results show that education increases the knowledge of how to plant trees as well as the farmer's perception of his or hers ability to successfully implement a tree plantation. These two factors in turn are shown to be important predictors of adoption.

3.2 Reduction in investment cost

A reduction in investment costs has two main sources, physical and financial assistance and the reduced

opportunities in making a living from alternative land uses.

3.2.1 Seedlings and cash incentives

It is no easy thing assessing the effect of monetary or physical incentives, such as seedlings, as they are difficult to separate from the institutional setting or market incentives. Schemes including these benefits have produced different results in different settings and Enters (2004) concludes that their effect is inferior to "enabling incentives" such as access to infrastructure, tenure security and access to credit. In a non-favorable environment with low prices and high risk their effect will be small but, if provided in a favorable setting, their marginal effect will be much bigger.

Planting programs often bundle a lot of factors meant to encourage tree planting in their programs, and seedling and cash payments are often provided simultaneously. This makes it impossible to disentangle their separate effects but cumulatively the results points toward confirming the above conclusion of Enters (2004). Nawir (2007) finds that if favorable conditions can be established where the farmers more easily can access markets and transaction costs are reduced, providing free seedlings can have some effect. Nibbering (1999) observes a triggering effect of free seedlings in combination with cash incentives in Indonesia where favorable conditions in the form of better access to market and reduced returns from agriculture were becoming more apparent. Cash incentives can be a way to encourage both unsure farmers to adopt a new technology (Lamb, 2011) and those unwilling to pay for what they usually gather in natural forests for free (Godoy, 1992). Lamb (2011) on the other hand observes a risk of encouraging economically non-viable tree plantations. The targeting should be made with care and focus on the more poor households who might be facing an actual capital constraint. It might also be that farmers only plant the trees for the short term cash and don't maintain the trees for the long-term benefits (Dewees and Arnold, 1999).

In programs including free seedling, and no cash payments, some influence on the willingness to plant trees is found. That seedlings can facilitate the initiation of planting trees is showed by Salam (2010) who finds a significant and positive effect of awareness of a government program providing free seedlings and extension services. The farmers were unable to afford the investment cost and reported that access to good seedlings were one of the inhibiting factors to initiate tree planting, which strengthens the argument that the provisioning of seedlings were effective. Also in India subsidized seedlings proved to have an effect on the willingness to plant trees (World Bank, 1994). The most

aggressive arguments for the effect of free seedlings is offered by Bannister and Murray (2004) regarding a nationwide tree planting program on Haiti. They claim that if seedlings had been sold at market price essentially no one would initiate tree planting, and even at a subsidized price of 10 % the market price barely 1/200th of the participating farmers would have joined they estimate. But, just like the combination of grants and seedlings, the large effect of the free seedlings is enhanced by beneficial circumstances with market accessibility, secure tenure and increasing wood scarcity combined with a growing market demand.

Some are less certain of the effects of providing free seedlings. According to Deewes and Arnold (1998) and Lamb (2011), planting trees is no big investment and the costs should not be a big hindrance to plant. Supplying seedlings might instead hamper the establishment of commercial nurseries creating dependence on outside assistance. They advise against free seedlings as a fiscal aid and urge it only be used when seedlings are hard to raise or difficult to acquire.

3.2.3. Reduced opportunity costs

When the potential income from agriculture decreases, tree planting can become the most rational land use. Reasons for a reduction in agricultural income are changes in available labor, increased cost of labor and other inputs, and diminishing yields.

3.2.3.1. The Cost of Labor

It is commonly agreed that planting trees is less labor intensive compared to agricultural land use. As a consequence a household with access to less labor is expected be more prone to adopt tree planting since it will not be able to utilize the land optimally with agriculture (Deewes, 1991; Thacher, 1997). The decision to plant trees then becomes the next best way to make use of the land when the household lacks the resources to use it more intensively (Dewees, 1991; Malla, 1999).

The reasons farmers do not have enough available labor for intensive agriculture have multiple explanations. Dewees (1991) find that older households are more prone to adopt tree planting as their children often have moved away and they are themselves unable to do much physical work. The loss of

household labor can also be explained by the increasing opportunities of off-farm employment. It either drains farm labor until agriculture is no longer viable or the farmer will himself plant trees to make more time for some alternative off-farm income (Thacher, 1997; Dewees, 1991; Yam Malla, 1999; Arnold, 1990, Arnold and Falconer, 1989; Dewees and Saxena, 1995 in Arnold and Dewees 1999).

