

Are Agricultural Extension Packages What Ethiopian Farmers Want? A Stated Preference Analysis^{*}

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Abstract

There is an evident dichotomy in many rural development policies in the world between extension driven adoption of modern inputs and community driven local public goods. However, the target populations of these policies seldom have the possibility to express their preference between these two policies. In this paper we report the results of a stated preference survey in the highlands of Ethiopia where the farmers are given a choice between an agricultural extension package and a local public good - health care or protected spring. The study finds that a majority of people prefers the public good. However, when the extension package is combined with insurance in terms of no payback of the credit in case of crop loss, then we find a significant increase in the choice of the extension package. The study thus sheds light on why Ethiopia's major development strategy has had limited success and gives evidence of how stated preference methodologies can be utilized for development policy design.

Key words: Agricultural extension, choice experiment, local public goods, Ethiopia, Africa

JEL-classification: D13; H41;H43;O13

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1. Introduction

There is an interesting dichotomy in rural development policies in general in the world today. This dichotomy between extension driven adoption of modern inputs, on the one hand, and community driven local public goods, on the other hand, is particularly evident in the highlands of Ethiopia. Despite the obvious trade-offs between these two approaches, the target populations seldom have a possibility to express their choice or preference between the two. In this paper we therefore use a survey based preference elicitation method - the choice experiment method – to examine the extent to which farmers prefer agricultural extension packages to two alternative local public goods—a health center and a protected spring.

The current extension approach in Ethiopia, referred to as Participatory Demonstration and Extension Training System (PADETS) focuses on farmers' demonstration plots, and is based on the provision of input credit under local government collateral arrangements, institutional linkages with rural development committees and systematic inclusion of women and the young (Bonger et al., 2004). Food crops that are included in the extension packages are varieties of maize, wheat, teff, barley, sorghum and millet while high value/commercial crops include coffee, peanuts, onions, tomatoes, cabbages, carrots and sweet potatoes. There are also packages in the livestock sector, post-harvest activities and natural resource utilization and conservation. Artificial fertilizer and improved seeds are the two most important inputs that have been adopted by Ethiopian peasants over the past decade or so. In spite of the removal of all input subsidies since 1997/8, consumption of fertilizer increased from 3,527 tons in 1995 to 216,876 tons in 1999. The quantity of improved seeds utilized during the same period increased from 1,104 to 17,778 tons. A dramatic change was also observed in the number of farmers participating in the extension system, as it increased from 31,256 in 1995 to 3,731,217 in 1999 (Bonger et al., 2004). However, in spite of the increase in the utilization of fertilizer and improved seeds, the rate of utilization is very low. For example, fertilizer consumption per hectare of land used for

cereal production for Ethiopia in 2002 was 20 kg. compared with 80 kg. for Kenya (FAO 2004).

Expansion and improvement in health services is another important component of the government's attempts to bring about development. Access to health services is very limited particularly in rural areas where about 85 percent of the country's population resides. The mean distance to a health center is about seven km and the problem is more serious in rural areas where the mean distance is close to eight km while the figure for urban areas is about 1 km (MOFED, 2002). There is also very limited access to safe sources of drinking water such as private and public taps and protected wells/springs. The source of drinking water for over 70 percent of the population is unsafe and the figure is over 80 percent for rural areas (MOFED, 2002).

