Designing commercial forestry schemes for subsistence farmers' climate resilience using adaptation finance

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Abstract

The hilly areas of the Northern Pakistan mostly rely on subsistence farming, which provides food, fodder and livelihood to the poor rural farmers. Nevertheless, farmers do not get sufficient crop yield due to poor quality marginal land and the problem is further compounded by climate change. As this is an arid region and crops rely on rainfall, changing rainfall patterns and frequent droughts result in crop failure, exposing poor farmers to multiple risks including loss of livelihood and food insecurity. Farmers need to adapt their farming practices to climate change, however, it is impossible for them to take-up adaptation measures without financial support as they lack access to financial instruments such as low interest concessional loans. The present research, therefore, proposes to implement commercial forestry using adaptation finance to: diversify the crops, reduce the risk of crop failure, and make farming resilient to climatic changes. The analysis aims to identify the economic incentives with which farmers can adopt and benefit from commercial forestry schemes (CFS) and donors would be willing to lend the concessional loans.

Using a primary survey and discrete choice experiment (DCE) approach, this study investigates farmers' willingness to uptake CFS. The findings reveal that farmers derive disutility from existing farming practices, i.e. high risk traditional food crops, for their susceptibility to climatic changes and are willing to adopt CFS for crop diversification. Amongst CFS attributes, farmers place a positive value on their own choice of CFS location on farm, wood share, and annual payment; however, they are reluctant to commit biodiversity area. In addition to CFS attributes, farmer age, education, household and farm size, off-farm work and market distance are some of the socioeconomic covariates that affect CFS choices. Results show that, farm households who are economically more empowered seems to disapprove some of the CFS terms.

Key words: *commercial forestry schemes, adaptation finance, subsistence farming, climate change*

1. Background

The hilly areas of the Northern Pakistan mostly rely on subsistence farming, which provides food, fodder and livelihood to the poor rural farmers. However, these hilly areas have generally poor quality marginal land that does not give sufficient yield, despite intensive tillage and concentrated use of expensive agro-chemicals. The problem is further compounded by climate change, as this is an arid region and agriculture in these areas is rain-fed and crops rely on rainfall (Baig et al., 2013). Changing rainfall patterns and subsequent droughts cause crop failure, exposing poor farmers to multiple risks, including loss of livelihood and food insecurity. Since there are limited off-farm income opportunities in these areas, farmers often cut the forests to survive, which leads to natural resource degradation and further aggravation of climate change problem. The antidote to this problem is farmers' adaptation of their farming practices to climate change; however, it is difficult for farmers to take-up adaptation measures without financial support as due to poor rate of return, lack of collateral, and farmers' inability to service loans, financial instruments like insurance and microcredit are not available. Furthermore, government do not have sufficient resources to finance climate adaptation initiatives to help these farming communities to adapt to changing climate.

The present research, therefore, proposes a self-sustaining financial initiative in which adaptation finance donors would provide financial resources to facilitate climate adaptation by setting in motion a well-designed commercial forestry scheme (CFS). Farmers would adopt CFS to diversify the crops, reduce the risk of crop failure and make farming more resilient to the unfavourable climatic changes. Under CFS, farmers would be incentivised to convert unsustainable marginal cropland and allocate it to tree plantation. As such, CFS is primarily an adaptation finance initiative that will allow poor farmers to shift less productive land from susceptible and high input traditional food crops to commercial forestry as an adaptive response to changing climate. Farmers will be compensated by adaptation finance donors to adopt and sustainably manage CFS in poverty-stricken hilly areas where people have limited means to make a living. Farmers' compensation includes initial plantation cost, monthly payment to manage the tree plantation in the non-yielding period of CFS, and a share in CFS wood (as an incentive) at the closure of scheme when it is matured.

This will enable farmers to diversify their livelihood by growing commercial forestry along with traditional crops, which can provide a buffer to them in case of a crop failure due to unfavourable climate as CFS is much less likely to be affected by it. Hence, CFS is a livelihood adaptation strategy for poor subsistence farmers in the hilly areas of the Northern Pakistan, which will enhance farmers' resilience by allowing them to diversify their crops and augmenting their existing stream of income.

CFS is similar to the schemes that encourage farmers to enter into environment improving contracts for monetary compensation (Arifin et al. 2009; Vedel et al., 2015), and they are paid for generating public good in the disadvantaged areas (Hanley et al., 2007).

CFS uptake is not difficult as farmers will only allocate a part of their land which is less productive and continue growing usual crops on their remaining land. Furthermore, growing commercial forestry under CFS has relatively less costs comparing mainstream crops that involves intensive use of inputs, land preparation, and farmers' time. Since managing CFS is not a full-time job, farmers can devote part of their time in other productive activities, including off-farm employment. In addition, as CFS proposes to grow the commercial tree species that are already being grown in these areas, the chances of failure of this scheme are minimal.

CFS is not only farmers' adaptive response to adjust their farming practices to changing climate, but is also an innovative idea of a profitable investment for adaptation finance donors. There are two types of returns on CFS investment for adaptation finance donors: one, wood at the end of the CFS contract, two, CERs (certified emission reductions) against carbon offset through tree plantation. Hence, CFS offers a promising opportunity to adaptation finance donors as they could benefit from the sale of sustainably certified wood (at a premium) and carbon credits achieved by carbon offset at the end of CFS contract. Despite ignoring carbon credits from CFS expected benefits owing to the uncertainty in carbon markets and considering the current market value of wood in study area, which is not sustainably certified, calculation shows the return on CFS investment is considerably high (see appendix-II). Thus, the investment on CFS will yield higher returns to adaptation finance donors while improving the climate as well as the lives of poor subsistence farmers. As CFS has ancillary environmental (social) benefits such as increased biodiversity, reduced soil erosion and creation of carbon sink to mitigate greenhouse gas emission, it will contribute to the public good. Thus, CFS is a socially optimal proposal that enhances private as well as social benefits.

Annual loan payments from donors to recipients are conditional on a verifiable set of performance criteria. For example, donors can monitor CFS investment by using different tailor-made forests monitoring software applications and geospatial referencing at verifiable key locations over time. Smart phone applications will transmit photographic evidence at pre-specified geospatial coordinates over time, after corroboration by multiple members of the community. Thus, it is possible for donors to identify and monitor the CFS location, plantation area, density, and growth. Additionally, CFS contracts will stipulate both individual and collective/communal responsibilities for all recipient farmers as communal social pressures effectively ensure compliance, especially in close-knit rural communities. Hence, communal responsibility and verification through digital means minimises the donors' risk of investment in CFS.