On the other hand, Patel (1995) finds that access to labor makes tree planting more likely, which might be explained by larger families having a bigger fuel wood demand and therefore grow more trees. Scherr (1995) also finds that access to water and labor are what constrains farmers from adopting agroforestry technologies.

Tree growing being less intensive than agriculture also makes it more likely to be adopted when agricultural wages increase, making agriculture more expensive to run (Patel, 1995). This effect has been observed in several Asia-Pacific countries where increased wages spurred private tree adoption rates (Enters, 2004). As the wages rise, planting trees is then chosen as the next best alternative (Arnold 1990; Arnold and Falconer, 1989). Depending on tree species and agricultural crop the need for fertilizers and pesticides might be reduced when turning to silviculture meaning increased costs in these commodities will have the same effects as increased labor costs (Arnold and Falconer, 1989).

3.2.3.2 Rainfall

Although the empirical evidence is sparse, some findings indicate that trees are preferred to agriculture in areas with lower rainfall, as they are more drought resistant. Their roots go deeper and are thus not as dependent on regular rainfall as agricultural food crops which make them a way for the farmers to ensure some income in times of drought (Arnold and Falconer, 1989).

4. Method

To understand how a small scale tree planting program can affect farmers' decision to plant trees a case study was done on the TIST-organizations and work in Tamil Nadu, India. The purpose of the data collection was to map the existing reasons among the TIST -members for choosing to plant trees. When attempting to comprehend the entire width of a situation a qualitative method is suitable and was used in this case study. The study is thus not intended to quantify the influential power of each incentive to plant but instead to describe the multitude of factors influencing the household decision to plant trees. The study also aims to examine which of the TIST factors that played a determining role in the farmer's decision to plant trees. As the ability of TIST to encourage the farmers to plant trees is not studied, and remains unproven, the thesis rests on the assumption that TIST have a marginal effect on the tree planting decision which will be discussed further below.

The experiences of the farmers are key to understanding their decision-making. A method focused on capturing the subjective experiences of the farmer was therefore chosen. In-depth, semi-structured interviews were used to collect the data. It enabled follow-up questions and provided the flexibility needed to understand each unique situation. It also gave room for unpredictable factors so surface. This ensured that the complexity behind the farmer's choice to plant trees could be discerned, and the determining factors identified. As the economical and physical conditions for the farmers varied greatly, and the incentives offered by TIST varied across villages, an open interview setting was even more suitable.

4.1 Case description

The case chosen is a tree planting program run by the International small group and tree planting program (TIST) that encourages small-scale farmers to plant trees on their own lands. The carbon dioxide sequestered by the trees is then sold internationally as carbon credits on the voluntary carbon market. The credit sales are administered by a for-profit organization called Clean Air Action Cooperation (CAAC) who also funds the TIST program. 70% of the sales are returned on a quarterly or yearly basis to the farmer as carbon payments and 30% are used to run the program and as returns on

investment for CAAC. The farmer remains the owner of the trees and all revenue it generates, but grants TIST the rights of the carbon credits. According to TIST official documents, aside from the direct payments the program is said to offer a multitude of benefits to the farmer that can be supposed to make planting trees a more attractive choice. The farmers are organized into groups of 6-12 people to strengthen their organizational capacity and to create a platform where information can be shared. TIST also educate the farmers on how to set up a plantation cheaply and provide them with seedlings for free or at reduced costs. They also inform them on matters such as health and the ecological benefits of woodlots.

The TIST program has thus far been able to attract 1400 farmers to offset all or a part of their land for tree plantations. The benefits offered by TIST can therefore be expected to have created some additional tree plantations compared to a case without them. Under this assumption it is of interest to further understand which parts of the TIST-program actually have an influential effect on tree planting behavior.

4.2 Interviews

The collection of data was done through individual semi-structured in-depth interviews with the TIST-members. The farmers are the actors of interest as they make the land-use decision on their farms. The nature of the questions was open-ended to capture unpredicted answers that might be lost in a survey questionnaire. The purpose of the interviews was hence partly explorative as they were looking for previously unknown information.