By conducting the choice experiment we are able to investigate how Ethiopian farmers evaluate the choice between extension packages and local public goods such as health stations and protected springs. The analysis also gives some insights as to reasons for the low adoption of modern inputs in Ethiopian farming. In particular, the potential inclusion of an insurance component in such packages is discussed. It has often been mentioned in the literature that production and investment decisions of farm households in developing countries are affected by a multitude of risks including crop failure and price risks.¹ Chemical fertilizers are usually obtained by farmers on short-term credit under institutional collateral arrangements. However, it has been noted in previous studies on Ethiopia that repayment requirements for short-term credit under uncertain weather conditions entail a high risk for resource-poor households (Kruseman, 2003). We hypothesize that linking the existing extension package program with some form of insurance improves the dissemination rates of extension packages. An important issue is the risk associated with fertilizer credit and measures taken by lenders when farmers fail to repay the loans. In a recent survey it was found that about 20 percent of the sample of Ethiopian farmers who took fertilizer credit did not repay in full, and one important reason for this was bad harvest. Those who did not repay were faced with strict penalties such as imprisonment, or had to

take such measures as selling livestock and other property or sell their food items (Bonger et al. 2004).

The paper is organized as follows. The next section presents a description of the survey. Section three describes the econometric model used. The results and discussion are presented in section four. Section five concludes the paper.

2. Description of the survey

The data for this paper come from a survey as part of a rural household survey on sustainable land use in the Ethiopian highlands conducted in 2002. The data was collected through a Sida/SAREC funded collaborative research project of the Departments of Economics of Addis Ababa University and Göteborg University. The survey covered a total of 1520 households from two zones in the Amhara region of Ethiopia-East Gojjam and South Wollo. East Gojjam is generally considered to have a good potential for agriculture, whereas South Wollo is considered to be seriously affected by soil erosion and subjected to recurrent drought. Twelve research sites were purposely selected, six from each zone while households within each site were selected at random. There was one supervisor for each of the sites under which enumerators were employed to conduct the interviews.

When analyzing preferences, the standard method in economics is to use data stemming from actual behavior. However, for several reasons we instead use a stated preference method in this paper. A stated preference method involves asking respondents to make hypothetical trade-offs between attributes; in our case choices between various extension packages and local public goods. First of all we wanted to directly investigate the issue of the choice between direct private benefits and more indirect benefits through local public goods. Second, we wanted to investigate the preference for an insurance attribute of the extension package; an attribute that does not exist today. Third, with an experiment we have better control over the data compared to real behavior. We use the so-called choice experiment method to evaluate the farmers' preferences.² In a choice experiment,

individuals are given a hypothetical setting and are asked to choose their preferred alternative among several alternatives in a choice set, and they are usually asked to perform a sequence of such choices. Each alternative is described by a number of attributes and attribute levels.

In the experiment, farmers were asked to make choices between an agricultural extension package and a local public good. Before the choice experiment a scenario describing the attributes and the choice task was read out to them. The scenario is presented in the appendix. The head of the household (who is typically the husband in our case) and another member of the household (typically the spouse) were asked the choice experiment questions. The extension package was described as improved seed and modern agricultural inputs. The seeds could be either maize or teff.³ Before the actual experiment started respondents had to decide whether they preferred the maize or the teff package and this package was then used throughout the experiment.⁴ The extension package was described by two additional attributes: (i) the amount of money they have to pay back at harvest time, and (ii) an insurance scheme. The levels of the first attribute were 200, 250, 300 or 350 Birr.⁵ The insurance scheme was either present or not. The insurance was described as a system where they would not have to pay back the cost for the extension package if there was a crop failure. This extension package was to be compared with a local public good. This good was either a health station or a protected spring. Both these goods were described in the scenario. Each respondent made eight pair-wise choices.⁶ An example of a choice situation is described below.

Figure 1 here.

However, most of the respondents are illiterate, so it would be difficult, although not impossible, for them to remember the levels of the attributes. We therefore supplemented the oral information with drawn pictures describing each choice situation. So the interviewer would hold up different pictures describing each of the options, an example of such a choice set is described in Figure 2.

Figure 2 here.