Through CFS, vulnerable farming communities can transition from; cutting natural forests to planting trees and growing high-risk traditional food crops to low-risk diversified crop-tree mixed farming. Considering forest management as relatively less labour intensive than growing crops, it may have the added advantage of liberating children from farm labour and allowing them to attend school. Furthermore, through CFS women can become economically active, who otherwise cannot participate in economic activities due to cultural barriers or time constraints. Thus, CFS has a component of women economic empowerment and independence in addition to farm households' climate resilience.

The aim of this study is to design economic incentives to implement CFS to strengthen the climate resilience of rural subsistence farming communities in the Northern Pakistan, using adaptation finance. A stated preference survey was conducted to assess participant's willingness to participate in a range of plausible adaptation finance scenarios. The responses were analysed deploying commonly used DCE modelling econometric techniques to reveal the respondents' preferences. The results will help to design the incentive structure with which farmers can adopt and benefit from CFS and donors would be willing to lend the concessional loans. This includes investigation of CFS economic viability, farmers' willingness to uptake, and financial terms (e.g. schemes duration, loan payment etc.) acceptable to both donors and farmers.

This research investigates the following specific research questions: rural farming communities' willingness to participate in donor-incentivised CFS, compensations (e.g. annual payment and wood share) required for the uptake of CFS, and the incentive structure under which farmers switch to CFS and donors lend the concessional loans.

2. Research methodology

2.1 DCE theory

This research uses discrete choice experiment (DCE) approach to model the farmers' preferences to adopt CFS. DCE is a survey-based quantitative non-market valuation technique, pioneered by Louviere and Woodworth (1983) and developed by Train (2003), Hensher et al., (2005) and others. DCE has its theoretical foundation in Lancaster's theory and random utility theory. Lancaster's theory is that the goods are not the objects of utility, which was believed prior to the 1960s; instead, consumer utility is derived from their characteristics or attributes (Lancaster, 1966; Alcaly and Klevorick, 1970). This is the theoretical basis of the DCE approach, where respondents value the particular features or attributes of the goods as opposed to the goods as a whole.

Random utility theory (RUT) helps us translate the behavioural choices represented by attributes and socio-demographic characteristics of alternatives of a choice outcome. A functional form is used to relate the observed factors to an individual decision maker's utility. The standard indirect utility function is the following:

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (1)$$

Where 'U_{nj}' refers to the utility of individual 'n' obtained from choice alternative 'j'. An individual will evaluate each alternative represented by 'U_j', given $j = 1, \dots, J$ and compare the '$U_1, U_2, \dots U_J$ and chose the one that offers the maximum utility 'U_j' (Hensher et al., 2005). Since there are aspects of the individual decision maker's utility that cannot be observed, utility 'U_{nj}' is decomposed (Train, 2003) into observable and unobservable components. 'U_{nj}' is a function of an observable deterministic utility component 'V_{nj}' and an unobservable random component 'ε_{nj}' that captures the unobserved influences on an individual's choice.

In DCE, the marginal utility estimates are converted into marginal willingness to pay (WTP) or willingness to accept (WTA) estimates for a change in the level of a specific attribute of a hypothetical good or service that contributes to the increase in utility. For this purpose, we estimate the model and calculate marginal prices (MP) as the ratio of parameters. In order to calculate the MP for an attribute, we take negative ratio of the coefficients (β_s) of respective attribute (β_1) and the coefficient of the price attribute($\beta_\$$).

$$MP\ (WTP/WTA) = -\beta_1/\beta_\$ \quad (2)$$

Since, this research investigates the compensations required for the adoption of CFS, the MP will be WTA for CFS attributes. WTA values in this study represent the economic value participating farmers place on different attributes of CFS. This indicates the compensations required to pay the farmers to enable them adopt CFS. In addition, WTA values for each attribute provide useful information regarding CFS' role as a strategy to diversify the small farmers' livelihood and develop their resilience against unfavourable climatic changes. As this research investigates the impact of farmers' socioeconomic characteristics on their choices regarding CFS adoption, these are also involved in WTA derivation to assess their impact on welfare estimates.

2.2 DCE design and application

This section presents a discussion on the steps involved in designing a DCE for this study such as experimental design, attribute selection, questionnaire development and data collection.

2.2.1 Experimental design

The foundation for a DCE study is an experimental design (Hensher et al., 2005). Creation of an experimental design involves collection of relevant background information, identification of attributes and attribute levels, specification of the statistical properties of the design and generation of selected design using a design software. This research has used two experimental designs: orthogonal experimental design and efficient (D-error minimizing Bayesian) experimental design. An orthogonal experimental design is a preliminary design, which was applied in first pilot survey to collect the priors for efficient design. The priors for orthogonal experimental design were determined based on collected background information. Orthogonal experimental design applied in first pilot survey included 36 choice situations, randomly divided into six blocks. Therefore, each respondent faced six choice situations on choice cards. However, efficient designs are more desirable as they impart the information about attribute parameters (Hensher et al., 2005), an efficient (D-error minimizing Bayesian) experimental design was created with the priors from first pilot. Efficient design was used in the second pilot as well as the final survey and the total choice situations, number of blocks, and choice situations per respondent in this design were identical to orthogonal design.

Ngene software was used to generate the code for both designs (orthogonal and efficient), as per specifications of attributes, attribute levels and alternatives. This code was used to create the choice situations, which were presented to respondents by means of choice cards. The choice cards included hypothetical alternatives from which respondents then made the choices. Six choice cards were presented to each respondent, and a choice card offered respondents a choice between three alternatives including one status-quo and two changes. The designs used for experiments in this study are unlabelled, which means that the heading of an alternative is generic and does not guide the respondents. The example of the choice cards can be found in Appendix-I.