Most variables are examined following a similar pattern. Firstly the respondent was asked to recall the time where they were introduced to TIST and if they have been aware they would receive the particular benefit by joining TIST. Secondly, the respondent was asked whether or not they would have joined TIST had this factor not been provided. For a variable to be considered crucial, the farmers had to state that they would not have joined the program had this benefit not been provided.

Toward the end of the interview the respondent was asked to rank the factors felt to have influenced his or her decision. In this way contradictions could be identified and the respondent was helped to structure his or her views.

To further understand the situation of the farmers in Tamil Nadu and their choice for planting trees an executive of the Tamil Nadu forest department and an assistant in a government reforestation program were interviewed.

As the farmers were dependent on TIST for the carbon payments and group meetings there was a risk that they would not be completely honest if they suspected their answers might affect their payments. For this reason all farmers were promised anonymity prior to each interview and it was explicitly stated that neither TIST nor anyone else would be able to trace their answers back to them. No farmer seemed reluctant to answer any questions truthfully due to fear they might lose TIST benefits. Instead it was often expressed that they would answer our question with or without being anonymous. In light of this it is deemed unlikely that the answers were influenced by any fear of repercussions from TIST.

Methodological issues

Using recalled data where the farmer remembers whether or not he or she would have joined the program with or without certain factors is highly problematic. Efforts were made for the farmers to properly recall the decision he or she was facing as TIST introduced themselves and what he or she was expecting to get from the program. It is still likely that the answers were influenced by the actual outcome of the TIST benefits. For example, the farmer might have expected the group meetings to be very beneficial but if they turned out not to be this could affect the recollection of the actual expectation that made the farmer join. An argument against this is that the stated influential power of the small groups did not differ between farmers in current non-functioning groups and functioning groups. The function of the group also turned out to be where the promise from TIST and the actual outcome differed the most, further strengthening the argument. Still, there is a potential risk the actual outcome affected the answers given.

4.3 The choice of interviewees

To ensure a diverse sample with maximal variation, interviewees were selected from seven villages in five geographical areas, which meant they had been contacted by four different TIST personnel. The interviewees varied in age, land size, and position within the village. The income distribution within the sample was also fairly large. Mostly men were interviewed as they were the household decision-makers, but in a few cases the woman of the household had made the decision to plant trees and was

thus interviewed.

The interviewees are divided into two groups based on the timing of their tree planting and involvement with TIST. The first group started planting after meeting the TIST staff, thus as a consequence of meeting them. The other group had already converted all or some of their land to tree plantations before meeting TIST.

For both groups interviews were made until no further aspects were revealed and theoretical saturation was assumed to be reached. In total 20 interviews were made of which 19 are complete. The sample is non-random and the data is not intended to be quantified within the groups.

4.4 Working with an interpreter

All interviewees spoke Tamil as their first language and I used an Tamil-English interpreter in the interviews. In one case the interviewee spoke English and so the interview was carried out in English. The interpreter was well instructed on the purpose of the study and the interview material so as to minimize the risk of misunderstandings. Using an interpreter always causes extra inaccuracy as the quality of the translation is hard to determine.

The interviews were recorded and a transcript made. All interviews were listened to at least twice and when in doubt of exact wording a second party did a double check to increase reliability.

4.5 Operationalizations

The external influential factors identified in chapter 2 will be operationalized. The operationalizations are very direct as a follows when the theoretical concepts are concrete.
The categories are sub-divided into the variables actually measured.

4.5.1 Reduced cost of investment

As could be seen from the description of the case, there are two benefits provided by TIST that could influence the cost of investment for the farmer. These are *free seedling* and *carbon payments.* As briefly

touched upon in section 2 the third factor able affect the cost of investment is the *opportunity cost of land.*

Free seedlings were operationalized by following the above mentioned procedure of recalling if they knew this would be a benefit of joining, and if they would have joined without it.

Operationalizing the *Carbon payment* was done in the same fashion.

Changes in opportunity cost of land was measured by asking questions of what the land would have been used for had the respondent not planted trees and what approximate income that would have generated. This was done by asking if the profitability in the alternative had changed during the years prior to the land use-change and what factors had contributed to it.

4.5.2 Improved use of productive factors

The theoretical concept of the improvement of productive factors is measured by improvement in e*ducation and tree planting knowledge*. Questions were asked regarding expected technical assistance from TIST and expected benefits from group meetings.