3. Econometric Model

Since we only observe the respondents' preference in terms of their choices we apply the random utility framework when analyzing the responses (McFadden, 1974). Let us define a latent indirect utility of the extension package for individual i in household h in choice situation t as

$$U_{iht} = V_{iht}(\beta x_{iht}) + \varepsilon_{iht}, \quad (1)$$

where x_{iht} is a vector of attributes and socio-economic characteristics and β is the corresponding parameter vector. The indirect utility function consists of a deterministic, $V_{iht}(\beta x_{iht})$, and a stochastic, ε_{iht} , part. We assume that the respondent maximizes utility when responding in the experiment, but we as researchers do not fully observe the utility function and hence we add the stochastic element to the utility function. In the experiment we only observe whether the respondent chooses the extension package or not. Let us define a binary variable, y_{iht} , which is equal to one if the respondent chose the extension package and zero if the respondent chose the local public good. The probability of this choice can be expressed as

$$P[y_{iht} = 1] = P[V_{iht}(\beta x_{iht}) + \varepsilon_{iht} > \delta_t]. \quad (2)$$

where δ_t is the utility of the public good in choice situation t . Since respondents in the household make repeated choices, the assumption of independence between observations may be violated since the choices can be correlated. Following Butler and Moffitt (1982) we therefore specify the error term as

$$\varepsilon_{iht} = u_{ih} + v_{iht}; u_{ih} \sim N(0, \sigma_u^2), v_{iht} \sim N(0, \sigma_v^2) \quad (3)$$

where u_{ih} denotes the unobservable household specific effect of individual i and v_{iht} denotes the remainder disturbance. The components of the error term are consequently independently distributed and we have

$$\text{Corr}[\varepsilon_{iht}, \varepsilon_{ihs}] = \rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}. \quad (4)$$

This is a standard random effects binary Probit model, see for example Greene (2000). The model is restrictive in the sense that it assumes equal correlation across periods for each household. In the case of a choice experiment, this implies an assumption of stable preferences and/or no learning or fatigue effects over the course of the choice sets for each household. Given the relatively simple choice experiment (few choice sets and few attributes), we believe that this is a plausible assumption.

3. Data, results and discussion

We are interested in analyzing the choices made between extension packages and one of the local public goods. Based on the adoption of agricultural innovation literature (see Feder et al., 1985 for a survey) we have chosen a number of explanatory variables that are expected to affect the demand for an extension package, given the alternative opportunity of a health station or improved water supply. The specification includes three sets of variables. The first describes the attributes of the experiment, i.e. whether the household has chosen the maize or the teff package, whether the public good is a health station or an improved spring, the amount that the household needs to pay back after harvest after having received the extension package, and whether this repayment needs to be done if there is a crop failure (insurance). The second set includes the standard socio-economic variables expected to affect such choices including the age, gender and literacy of the respondent, the family size, and wealth and resources indicated by ownership of livestock, trees and land. The third set of explanatory variables is chosen to control for the availability of the proposed goods. The preference for clean water is expected to be dependent on whether the

household uses an unsafe source of drinking water and the distance to the water source. Similarly, the demand for a health clinic is expected to depend on the distance to existing health facilities. Finally, interest in extension package is expected to be positively correlated with past use of fertilizers. The descriptive statistics for the selected explanatory variables are shown in Table 1.

Table 1 here

Our final data set includes 12591 choices made by 1591 individuals in 1012 households in East Gojjam and South Wollo. A number of responses were excluded from the data set because of item non-response. In particular 15 respondents that answered less than three choice sets (out of eight) were excluded while 177 respondents were dropped from the analysis due to inconsistent responses.⁷ As described above, choices were made between an agricultural extension package and a local public good (for the village). A large majority opted for the public good. The share of choices made in favor of the extension package was as low as 20 percent. The proportion of households that chose the health station and protected spring were 84 percent and 76 percent respectively. In Table 2, the share of respondents choosing the extension package at various levels of the attributes is presented.