2.2.2 Attributes selection

Attributes selection is a crucial issue and must involve extensive enquiry to select the attributes that influence individual choices (Hensher et al., 2005). In this regard, sufficient relevant background information was collected and used to design the CFS attributes in order to minimize the unobserved sources of influence on respondents' choice behaviour. This includes a review of literature, as well as information on successful commercial forestry practices and relevant species and calculation of their expected return in context of our study area. The in-depth interviews with forestry experts and local farmers who grow commercial trees augmented the information gathered from secondary sources. This background work yielded useful data and insights regarding the costs involved in growing commercial forestry, time and labour requirement and benefits[1] of tree plantation, which ultimately helped in estimation of CFS expected net benefits. The CFS expected net benefits were then compared to the return on traditional crops (see Appendix-II for further details), which helped in determining

[1] The benefits and costs are calculated for poplar tree species that is grown for commercial purpose in this area.

the levels of monetary attributes of CFS, i.e. annual payment and the proposed farmer wood share. Status-quo denotes the existing practices of growing traditional crops and option 1 and option 2 are the proposed changes, i.e. CFS.

Table 1: Attributes table

Attributes	Status-quo	Option 1		Option 2	
Biodiversity area		$1/4^{th}$ of CFS area		$1/3^{rd}$ of CFS area	
Scheme location		Farmer choice		Donor choice	
Wood share		7 (134,549)	5 (99,549)	3 (64,549)	2(29,549)
Annual payment (PKRs.)		0	5,000	10,000	15,000

The attribute table used in this study includes four attributes: biodiversity area, CFS scheme location, farmer wood share and annual payment (Table 1). Biodiversity area represent the proposed on-farm biodiversity patch which is comprised of fodder grass and shrubs with no human/animal intervention. This has two levels which include biodiversity patch equivalent to $1/4^{th}$ of total CFS area and biodiversity patch equivalent to $1/3^{rd}$ of total CFS area. CFS location is on-farm location of the CFS plantation and the two levels represent farmer choice of CFS location, and donor choice of CFS location. Wood share attribute denote the farmer share in wood as a final product at the conclusion of CFS contract and it has four levels: 2%, 3%, 5% and 7%. The monetary values of the stated percentages of farmer wood share are given in brackets. The annual payment attribute is the monetary attribute that signify compensations or farmer WTA against the proposed adoption of CFS. Annual payment also has four levels and correspond to the levels of wood share attribute; however, due to the trade-off between both, they are inversely related.

2.2.3 Study site

This study is conducted using a primary survey which was administered with subsistence farmers in rural hilly areas of district Haripur in the Northern Pakistan. Haripur is a district with area of 1,927 km^2 in the Khyber Pakhtunkhwa province of Pakistan. The population of the district, according to 2017 census, is 1,003,031 and the number of households are 163,490. Haripur has a diverse terrain with 87% population residing in rural areas where agriculture is the main source of livelihood. The villages selected for this survey are the rural hilly areas and rely on small-scale subsistence farming which is done on poor quality land. Furthermore, since the agriculture in these areas is arid which depends on rainfall, crops often fail due to droughts that have become frequent phenomena with recent climatic changes. Hence, farmers in these villages predominantly grow two main crops, i.e. maize and wheat, for their food consumption need. Due to remote areas with hilly terrain, poor road infrastructure, and hence connectivity with urban centres, there are limited off-farm income sources in these villages. The available off-farm opportunities are very few and confined to government jobs, daily wages labour and small businesses in local markets that caters a small fraction of the population.

2.2.4 *Data collection*

As this is a primary survey based study, data was collected using a questionnaire and experimental design(s) which were piloted twice before the final survey. Pilots include the complete interviews of 15 to 20 respondents in the study area. The sample size for this research comprise 450 farm households. Since it is a choice experiment survey; each respondent has faced six choice cards and each choice card had three alternatives, there are 18 observations per respondent. Thus, the total number of observations with three alternatives and six choice cards are (450*3*6) 8100. The survey had few incomplete interviews, which were dropped from the analysis. Data collection for this research involved face-to-face interviews of respondents. The surveys were administered by trained enumerators who interviewed respondents using the survey instrument. DCE modelling has its own data set-up requirements, which requires that data are set-up in specific formats that vary across data analysis software packages (Hensher et al., 2005). As the data analysis for this research is carried out using Stata software, hence the data format and set-up is for Stata.

2.2.5 *Econometric analysis*

The starting point for model estimation for discrete choice data in choice modelling is the conditional logit (CL) model, which is a specification of standard multinomial logit model. This model specification is used to investigate choice-specific characteristics instead of individual-specific characteristics, which makes it different form standard multinomial logit model. CL model explains the way various alternatives' characteristics or attributes affect individuals' choices. However, CL model has various limitations, for example, it cannot account for preference heterogeneity among the respondents due to the assumption that respondents have same preferences, the random terms are IID (independent and identically) type – I extreme value distributed, and independence from irrelevant alternatives (IIA).

An alternative model specification, which does not suffer from these restrictions is the mixed logit model (MXL) (Revelt and Train, 1998). MXL is a flexible model specification that can approximate any random utility model (McFadden and Train, 2000). It extends the standard CL model by allowing one or more of the parameters in the model to be randomly distributed. This model specification resolves three limitations of the CL model by allowing for random taste variation, unrestricted substitution patterns (IIA), and correlation in unobserved factors over time (Train, 2003; Hensher et al., 2005). Unlike CL, MXL assumes that respondents have heterogeneous preferences by explicitly allowing utility coefficients to vary across decision makers.

3. Results and discussion

This research investigates the subsistence farmer preferences for CFS, which are determined by CFS attributes as well as farmer socio-demographic characteristics. Hence, the results discussion starts with the main socio-demographic characteristics of the sampled farm households.

3.1 Sample characteristics

Data show that while the average age of respondents is 39 years, the reported minimum and maximum respondent ages are 15 and 75 years, respectively. This shows that sample of this research comprises both young and old farmers. Respondent education is the 'number of years of schooling' and data shows that average respondent education is eight years, indicating that on average farmers in study area possess primary schooling. The household size is almost seven which is in line with the '2017 Population Census' household size data of district 'Haripur Rural'. Data shows that households in study area have comparatively more number of members working on-farm which is expected as farming is the main source of livelihood in study area. However, reported household income data suggest that on average households have significantly high annual income from off-farm sources.