5. Results

In total 20 interviews were made, of which 19 were complete and used in the study. Nine farmers report they would not have planted trees in a case without TIST and ten farmers either would have planted anyways or had already planted before being introduced to the program. At the end of this section a comparison between these groups will be made. The rest is dedicated to presenting whether or not the TIST benefits were thought of as necessities for planting trees and expressed external determining factors. For clarification, when TIST incentives are the determining reason only results from the group who would not have planted without TIST are presented. For non-TIST reasons the results from all nineteen interviews are presented.

5.1 Increments in productive factor endowments through education

As described in the *Case Description* education on how to care for their tree plantation was provided by TIST in two ways. Firstly through technical advice on how to plant the trees and how to maintain them as they matured, and secondly through group meetings. Due to different working methods of the TIST staff sometimes the farmer did not know they would receive any help until after they joined and was about to initiate the plantation. Farmers who were aware of the technical assistance "were expecting some information to get about how to plant and what kind of things of use in the field", but none found it to be a determining factor and would have joined without it. They either knew how to plant already or they "would still do it, but in their own convenient way". The same was true for the expectations on the group meetings, they either could see no benefits from them or didn't find them attractive enough. The general knowledge of how the groups would work was low.

5.2 Reduction in investment cost

The factors causing a decrease in investment costs comes in two forms, financial and physical aid from TIST or external factors causing reduced income in agriculture.

5.2.1 Free seedlings from TIST

Free seedlings was one factor that some farmers would not have planted without. It either tipped the scale for the farmer to initiate a tree plantation on its own or it worked in combination with for example carbon payments. In all examined villages TIST handled out free teak seedlings in quantities ranging from 50 to 4000. The perceived price of seedlings in the market varied greatly between the villages, from 2 to 50 rupees and so the total expense saved ranged from 2100 to 36 000 rupees. This cost was too much for the farmers to bear on their own.

All farmers had access to seedlings in the market but many were most often limited by their budgets to buy them. They "couldn't afford the initial seedling cost" and therefore "if they need to buy outside they won't do it [plant trees]". The free seedlings either significantly added to an already planned number of trees or made planting possible altogether. This was because the farmers would only have been able to afford just "a few trees on their own". A farmer with five acres of land "could afford around 50, and just planted" in a case with no free seedlings instead of 2500 which later became the actual case. So without the free seedlings no viable land use consisting of tree plantation existed. In one special case one farmer "felt he didn't need them that much" but since they were given for free he thought he might as well take them as he had some spare land.

5.2.2 Received Carbon Payments from TIST

Based on standing trees the farmers are given a set amount of money per tree on a yearly, six-month or quarterly basis. The amount varies slightly between farmers in the interval of 1.5-2.0 rupees per tree and year. It was given as a necessary incentive to plant the trees. The carbon money provided an extra income and security for the farmer as the money is used to replace lost seedlings in the initial stage of the plantation (at this point the seedlings are more susceptible to drought). Two reasons were mentioned for why the carbon payments was a necessary factor. First, it is used "to preserve the plants the first years on their life when they're vulnerable so "if some plants are lost, I can afford to replace them". Secondly the payments are attractive only as additional short-term income and fill no particular purpose. Getting income in the present can even provide more of an incentive to plant the trees than the actual income from the trees as "the carbon money he is going to get right now, once in every three months. But the fruits and the teak it is going to be in the future".

5.2.3 Reduced Opportunity Costs

Not being able to make a living from agriculture was a major reason for choosing to plant trees. Three factors were mentioned that reduced income from agriculture or made it impossible to run altogether: increasing labor costs, difficulty to find labor and reduced rainfall.

5.2.3.1. The Cost of Labor

The most common crops grown prior or parallel with the tree plantation was rice paddy, sugar cane and peanuts. They were all said to be more labor intensive as "on the plantation he only need 25 % of the labor he would need in agriculture" and "you plant only once" and then the trees are fairly low maintenance. When the farmers met higher agricultural wages it affected the agricultural profitability severely. The farmers reported large increases in labor wages - by up to 600% over the past few years - "the cost of [a days] work has increased from previously 20 rupees, and right now for one person 120 rupees". At the time of ”doing some agriculture labor was very cheap [...] but right now I am not [doing agriculture]." The increased wages strained the budget until they "could get no profit in agriculture because labor and fertilizer cost has increased". The government was blamed for the increased wages when they introduced a welfare program - the Mahatma Gandhi National Rural Employment Guarantee Act (N.R.E.G.A) - which provides 100 days of government employment per year (Zimmerman, 2012). "...agriculture is losing because of the government. Because if the people, a normal person, a laborer he is going to get 100 rupees per day for not doing any work so of course he's going to work for the government. They're saying they just sleep on their job, and they just sleep and [the employers] give them money, why do they need to do work in the field?"