Table 2 here

As can be seen from Table 2, the respondents are rather unresponsive to the amount of money they have to pay back after harvest. The share of respondents opting for the extension package remains almost unchanged although the cost increases by 75%. However, the share choosing the extension package more than doubles if the cost of inputs does not have to be paid in case of crop loss. This gives a clear indication of the importance of risk aversion in reducing the adoption rate of modern inputs in Ethiopian agriculture. Finally, there are also some differences with respect to which public good that they are asked to make a trade-off with, health station being more preferred than protected spring.

In Table 3 we present the results from the estimation of the random effects Probit model where the dependent variable is equal to one if the respondent opted for the extension

package. The estimates for the pooled sample are followed by estimates for the observations in South Wollo and East Gojjam, respectively, since we expect regional differences in agro-climatic conditions, potentials in agricultural productivity and profitability, and subsequently in preferences between the two zones.

Table 3 here.

The estimated correlation between the error terms, ρ , is high and highly significant throughout, which means we cannot reject the random effects model in favor of a more restrictive model with no correlation between the error terms. The dummy variable for the Wollo region in the pooled sample is also highly significant, strengthening our case for pursuing a regional division in the analysis. Furthermore, in a likelihood ratio test we can reject the hypothesis of equal parameters between the two samples.⁸ So we will from now concentrate on the separate regressions.

If we turn to the attributes of the choice experiment, we find the coefficient of the amount payback is negative and significant in the Gojjam sample while in the Wollo sample it is negative but not significant. The result for Wollo may be taken as another indication of the lack of interest among farmers in Wollo for improved inputs. There could be many reasons for this, including agro-ecological conditions making it less profitable to apply fertilizers and improved seeds on steep and degraded soils. However, the risks involved in such applications could also be important, as indicated by the positive and highly significant coefficients for insurance. These results indicate that the high level of risk implied by taking farm inputs on credit is a major constraint for adoption of modern inputs in the Ethiopian highlands. Subsequently, if this risk could be addressed, by reducing the risk aversion of the farmers or through the introduction of some kind of soft default mechanism, then adoption rates could be expected to go up. The insignificant coefficients for past fertilizer use suggests that learning effects and experience from use of fertilizer do not play a role in farmers' choice of extension package.

The negative and significant impact of the health station variable suggests that from the two local public goods included in the choice experiment, the respondents preferred a health station to a protected spring. The overall result, as indicated by Table 2, is that households in these regions in general prefer such local public goods as compared to the proposed extension package. The existing availability of such amenities had varied significance. Households in Wollo with unsafe water source are more likely to choose the local public good while the coefficient of this variable is not significant for households in Gojjam. The impact of distance to health services is, however, insignificant in both sub-samples. More disaggregated analysis of this data could of course be used for targeting community interventions. Households that chose the maize package were less likely to prefer the extension package compared with those who chose the teff package.

The socio-economic characteristics also give some interesting insights. The probability of choosing the extension package decreases with age in Gojjam while age is not a significant factor for Wollo. There is also a significant difference across gender. Female respondents are less likely to opt for extension packages than their male counterparts both in the Wollo and Gojjam sub-samples. Literacy is surprisingly insignificant for each of the two sub-samples, maybe because increased literacy has a similar impact on both the preference for extension packages and health-improving local public goods. Family size has a negative and significant effect on choice of extension package in Gojjam suggesting that larger families in Gojjam prefer health facilities and protected springs to extension package. The coefficients for livestock holdings are negative and significant throughout. A possible reason for this could be that manure from the livestock is a close substitute to chemical fertilizers. We also find that while whether or not the household has some land is not significant in Gojjam, the size of land owned has a positive and significant impact both in Wollo and Gojjam. The positive effect of size of land could stem from the greater probability to have at least some land suitable to modern inputs, if the land is larger.