Table 2: Farm household characteristics

Characteristics	Mean	St. Dev.	Min.	Max.
Respondent age (years)	38.88	14.86	15	75
Respondent education (years)	8.40	4.08	0	16
Household size	7.39	3.2	1	20
Male to female ratio	1.30	0.84	0.16	6
Household members working on-farm	1.79	1.79	0	12
Household members working off-farm	1.39	1.31	0	12
Household on-farm annual income (PKRs)	132959.8	396102.8	0	7000000
Household off-farm annual income (PKRs)	220101.8	415736	0	7000000
Farm size (acres)	24.14	50.57	0	400
Market distance (Kms)	5.17	26.32	0	50

The main reason of this is small-scale subsistence farming, which has higher production costs and lower yields due to poor quality marginal land, unfavourable climate and lack of economies of scale. Furthermore, unlike off-farm income which increases with the passage of time, on-farm income is either fixed or decreases with the increase in the cost of agricultural inputs. The average farm size[2] in study area is almost 24 acres, but it demonstrates very high standard deviation which is expected in rural tribal societies in Pakistan where a small fraction of households usually own more land than majority. The average distance of a household from the nearest market is approximately five kilometres; however, the relatively high standard deviation shows that some of the households are

[2] Farm size in hilly areas of Northern Pakistan refers to the total area of farm; however, generally the arable land is a small part of the total farm as most of the farm has rough grazing area with grass, which grows naturally.

too far from nearest market. This impedes their access to off-farm income opportunities available in local markets, and hence households residing away from local market tends to be more vulnerable.

3.2 DCE model results

This section presents the results of DCE models estimated using the survey data gathered from subsistence-farmers to study their preferences for the adoption of CFS. Analysis is carried out using econometric techniques to investigate the determinants of farmer choice. This includes CFS attributes and farmer socio-demographic characteristics, from which their preferences for adopting different CFS scenarios are derived. Results discussion starts with the estimates of conditional logit (CL) model (Table 3), a basic model specification that is often used as a starting point in DCE estimation. Model 1 in Table 3 is the base model which is estimated with CFS attributes, whereas Model 2 also includes some attribute interactions found to be meaningful and significant. Since, household characteristics do not differ between each choice set, they enter into the regression models as attribute interactions.

CL model has fixed coefficients due to the assumption that all respondents have the same preferences. The standard errors of parameters as well as marginal utility estimates are in parentheses. Information criteria, e.g. log-likelihood, Akaike information criterion (AIC) and Bayesian information criterion (BIC), are used to compare the model fit. Comparison of the model fit of both models using information criteria shows that the goodness-of-fit increases while including additional parameters as attribute interactions. This means that Model 2, which incorporate attribute interactions using socioeconomic covariates, has a better model fit for this data than Model 1 with CFS attributes only.

The parameter estimates of Model 1 show that both levels of biodiversity area attribute have negative signs, which means that farmers derive disutility from committing to the biodiversity condition of CFS. This is expected as farmers cannot cut the grass or leave animals in the designated biodiversity area, in addition to the risk of wild plant and shrub growth in farms which are invasive in nature. WTA estimates show that farmers demand 1,879.67 and 3,063.16 Pakistani rupees for designating an area for biodiversity equivalent to $1/4^{th}$ (25%) and $1/3^{rd}$ (33%) of CFS area on their farms, respectively. This means that while farmers need 1879.67/25=75.19 rupees per percentage point to designate 25% biodiversity area, their per percentage point WTA for designating 33% biodiversity area is 3063.16/8=382.91, which is almost five times higher than the first level. This shows that although farmers demand higher compensation for 25% biodiversity area, their WTA drastically increase for 33%, indicating their disinclination to pledge biodiversity areas. It is also important to highlight that WTA estimates for biodiversity attribute are higher than all other attributes in this model, which suggests that farmers derive significant negative utility from pledging to biodiversity condition of CFS, and hence demand relatively high compensations for this attribute.

CFS location attribute has very interesting results; for example, farmer choice of CFS location on the farm is significant with a positive sign, whereas the coefficient of donor choice of CFS location is not only insignificant, but is also negative. This shows that while farmers derive positive utility from their own choice of CFS location on the farm, they dislike allowing CFS donor to decide about the location of CFS, which means farmers are disinclined to forgo the control on their farmland. Farmer WTA for own choice of CFS location is negative, implying that they are willing to give up some amount of annual payment instead, i.e. 3,816.16 rupees, to be able to choose CFS location themselves. On the other hand, farmer WTA for allowing donor to choose the CFS location on their farms is positive as they demand a compensation of 894.00 rupees. This shows that nevertheless farmers see CFS favourably and are aware of the expected returns, they are unwilling to allow donor to decide about the scheme location. This suggests that there is a lack of trust for CFS administration among farmers, which is expected owing to the businesses' thin compliance to the regulations, poor law enforcement and overall corruption. However, this lack of trust could be mended by ensuring the transparency and involving local communities in the design and implementation of CFS.

All wood share attribute levels are significant with positive signs, indicating that farmers derive positive utility from having wood share, and hence prefer it as a CFS attribute. This denotes that farmers understand the value of wood share as it is an asset that they can sell in poor times. Interestingly, WTA estimates for all levels of wood share attribute are negative, which means that farmers are willing to pay to attain the wood share. However, as wood share is negatively correlated with annual payment in choice cards and there is a trade-off between both attributes (Table 1), i.e. an increase in annual payment corresponds to a decrease in wood share, the negative WTA estimates imply that farmers are willing to forgo a certain amount of annual payment to get a share in CFS wood instead. Nevertheless, it is striking to see that the amount of annual payment that farmers are willing to forgo to get a wood share is significantly lower than the monetary value of respective wood share. For example, they are willing to forgo (trade) 7,203.20 rupees of annual payment to attain 2% wood share, the monetary value of which is 29,549.00 rupees.

This shows that despite limited literacy and education, farmers have made rational choices while making the trade-offs between annual payment and the wood share. A more intriguing aspect of these results is that farmers have preferred wood share over annual payment, despite knowing that annual payment has minimal risk and wood share is uncertain. This indicates that farmers are willing to take some risk for expected higher returns; however, farmers are being very precise in taking this risk as they are willing to forgo a certain amount of annual payment which is significantly *lower* than the value of expected wood share. This establishes that farmers do not only strike the right balance between both monetary attributes, but they also make a rational choice and a wise trade-off considering the risk and expected return of wood share.