4.5.3.2 Difficult to find labor

When doing agriculture the need for labor varies drastically over the season and is concentrated during planting and harvesting. In sugarcane production the timing of these events are very crucial and the farmer need "labor at the right time". But as farmers "can't find labor" for these sensitive periods they become unable to properly grow sugarcane. Planting trees is then seen as a better option since the need for labor is less and not as time dependent.

4.2.3.3. Reduction in rainfall

Some farmers have experiences a reduction in rainfall over the course of their lifetime. This has never been the sole reason to start planting trees (which are less water intensive). But, it has nevertheless been a strong push-factor since as "the water resources have decreased so we don't have sufficient water to do agriculture". For others it had just made the agriculture "not going so well" and reduced their income. The reduction in rainfall had made farmers dependent on pumping groundwater through bore wells but "there is scarcity of electricity here so I couldn't get a proper water supply". In combination with increased labor costs the effects on agriculture was severe. Although the main factor was higher wages "the second factor is rain, not getting enough water. He's doing hard work in agriculture but he's not getting any income."

TIST-assistance in watering

It was not customary for TIST to offer help with the water situation, but in one case they were found to have "promised to give water". The farmer had experienced big reductions in rainfall over his lifetime which impacted his agricultural yields – he had previously abandoned parts of his land that had become infertile. With the rest of his land losing profitability tree planting seemed like a promising option but "if they didn't say about free water they would not have accepted the free plants" and joined the program.

5.3 Altruistic reasons

Besides the above mentioned reasons for planting another reason was mentioned which is not explained by the models in part 2. Farmers claimed to have planted solely for the altruistic reason to provide environmental benefits for the local and global community. They either planted on their own initiative or on the encouragement from TIST.

5.3.1 Personal Initiative

The awareness of the positive environmental impact of planting trees was big and it was expected to clean the air, increase rainfall and reduce disease. It was mentioned as a contributing reason to plant

trees secondary to earning an income. But it also occurred that their positive effects on the ecosystem was enough to inspire establishing a tree plantation altogether. "We are a developing country [...] but we are not developing nature, we are demolishing it" was one perspective that led to the intention to be "a person to protect the nature". The wish to preserve nature was motivated by the wish that future generations can experience it: "I have seen the nature, I want my grandson and granddaughter to see the same thing." The trust in the government to protect the environment was low as "they took no interest in that" which spurred the initiative to alone "save the environment".

5.3.2 Encouraged Altruism

Some peculiar examples exist of how TIST had an influence over the farmers' adoption of the tree planting practice. The farmers perceive themselves as being altruistic and that "it is our duty to control the pollution, so that other people are not affected". Still they had not planted trees before TIST contacted them, either because they were not aware of the benefits of tree planting or they had simply not considered the option. When not knowing about the environmental use they still "knew previously that we can get [financial] benefits from the trees, but we didn't start until the TIST informed us [of the environmental benefits]". In the case when they knew of the environmental benefits, but had just not initiated a plantation, the influence from TIST was more subtle. Even though they had some knowledge that the "pollution was high there" and that planting trees could help they still didn't plant until the TIST staff "told him of the importance of the environmental goods". In these cases the only new information TIST brought was thus the benefits for the environment for planting trees, which were perceived as being the main reason for joining.

5.4 With and without TIST

The farmers who stated that they would not have gone through with their plantation without the help from TIST consist of nine farmers. Out of these, seven were dependent on the physical and financial assistance, such as seedlings, carbon payments and help with providing water, from TIST and two were instead influenced by the environmental benefits of the trees. The farmers that would plant without the help from TIST make up ten people.

The sample is too small and the selection non-random rendering any proper statistical analysis

impossible. Still, some general observations can be made when comparing the two groups providing a weak indication at best.