5. Concluding remarks

Rural development is of utmost importance in many poor countries in order to decrease poverty, improve livelihoods and support the transformation of the whole society to a more sustainable development, e.g. as expressed in the Millennium Development Goals. Over the years, numerous approaches and interventions have been tried in order to support such rural development. From the perspective of a rural household many of these interventions can be classified as either supporting the household directly with various inputs or supporting the community through various local public goods such as roads, schools, health care etc. Both approaches are currently used in Ethiopian rural development policies, but agricultural extension, which has been the dominant rural development strategy, has been slow in penetrating rural agriculture and the farmers seem to “vote with their feet” by showing great hesitation in adopting modern agricultural inputs that are made available, or more aggressively promoted by extension agents, with credit.

This paper used the choice experiment method of valuation to look into the choices of a sample of Ethiopian farmers between an agricultural extension package (improved seeds and modern farm inputs) on the one hand and a health station or a protected spring on the other. The agricultural extension package was proposed, with or without insurance, in the form of a loan to be repaid at harvest time. In some of the choices the extension package was bundled with a kind of insurance that meant that the credit did not have to be repaid in case of crop loss.

The results from this choice experiment support the general impression that Ethiopian farmers are extremely skeptical to the adoption of an extension package made available with credit. When given the choice, a large majority rather chooses a local public good instead. However, it also gives some further insights to this development dilemma that Ethiopian policy makers, concerned with a structural food shortage, are facing today. This study, following Yesuf (2004), points at the importance of vulnerability and that the high level of risk aversion among farmers in the Ethiopian highlands affects their behaviour and limits their adoption of modern agricultural inputs. This situation, also described as a poverty trap (Dercon, 2004), could be addressed either by reducing the underlying factors

leading to the high degree of risk aversion (Yesuf, 2004), or, as exemplified in our inclusion of an insurance component in the extension package, by directly reducing the risk from adoption.

This application also suggests that stated preference methods could be useful tools in designing of policies and implementation of rural development projects. Despite the obvious trade-offs that have to be made when development interventions are designed, the preferences of the target group between private and public goods are seldom elicited in a structured way that enables aggregation and evaluation. Stated preference methods can be used for such purposes (see for example Köhlin (2001)). The analysis in this paper also gave numerous insights into factors affecting the preferences for various interventions and highlighted the importance of regional, household and individual characteristics in the formation of these preferences. Such information could be utilized to improve the design and targeting of rural development interventions.

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Table1. Descriptive statistics

Variable	Description	Mean (std. dev)		
		Full sample	Wollo	Gojjam
Extension package	=1 if respondent chose extension package	0.20 (0.40)	0.14 (0.34)	0.28 (0.45)
Maize package	= 1 if respondent opted for maize package	0.28 (0.45)	0.18 (0.38)	0.41 (0.49)
Age	Age of respondent in years	42.86 (15.10)	43.77 (15.13)	41.72 (14.97)
Read and write	= 1 if respondent can read and write	0.32 (0.47)	0.35 (0.48)	0.29 (0.45)
Female	= 1 if respondent is female	0.50 (0.50)	0.50 (0.50)	0.49 (0.50)
Family size	Number of household members	5.79 (2.23)	5.86 (2.22)	5.70 (2.24)
Livestock	Animal holdings converted to tropical livestock units	3.15 (2.66)	2.54 (2.33)	3.91 (2.84)
No land	= 1 if household has no land	0.13 (0.33)	0.01 (0.09)	0.28 (0.45)
Land area	Land area in hectares	0.97 (0.69)	0.97 (0.55)	0.97 (0.84)
Fertilizer use	= 1 if household uses fertilizer	0.49 (0.50)	0.21 (0.41)	0.84 (0.37)
Unsafe water source	= 1 if source of drinking water is unsafe	0.19 (0.40)	0.13 (0.34)	0.27 (0.45)
Distance to health facility	= Distance to health facility (in hours)	0.48 (0.80)	0.38 (0.61)	0.61 (0.97)
Wollo	= 1 if household is located in South Wollo	0.55 (0.50)	n.a.	n.a.

n.a. = not applicable.