Table 3: Conditional logit model estimates

Attributes	*Model 1*		*Model 2*	
	Coefficients	*WTA*	*Coefficients*	*WTA*
Status-quo	*-0.021*	-	*-1.026****	-
	(0.109)	-	*(0.240)*	-
1/4th biodiversity	*-0.120**	*1879.67*	*-0.0956*	*1609.24*
	(0.063)	*(979.06)*	*(0.067)*	*(1119.31)*
1/3rd biodiversity	*-0.196****	*3063.16*	*-0.111*	*1875.44*
	(0.063)	*(1003.37)*	*(0.073)*	*(1240.81)*
Farmer choice	*0.245****	*-3816.16*	*0.221****	*-3727.81*
	(0.062)	*(999.05)*	*(0.066)*	*(1137.06)*
Donor choice	*-0.057*	*894.00*	*0.318***	*-5358.12*
	(0.064)	*(1001.37)*	*(0.133)*	*(2254.31)*
2% wood share	*0.462****	*-7203.20*	*0.361****	*-6067.71*
	(0.093)	*(1510.25)*	*(0.098)*	*(1703)*
3% wood share	*0.692****	*-10791.24*	*0.566****	*-9519.11*
	(0.091)	*(1557.76)*	*(0.095)*	*(1730.83)*
5% wood share	*0.674****	*-10521.41*	*0.535****	*-9007.61*
	(0.093)	*(1541.51)*	*(0.098)*	*(1717.41)*
7% wood share	*0.722****	*-11270.01*	*0.539****	*-9068.72*
	(0.091)	*(1511.99)*	*(0.108)*	*(1880.81)*
Annual payment	*6.41e-05****	-	*5.94e-05****	-
	(4.33e-06)	-	*(4.54e-06)*	-
*Status-quo*age*	-	-	*0.015****	*7408.20*
	-	-	*(0.004)*	*(3168.36)*
*Status-quo*hhsize*	-	-	*0.0355***	*12859.55*
	-	-	*(0.018)*	*(3645.71)*
*1/3rd biodiv.*farmsize*	-	-	*-0.003****	*3178.84*
	-	-	*(0.001)*	*(1179.51)*
*1/3rd biodiv.*mktdist.*	-	-	*0.009***	*1092.41*
	-	-	*(0.004)*	*(1219.31)*
*Donor choice*edu.*	-	-	*-0.047****	*1298.45*
	-	-	*(0.014)*	*(1144.96)*
*7% share*offinc*	-	-	*2.56e-07*	*-9802.15*
	-	-	*(2.42e-07)*	*(1699.51)*
Pseudo R2	*0.15*	-	*0.14*	-
Log-likelihood	*-2423.64*	-	*-2144.664*	-
AIC	*4867.28*	-	*4321.33*	-
BIC	*4936.82*	-	*4430.62*	-
No. of parameters	*10*	-	*16*	-
Observations	*7,740*	-	*6,840*	-
N	*430*	-	*380*	-

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The coefficient of status-quo is insignificant; however, the negative sign suggests that farmers derive disutility from existing farming practices, e.g. only food crops, for their susceptibility to unfavourable climatic changes such as droughts, and would prefer crop diversification instead. The coefficient of the annual payment is significant with a positive sign, which is expected. Overall, these results suggest that farmers in study areas are willing to adopt CFS as a strategy to align their farming to climate change; however, they are disinclined to pledge biodiversity area and allow donor to choose CFS location the on farm. Furthermore, farmers place a relatively higher value on wood share as they prefer wood share over annual payment, and hence are willing to sacrifice some annual payment for the expected higher returns.

As stated above, Model 2 is a CL model with some meaningful and significant attribute interactions, in addition to CFS attributes. Considering a-priori expectations, including these characteristics in analysis minimizes biases that would otherwise arise in the parameter estimates of the CFS attributes. While incorporating the attribute interactions in Model 2, the sign and significance of some of the attributes is altered, which is expected. As inclusion of interactions alters the base model results of CFS attributes, we restrict the discussion to attribute interactions. Results show that relatively aged farmers prefer existing agricultural practices and are less likely to choose CFS, which means that older farmers are more risk averse than younger farmers. Nevertheless, this can also be due to the limited education and awareness of older farmers and thus a lack of clear understating of CFS as well as its expected returns. WTA estimates shows that older farmers require 7408.20 rupees additional annual payment to sign-up for CFS which in other words is the monetary value of their preference for status-quo over CFS.

Similarly, findings reveal that farmers with large household size are also less likely to favour the uptake of CFS, which is conceivably due to household possible off-farm sources of income owing to its large size. Farm households with large size demonstrate 12859.55 rupees additional WTA to sign-up for CFS. Likewise, farmers with relatively large farm size drive more disutility from committing to biodiversity area equivalent to 33% of CFS. Farmers' disinclination to designate greater biodiversity area despite their large farm size is perhaps due to their higher farm income and opportunity cost, in addition to greater resilience to climatic changes. WTA estimates show that farmers with relatively large farm size demand 3178.84 rupees additional for pledging 33% biodiversity area as a part of CFS.

Results shows that farm households with relatively more education derive negative utility from donor choice of CFS location on their farm, and demand 1298.51 rupees additional for allowing donor to choose the CFS location. The most plausible interpretation of this finding is that farm households with relatively higher education are economically empowered and thereby more resilient. This reinforces the above interpretation of economic empowerment and its impact on farm household choices regarding CFS as these households are willing to adopt CFS to diversify their crops and adjust their farming practices to climate change, but they disapprove some of the CFS terms because of their unique socioeconomic profiles.

On the contrary, farm households with larger distance from nearest market are more likely to commit biodiversity area equivalent to 33% of CFS, which shows households further from market feel more vulnerable and are extra keen to adopt CFS. This can be due to their limited engagement in off-farm work which is either conducted in or facilitated by the nearest market. For example, small markets in study areas are mostly located on main roads which provide access to public transport, and hence nearest urban centres to engage in off-farm work. Interestingly, farm households further from market are not only willing to pledge greater (33%) biodiversity area, but also have lowest WTA, i.e. 1092.41 rupees, for 33% biodiversity area.