The seven farmers in need of physical and financial assistance had on average half the annual income at time of planting compared to the rest of the sample. They also report being constrained on capital to a larger extent when it comes to the initial investment cost. This is expected as they were not able to afford seedlings in the market. In terms of land the group planting without TIST have more arable land, on average 7,6 acres compared to 6 for those in need of TIST.

The group in need of TIST assistance all had an alternative income, either from productive agricultural lands or from off-farm sources. The other group on the other hand only had other sources of income in 4 cases, the rest being fully dependent on making a living of planting trees. Their ability to support themselves from agriculture had diminished for already mentioned reasons and with land being their only source of income it provided them with a higher incentive to invest in tree plantations.

6. Discussion & Conclusions

In this section the effects of the external factors and the TIST-benefits will we discussed and connected to the theoretical models and the literature review.

6.1 External Influence

6.1.1 Labor

The literature suggests that increased wages will encourage tree planting (Enters, 2004; Arnold, 1990), which is in line with the economic model of Shively (1998). This explains well the results in this report as rising labor costs seem to have spurred farmers to plant trees, meaning the opportunity cost of planting trees decreased. The increase in wages was partly attributed to the introduction of the N.R.E.G. A. program. It is a public work program that guarantees 100 days of public unskilled work for the rural, poor population with the purpose to relieve poverty. It is a country wide program and was first started in 2005 and as of 2009 provided a minimum wage of 120 rupees per day. (Zimmerman, 2012) A study by Berg (2012) show that in the average district the real agricultural wages increased by 5.3 % within 6 to 11 months after the program was introduced. Nominal wages are reported to have increased even more as the program was being implemented and so the wage increase as perceived by the farmers was likely higher than the increase in real wages. The intensity of how the program was introduced varied among districts and has led to high variability in the effect of the program among districts. For example in Tamil Nadu the agricultural wages increased more than that of the off-farm labor. (NCAER, 2009) Considering these facts it can be assumed that at least some of the experienced rises in wages were due to N.R.E.G. A. and is a contextual factor contributing to farmers moving away from agriculture to tree plantations.

The study revealed that the reduced availability of labor could be the main reason farmers chose trees over food crops. Under the N.R.E.G.A. program these effects have been witnessed and landowners have been known to “request program to be banned during peak agricultural season" (NCAER, 2009). There are reports of farmers leaving their land uncultivated due to lack of labor when workers prefer working under N.R.E.G.A. as it is seen as more dignified (NCAER, 2009). The situation reported by

the farmers participating in the TIST program appear similar to other findings which find a connection between lack of labor and a willingness to plant trees. Although most of these studies focus on available household labor and not hired labor the constraints it imposes should be fairly similar (Thacher, 1997; Dewees, 1991; Arnold, 1990, Dewees and Saxena, 1995 in Arnold and Dewees 1999). Yam Malla (1999) observes similar effects in Nepal when work opportunities in the urban centers drain the countryside of laborers and as a response more farmers grow trees. Arnold & Falconer (1989) reported over two decades ago that farmers in India chose to plant trees due to increasing labor costs and less available labor. The N.R.E.G.A. must be seen in a broader picture in a society with a rapid urbanization and industrialization.

Interviews with forest office officials point out that the N.R.E.G.A has shifted the power balance between farmers and farm workers. Previously the farmers had been able to exploit the workers as no alternative source of income existed. Since the program started, the workers are able to demand higher wages and better working conditions. In the meetings with the TIST-farmers some frustration was apparent over this new situation and they complained about the outrageous demands to get proper lunches and compensation for transportation. Even anxiety for future rice prices was expressed as the number of growers was said to be in decline. In sum, both the model of Shively (1998) and earlier research on the connection between labor availability and tree planting provide a plausible explanation for the expressed view of the TIST farmers that lack of accessible labor and increased wages have forced them to plant trees. As for the effects of N.R.E.G.A more research is needed on how the public-work programs influence land-use-decisions on fertile lands.