Table 2. Overview of share of respondents choosing the extension package for different attributes and attribute levels

Amount	200	250	300	350
	0.21	0.19	0.21	0.19
Insurance	Without 0.12	With 0.28		
Alternative public good	Protected Spring 0.24	Health Station 0.16		

Table 3. Results of random effects Probit model for the choice of extension package

	Full sample	Wollo	Gojjam
Constant	-0.883 ^{***}	-2.467 ^{***}	0.404
<i>Attributes</i>			
Amount payback harvest	-0.115 ^{***}	-0.044	-0.163 ^{***}
Insurance	1.115 ^{***}	1.351 ^{***}	0.962 ^{***}
Health station	-0.542 ^{***}	-0.487 ^{***}	-0.643 ^{***}
Maize package	-0.338 ^{***}	-0.596 ^{***}	-0.312 ^{***}
<i>Characteristics</i>			
Age	-0.006 ^{***}	0.003	-0.020 ^{***}
Read and write	-0.072 [*]	-0.098	-0.070
Female	-0.193 ^{***}	-0.221 ^{***}	-0.263 ^{***}
Family size	0.024	0.009	-0.069 ^{**}
Livestock	-0.114 ^{***}	-0.113 ^{***}	-0.064 ^{***}
No land	0.369 ^{**}	n.a.	0.154
Land area	0.310 ^{***}	0.428 ^{***}	0.217 [*]
Fertilizer use	0.111	0.011	0.272
Unsafe water source	-0.593 ^{***}	-0.842 ^{***}	-0.184
Distance to health	-0.001	-0.009	-0.010
Wollo	-0.894 ^{***}	n.a.	n.a.
ρ	0.759 ^{***}	0.806 ^{***}	0.696 ^{***}
Number of households	1012	577	435
Number of choices	12591	6968	5623

***, ** and * represent significance at the 1, 5 and 10 percent levels respectively.

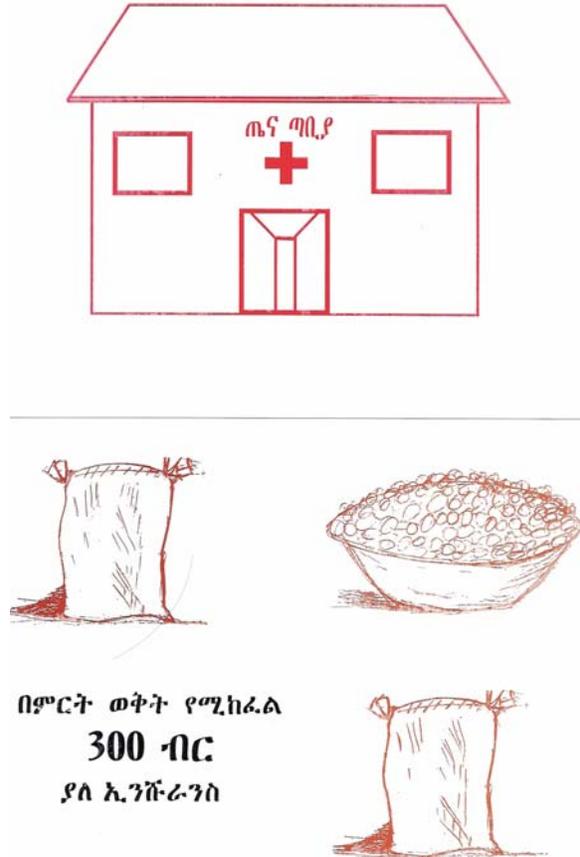
n.a. = not applicable.