Table 4: Mixed logit model estimates

Attributes	***Model 3***		
	Coefficients	***SD***	***WTA***
Status-quo	*-2.127****	*3.667****	-
	(0.355)	*(0.332)*	-
1/4th biodiversity	*-0.161***	*-0.138*	*2014.39*
	(0.081)	*(0.345)*	*(993.04)*
1/3rd biodiversity	*-0.247****	*-0.481****	*3088.02*
	(0.085)	*(0.181)*	*(1079.93)*
Farmer choice	*0.288****	*-0.491****	*-3595.51*
	(0.080)	*(0.170)*	*(1030.02)*
Donor choice	*-0.084*	*0.450***	*1051.82*
	(0.083)	*(0.201)*	*(1039.01)*
2% wood share	*0.644****	*0.058*	*-8055.83*
	(0.119)	*(0.702)*	*(1524.07)*
3% wood share	*0.886****	*-0.695****	*-11072.19*
	(0.125)	*(0.193)*	*(1677.02)*
5% wood share	*0.867****	*-0.604****	*-10839.57*
	(0.125)	*(0.218)*	*(1613.72)*
7% wood share	*0.977****	*0.853****	*-12218.12*
	(0.132)	*(0.211)*	*(1717.66)*
Annual payment	*8.00e-05****	*-6.03e-05****	-
	(7.05e-06)	*(1.09e-05)*	-
Log-likelihood	*-2058.73*	-	-
AIC	*4157.46*	-	-
BIC	*4296.54*	-	-
No. of parameters	*20*	-	-
Observations	*7,740*	-	-
N	*430*	-	-

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Farm households with off-farm income prefer 7% wood share and are willing to sacrifice additional 9802.15 rupees from annual payment to attain the maximum wood share. This is an interesting result which shows that farm households with off-farm income are ready to take more risk as they see an incentive in choosing higher wood share over annual income and are willing to forgo relatively higher amount of annual payment for wood share. Attribute interaction results from Model 2 suggest that, since large farm and household size, off-farm work, and education indicate farm households' improved wealth and socioeconomic status, they are conceivably less vulnerable to climate shocks, and hence seek favourable CFS terms to adopt it as an adaptation strategy to climate change.

The second model specification used in this research to investigate the determinants of farmer choice of CFS is mixed logit (MXL) model. MXL is estimated with 1000 Halton draws and the results include means and standard deviations of the coefficient distributions. The fitted model shows that MXL has a higher log-likelihood value and lower AIC and BIC than those for the CL, which means that the MXL has better model fit with this data than CL. Again, Model 3 is the base MXL model with CFS attributes (Table 4), whereas Model 4 incorporates the attribute interactions as well (Table 5). Comparison of the model fit of both MXL models shows that the goodness-of-fit increases while incorporating extra parameters as attribute interactions in Model 4, as expected.

Model 3 reveals that the estimates of base MXL model are similar to those of base CL model, except for the improvement in the significance of status-quo and first level of biodiversity attribute (1/4th of CFS). Coefficient of status-quo is significant with a negative sign, which confirms the interpretation that farmers in study area dislike the current farming practices, suggesting their interest in the adoption of proposed CFS for crop diversification. Biodiversity area attribute also returned negative coefficients affirming that farmers have disapproved to pledge to biodiversity condition of CFS. WTA estimates from MXL show that farmers demand 2014.39 and 3088.02 rupees for designating an area for biodiversity equivalent to 25% and 33% of CFS on their farms, respectively. This means WTA estimates for biodiversity attribute are slightly higher than those from CL.

Attributes representing the choice of CFS on-farm location also retuned the results similar to Model 1, i.e. farmer choice of CFS location is again significant with a positive sign and donor choice of CFS location is insignificant with a negative sign. WTA estimates shows that while farmers have negative WTA for their own choice of CFS location, their WTA for allowing donor to choose the CFS location on their farm is positive. This implies that farmers are still willing to forgo some amount of annual payment for CFS location choice, and demand compensation for allowing donor to choose the CFS location. Nevertheless, there are slight variations in the welfare estimates of CFS location across CL and MXL model specifications, which is expected. This validates the Model 1 results of farmer preferences regarding the choice of CFS location which are tilted against donor choice of CFS location.

This suggests that farmers do not even want to consider this as a matter of choice, but a predetermined decision.

Table 5: Mixed logit model estimates

Attributes	*Model 4*		
	Coefficients	***SD***	***WTA***
Status-quo	*-5.242****	*4.230****	-
	(0.886)	*(0.442)*	-
1/4th biodiversity	*-0.107*	*-0.027*	*1479.54*
	(0.083)	*(0.387)*	*(1142.43)*
1/3rd biodiversity	*-0.135*	*0.335*	*1867.08*
	(0.096)	*(0.242)*	*(1325.31)*
Farmer choice	*0.255****	*0.479****	*-3517.54*
	(0.084)	*(0.181)*	*(1186.18)*
Donor choice	*0.314**	*0.395**	*-4335.15*
	(0.174)	*(0.223)*	*(2420.24)*
2% wood share	*0.510****	*0.099*	*-7042.45*
	(0.122)	*(0.503)*	*(1741.61)*
3% wood share	*0.722****	*0.690****	*-9959.97*
	(0.128)	*(0.202)*	*(1885.53)*
5% wood share	*0.685****	*0.652****	*-9448.21*
	(0.128)	*(0.214)*	*(1831.8)*
7% wood share	*0.814****	*0.814****	*-11236.87*
	(0.134)	*(0.226)*	*1944.15*
Annual payment	*7.25e-05****	*5.89e-05****	-
	(7.14e-06)	*(1.14e-05)*	-
*Status-quo*age*	*0.063****	-	*38370.05*
	(0.0171)	-	*(7584.5)*
*1/3rd biodiv.*farmsize*	*-0.003***	-	*1719.27*
	(0.002)	-	*(1188.32)*
*1/3rd biodiv.*mktdist.*	*0.011***	-	*3014.43*
	(0.005)	-	*(1258.21)*
*Donor choice*edu.*	*-0.052****	-	*1071.05*
	(0.018)	-	*(1300.76)*
Log-likelihood	*-1798.80*	-	-
AIC	*3645.60*	-	-
BIC	*3809.54*	-	-
No. of parameters	*24*	-	-
Observations	*6,840*	-	-
N	*380*	-	-

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Parameter estimates of wood share attribute from Model 3 are similar to those in Model 1 in terms of sign and significance, endorsing the interpretation that farmers place a positive value on wood share as a CFS attribute. WTA estimates for all four levels of wood share attribute are also negative, implying that farmers are willing to relinquish a certain amount of annual payment to attain the wood share owing to higher expected returns from wood. Farmer implied willingness to pay, which is the amount of annual payment that they are willing to sacrifice for wood share, from Model 3 is somewhat higher than the same from Model 1. However, the amount of annual payment that farmers are willing to forgo is still lower than the monetary value of respective wood share, which reaffirms the above offered interpretation that farmers are willing to take some risk for expected returns, despite the uncertainty.