6.1.2 Water

Less precipitation was a contributing reason for the reduction in agricultural income. Although there are only few references in the literature that makes the connection between reduced rainfall and increased tree planting it follows well from Shively (1998) that circumstances lowering the opportunity cost of tree planting will make it more attractive. The actual precipitation data between 2000-2012 show no actual reduction in rainfall for Tamil Nadu as a whole (Department of economics and statistics, 2013). The data are however very coarse and does not display regional variation. Looking at the regional rainfall data some reductions can be discerned although the data only shows rainfall for the past five years (India Meteorological Department, 2012). In an interview with the Chief Director of the

forest department and an assistant in a government reforestation program (similar to that of TIST) the farmers' perception of a reduction in rainfall was confirmed. According to them the rainfall had diminished, increasing the need to use bore wells in agriculture, which in turn had lowered the ground water table. They also see this as a main reason for the success of their own reforestation program, where farmers also experience lessened crop yields. Although a reduction in rainfall cannot be determined due to lack of data, the distribution of the rainfall might still have changed, becoming less in sync with the growing seasons. The farmers' experiences still point to a relationship between access to water and the propensity to grow trees, which is observed by Arnold & Falconer (1989). And, if farmers choose to plant more trees when precipitation lessen and change, as the results indicate, planting trees might be a way to adapt to climate change. As it provides an alternative source of income when agricultural yields fail tree-planting programs can work to mitigate the effects of a warmer climate with changing rainfall patterns.

6.2 TIST benefits

6.2.1 Education and group meetings

The incentives that failed to attract farmers to any larger extent were the promise of technical assistance and expected benefits from group meetings. They were still found to have some attractive power although not enough for the farmers to feel it was a necessary prerequisite for joining. Why the promised information from TIST on how to establish the plantation was not effective might be because the farmers were already familiar with tree planting. All farmers either had some previous experience in planting trees or knew someone who did. This likely made them more comfortable in adopting it themselves and perceived the risk as lower as predicted by Amacher (1993) and Pattanayak (2002). Often the information about the groups were poorly communicated and the original purpose of a forum to exchange knowledge and learning together was often lost in exchange for a convenient way to transfer the carbon payments. The main purpose of the group is also less concrete, compared to for example seedlings, and it might be hard to see how it can actually benefit the plantation. It is also difficult to have any clear expectation about a way of working that might be new to the farmer. All in all, the education and working groups were not effective in convincing the farmers to plant trees.

Amacher et. al. (1993) predict that an increase in education will ultimately increase the propensity to plant trees. But this might not be fully applicable to the attractiveness of TIST's promise of education and technical assistance as it will only provide an expectation of more knowledge, but no actual increase in knowledge. It would have been interesting to compare the current working method to one where the farmers are given an introductory course and then offered to join the program.

6.2.2 Help with watering

Even though trees require less water than food crops, help with watering was still found to be an important reason for planting trees. This is likely a consequence of past experience with the detrimental effects of reduced rainfall with diminishing yields and land becoming unable to support agriculture. When then help with watering was offered it was seen as a great help and of course might have helped to keep the seedlings alive in their first, fragile years.

6.2.3 Seedlings & Carbon payments

A reduction in investment costs are expected to have a positive effect on the willingness to plant trees according to model 1 (Shively, 1998). The empirical evidence on the effect of providing seedlings and cash payments in section 3 all point to these incentives being of secondary importance compared to secure tenure, price, access to markets and infrastructure. As neither of these factors has been studied, no claims can be made regarding them. But, the general notion that seedlings and payments are most effective when the general incentives to plant trees already exist is applicable to this case. Drawing on the findings of Nibbering (1999) that a reduction in agricultural returns made way for free seedlings and monetary payments to have an impact, we can see clear similarities in our case. Instead of degradation of land it is increased labor costs and reduced rainfall that cause the returns in agriculture to decrease. Building on this previous knowledge it is likely that these incentives from TIST had an effect since the economic context already provided good reasons to abandon agriculture for silviculture. As intuition might predict, the reason for the effectiveness of the seedlings and payments was that farmers were limited in their ability to afford seedlings and the maintenance costs. Lamb (2011) makes the same observation and concludes that the effectiveness of free seedlings depend on the farmer's

ability to afford them at market price. So in this setting, with farmers facing problems in agriculture, TIST has a good chance to encourage farmers and even more so if they are able to target the more capital constrained groups.

6.2.4 Altruism

TIST was able to convince farmers to plant trees by informing them about the environmental benefits of tree planting such as reducing pollution and getting more rainfall. It should be kept in mind that this has an effect and should be mentioned when introducing the program to new farmers.

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