Figure 1. Example of a choice situation

Option 1	Option 2
Extension package	Protected spring
Payment at harvest time: ETB 200	
Insurance	

Figure 2. An example of cards describing a choice set

(A health station compared with fertilizer and improved seed which will cost Birr 300 without insurance to be paid during harvest time)



Appendix: Choice experiment scenario

Consider that the project will be implemented in your village. Money will then be spent on community development in the community. Within the community workshop it has to be decided what to do with the money. There are essentially two alternative uses of the money:

- (i) To directly support the households for example by subsidizing agricultural inputs such as fertilizers and improved seeds; or
- (ii) To invest the money in a protected spring or a health station. In this part of the questionnaire we will ask you to choose between such alternative orientations of the project.

There are two possible community activities:

A. An additional protected spring would be constructed for the village. It will be located so that the walking distance from your house is approximately 15 minutes. The water in the spring is safe to drink and available all year round.

B. An additional health service station would be constructed and maintained in your Kebele. The station will have a number of trained health attendants. There is never more than two hours waiting time. Medicine and shots are available at the station, but there are no sick beds. All services are provided at no cost for you.

Alternatively, the project could support you with an extension program. With this program your household receives subsidized inputs, advice on their application and in some cases an insurance. You can choose between a Maize package and a Teff package. The maize input package consists of:

50 kg DAP, 50 kg Urea and 12.5 kg hybrid maize seed, suitable for 0.5 ha,

or, for those who prefer Teff, the Teff package consists of:

50 kg DAP, 50 kg Urea and 17.5 kg improved Teff seed and 0.5 l herbicide, suitable for 0.5 ha.

The inputs would be available through the Office of the Agriculture Department of the Woreda (district) before sowing time.

Choice of package (only one choice possible):

Maize package: _____ (Yes=1, No=2)

Teff package: _____ (Yes=1, No=2)

These packages are similar to the current ones in the agricultural extension program. The payment is due one month after the main harvest. For research reasons we will make some changes to this package. We will vary the price that has to be paid at harvest time of this package and also introduce an insurance if there is a crop loss. The insurance would work like this: If there is a crop failure the package will not have to be paid at all.

We will now ask you to choose between different such extension packages and one of the two community investments, either a protected spring or a health station.

¹ For example in Yesuf (2004) it was found that risk preference is one of the major covariates explaining variations in fertilizer adoption decisions of the same sample of farm households as in this paper. It was also found that many farmers had extreme levels of risk aversion

² For an overview of the choice experiment method, see Alpizar et al. (2003) and Louviere et al. (2000).

³ Teff is a cereal used to make Injera—a pancake like bread which is a staple food particularly in the northern parts of Ethiopia.

⁴ The maize package consisted of 50 kg DAP, 50 kg Urea and 12.5 kg hybrid maize seed, suitable for 0.5 ha. The teff package consisted of 50 kg DAP, 50 kg Urea and 17.5 kg improved teff seed and 0.5 l herbicide, suitable for 0.5 ha.

⁵ At the time of the study, an extension package, given the description in our experiment, cost about Birr 275 in Wollo and Birr 300 in Gojjam. Hence, levels, Birr 200 and 250 in our experiment imply subsidies of Birr 100 and 50 (equivalent to USD12 and 6) in Gojjam and Birr 75 and 25 (equivalent to USD 9 and 3) in Wollo. With insurance, the subsidies are even greater.

⁶ The total number of combinations of attribute levels is 16. Therefore we created two different versions of the choice experiment, with 8 choice sets in each.

⁷ Some respondents most likely misunderstood the experiment. They switched from preferring the local public good to the extension package as the amount of payback at harvest increased.

⁸ In any discrete choice model the estimated parameters are confounded with the scale parameter; see e.g. Train (2003). In order to consider this fact when testing whether the parameters are equal or not we use the grid search procedure proposed by Swait and Louviere (1993). The relative scale parameter is estimated to be 1.36. Imposing this on the data we can reject the hypothesis of equal parameters between the Wollo and Gojjam sample. The χ^2 statistic for the null hypothesis of equal parameters is 64.14 with 16 degrees of freedom, and the corresponding critical value of the χ^2 distribution at the 95% confidence level is 26.30.