Model 4 is an MXL model that includes attribute interactions (Table 5) in addition to the CFS attributes presented in Model 3. While MXL has fewer attribute interactions than CL, results of interactions terms are similar across both model specifications (Model 2). For example, interaction of status-quo with farmer age is significant with a positive sign, suggesting that older farmers prefer existing agricultural practices. However, the older farmers demand 38370.05 rupees additional annual payment to sign-up for CFS, which is almost five times higher than farmer WTA for the same in Model 2. This elucidates relatively older farmers' strong disinclination for the adoption of CFS, which confirms the same result from CL.

Similar to Model 2, farmers with relatively large farm size are reluctant to designate greater biodiversity area, despite their large farm size. Large farmer demand 1719.27 rupees additional for pledging greater biodiversity area, which is lower compared to the same in Model 2. Likewise, farm households further from nearest market are more likely to commit greater biodiversity area; however, their WTA is 3014.43 rupees additional, which is higher than the WTA for this attribute interaction in Model 2. Results show that farm households with relatively more education rejected donor choice of CFS location on their farm, and demand 1071.05 rupees additional for allowing donor to choose the CFS location, which is almost half of their WTA for same attribute interaction in Model 2.

Model 4 results of interaction attributes suggest that since large farm size, education and market distance indicate farm households' improved socioeconomic status, they are conceivably less vulnerable to climate shocks, and hence feel more empowered to seek favourable CFS terms. For instance, while farm households with more resources and education are also willing to adopt CFS to diversify their crops and adjust their farming practices to climate change, they disapprove some of the CFS terms because of their unique socioeconomic profiles. Therefore, these results reinforce the above interpretation of economic empowerment and its impact on farm household choices regarding the adoption of CFS as an adaptation to climate change.

4. Conclusion

The present research proposes to implement CFS using adaptation finance to enable subsistence farmers to align their farming to climate change in the hilly areas of Northern Pakistan. Using DCE approach and a primary survey, this study has investigated the rural farming communities' willingness to participate in donor-funded CFS. The aim of this research is to explore farmer preferences and required compensations for the adoption of CFS as an adaptation to climate change. The use of the DCE approach in this study has contributed to a deeper understanding of the farmer preferences for the design of CFS. This methodology enabled the discovery and quantification of the trade-offs farmers make regarding CFS attributes, for example, it uncovers the CFS attributes that farmers prefer and their positive and negative WTA for each attribute and attribute level, which furnishes actionable information for key stakeholders of this research. Analysis yields useful insights for policy makers to design an incentive structure under which farmers switch to CFS and donors invest in the proposed schemes.

DCE modelling results show that farmers derive disutility from existing farming practices, which is cultivation of only food crops, for their susceptibility to climatic changes such as droughts. As this is a hilly area with poor quality marginal land used for small scale farming and crops rely on rainfall due to arid region with rain-fed agriculture, persistent droughts result in crop failure and farmer prefer the adoption of CFS for crop and livelihood diversification. This implies that, despite their limited education and awareness, farmers have perceived the benefits of CFS, and hence are willing to adopt it. This result has an important policy implication for aligning farming to climatic changes in less favourable areas and designing policy interventions by engaging local agricultural extension infrastructure.

Findings show that farmers derive disutility from pledging to biodiversity condition of CFS, and demand significantly high compensations for designating a biodiversity area on their farms. This implies that farmers are interested in CFS for their private benefits such as crop and livelihood diversification; however, they are not keen about biodiversity and thus the environmental improvement. The obvious policy implication of this result is that farmers need to be educated on the importance of biodiversity related benefits of CFS. This result also suggests to design more targeted interventions and incentive schemes which could improve the social aspect of CFS.

Similarly, result reveal that farmer prefer their own choice of CFS location on their farm and dislike allowing CFS donor to choose the scheme location. For example, while farmers demand compensation for allowing donor to choose the CFS location, they are willing to sacrifice some amount of annual payment for choosing CFS location themselves. This indicates farmers' disinclination to forgo their control on their farm land, which most plausibly is due to farmers' lack of trust on CFS administration which is expected owing to the businesses' thin compliance to the regulations and poor law enforcement. Policy makers should take appropriate measures to mend this lack of trust amongst farming communities as this can significantly impede the adoption of technologies by them.

An interesting result of this research reveals that farmers place a positive and significant value on the wood share as attribute of CFS, for example, they are willing to forgo annual payment for having a share in the wood at the end of project. However, it is striking to see that the amount of annual payment that farmers are willing to forgo for each level of wood share is significantly lower than the monetary value of respective share. This result has a strong implication for the success of CFS as a farming adaptation to climate change using adaptation finance as well as the design and implementation of similar commercial forestry schemes. For instance, this shows that despite limited literacy, farmers have made rational choices while making a trade-off between annual payment and wood share. Furthermore, a more intriguing aspect of this result is that farmers have preferred wood share over annual payment, despite knowing that annual payment has minimal risk and wood share is uncertain. This indicates that farmers are willing to take some risk for expected returns; however, they are being very precise in taking this risk.

Significant socioeconomic covariates, as attribute interactions, were also incorporated in utility function to assess their impact on choice probabilities as well as the welfare estimates of respective attributes. Results show that farmer age, household size, farm size, distance from nearest market, greater participation in off-farm work, and off-farm income affect the farmers' willingness to adopt the CFS. For example, aged farmers and farmers with large household size seems to prefer existing agricultural practices over CFS, and hence demand additional compensations to sign-up for CFS. This is conceivably due to older farmers' limited education, and hence a poor understating of CFS terms as well as expected returns in addition to large households' possible off-farm sources of income. This suggests that relatively young farmers with small households see the CFS proposal more favourably.

Similarly, farmers with relatively large farm size are disinclined to designate greater biodiversity area, and hence demand additional compensation, which is possibly due to their higher farm income and greater resilience to climatic changes. Findings reveal that farm households with greater participation in off-farm work disliked donor choice of CFS location on their farm. Furthermore, these households are willing to forgo some amount of annual payment to be able to choose the CFS location on their farm. This shows that farm households with higher income and wealth are more likely to decline some of the CFS terms, which clearly indicates that these households are economically more empowered and choose to negotiate more favourable CFS terms.

Likewise, farm households with relatively more education also prefer their own choice of CFS location on their farm, which most plausibly is due to their higher sense of arbitration. This reinforces the above interpretation of economic empowerment and its impact on farm household choices. It is noteworthy that these households are willing to adopt CFS to diversify their crops and adjust their farming practices to climate change, but they disapprove some of the CFS terms because of their unique socioeconomic profiles. Farm household distance from nearest market however has positive impact on committing a greater biodiversity area against relatively low WTA. This implies that households further from market feel more vulnerable and are extra keen to adopt CFS, which is plausibly due to their limited engagement in off-farm work and access to nearest urban centres that is facilitated by the nearest market. In a way, this findings also complements the notion of improved socioeconomic status and its impact of household choices. These results clearly suggest that households with less income, education and wealth feel more vulnerable, and are less likely to negotiate the favourable CFS terms.

Interestingly, farm households with off-farm income are more likely to prefer wood share over annual payment, which implies that farm households with multiple sources of income are likelier to take more risk for expected gains. This implies that off-farm income do not only improve the socioeconomic status of the farm households, but it also develops their entrepreneurial spirit and liberate them to take precise risks to engage in productive activities such as adoption of new technologies. This finding spells out a clear policy implication: livelihood diversification is a key determinant to the adoption of technologies and thereby rural farm household resilience to unfavourable climatic shocks, safeguarding them from slipping into a poverty-trap.

References

Alcaly, R. and Klevorick, A. (1970)' 'Judging quality by price, snob appeal, and the new consumer theory', Zeitschrift für Nationalökonomie. 30 (1-2). 53–64.

Arifin, B., Swallow, B. M., Suyanto, S., Coe R. D., (2009), 'A conjoint analysis of farmer preferences for community forestry contracts in the Sumber Jaya Watershed, Indonesia', Ecological Economics, Volume 68, Issue 7.

Hanley, N., Colombo, S., Mason, P., and Johns, H., (2007), 'The reform of support mechanisms for upland farming: paying for public goods in the severely disadvantaged areas of England', Journal of Agricultural Economics, Vol. 58, No. 3, 2007, 433–453.

Hensher D. A., Rose, J. M., and Greene, W. H., (2005), 'Applied Choice Analysis: a Primer', Cambridge, UK: Cambridge University Press, 2005.

Lancaster, K., (1966), 'A new approach to consumer theory', The Journal of Political Economy 74: 132–57.

Louviere J. J., and Woodworth, G. (1983), 'Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data', Journal of Marketing Research 20:350.

McFadden, D., Train, K., (2000), 'Mixed MNL models for discrete response', J. Appl. Econom. 15,447–470.

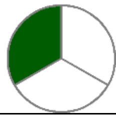
Revelt D, and Train K. (1998),' Mixed logit with repeated choices: households' choices of appliance efficiency level', Review of Economics and Statistics 80: 1-11.

Train, K. (2003), 'Discrete Choice Methods with Simulation', Cambridge University Press: Cambridge, U.K.

Vedel, S, E., Jacobsen, J, B., and Thorsen, B, J., (2015), 'Forest owners' willingness to accept contracts for ecosystem service provision is sensitive to additionality', Ecological Economics, Vol.113, 2015, 15-24.

APPENDICES

Appendix-I

Attributes	Status-quo	Option 1		Option 2	
Biodiversity are 		1/4th of total 		1/3rd of total 	
Scheme location 		Farmer choice 		Donor choice 	
Farmer wood share 		7 (134,549)	5 (99,549)	3 (64,549)	2(29,549)
Payment (PKRs.) 		0	5,000	10,000	15,000

Appendix-II

CFS net profit calculations

Following Table A1 presents the net profit that is calculated for conventional crops, i.e. wheat and maize. The average annual return on conventional crops is approximately 15,000 Pakistani rupees. Table A2 shows that return on commercial tree plantation. Total 500 plants are planted/kanal and with 80% survival rate a farmer gets 400 mature trees. Thus, the net profit is calculated for 400 plants/kanal assuming seven years maturity period, which is the minimum time for poplar to become saleable.

Table A1: Return on conventional crops

Wheat (7 months)		Maize (5 months)	
Seed/kanal = 6 kg @ Rs 50/kg	300	Seed/kanal = 4 kg @ Rs 30/kg	120
Fertilizers/kanal = 14 kg	1,400	Fertilizers/kanal = 14 kg	1,400
Ploughing/kanal	700	Ploughing/kanal	700
Spray/kanal	300	Spray/kanal	300
Harvesting/kanal	1,000	Harvesting/kanal	1,000
Thrashing/kanal	300	Thrashing/kanal	100
Total cost/kanal	4,000	Total cost/kanal	3,620
Yield = 5 mounds @ Rs 1500/mound	7,500	Yield = 4 mounds @ Rs 1200/mound	6,000
Fodder 10 mounds @ Rs 600/mound	6,000	Fodder 5 mounds @ Rs 500/mound	3,000
Total revenue/kanal	13,500	Total revenue/kanal	9,000
Profit/kanal for a crop season (Rs)	9,500	Profit/kanal for a crop season	5,380

The benefits are calculated using the current wood rate, however this wood can be sustainably certified and sold at a premium. Our calculations show that after adjusting for all the costs of managing commercial forestry, the average annual profit from polar farming in those areas is 290,143 Pakistani rupees, which is almost equal to 20 years of return on conventional crops.

Table A2: Retrun on tree plantation

Features	**Values**
Biodiversity patch/annum (kanal)	1
Life cycle/Maturity period (years)	7
Saplings/kanal	500
Survival rate (%)	0.8
Total trees/kanal	400
Average length of a tree (feet) at maturity	30
Annual growth rate (feet)	4.3
Total wood (feet) from 450 trees	12000
Cost/sapling (Rs)	8
Price of wood/foot (Rs)	180
Costs	
Saplings/kanal = @ Rs 8/sapling	4,000
Plantation labor = 4days @ Rs 1,000/day	4,000
Sapling carriage from nursery to farm	1,000
Labor for 1 year @ Rs 9000/month	108,000
Verification cost	5,000
Cutting/loading	5,000
Fertilizers	00
Biodiversity patch/annum = 1000	7,000
Total costs/kanal of plantation for 7 years	134,000
Revenue	
Total value of wood/kanal = wood*per feet rate	2,160,000
Leftover fuelwood of 400 trees	5,000
Total revenue/kanal	2,165,000
Total profit/kanal (PKRs) = total revenue – total cost	**2,031,000**
Annual net profit/kanal (PKRs) = net profit/life cycle	**290,143**