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# The Management of Trust for Stimulating the Adoption of Improved Maize Seed in Malawi

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**Abstract**

*Adoption of improved seed is the major pull factor of the seed value chain. Especially trust is an important element of the adoption decision. The aim of the study is to assess ways to manage trust. By using survey data from Malawi to elicit the role of trust in the decision making process of farmers to adopt improved seed. We use these data in a dynamic simulation model to assess the historical seed adoption pattern in Malawi and to assess branding as a policy measure to manage the trust stock. We find that branding has been contributing to seed adoption in Malawi and our analysis confirms that it can further stimulate demand in combination with strategies of pricing and new product supply.*

# 1 Introduction

Although the public crop research institutes have breeding programs, the subsequent, private sector stages of the seed value chain are underdeveloped. Therefore improved seed varieties developed by the national and international agricultural research centers very often fail to get adopted by the smallholder farmer (Morris et al 1999). Quality seed can play a critical role in increasing agricultural productivity as well as farmer incomes, which impacts food security. Quality of seed determines the upper limit of crop yields and the productivity of all other agricultural inputs into the farming system (Maredia et al 1999; Morris et al 1999). The development of new crop varieties is also a key factor to shape the future severity of climate change impacts on food production (Lobell et al 2008). A well functioning seed supply chain that generates improved varieties through research, produces them, and delivers them to farmers needs push and pull forces to develop. In this paper we address the determinants of farmers' adoption of improved seed as the major pull force in the seed supply chain. We specifically focus on improved seed for the food crop maize that is important for the transformation process from subsistence agriculture to small-scale commercial agriculture.

Product adoption results from a dynamic interplay between the evaluations of the utility of improved seed varieties and trust in the quality of improved seed varieties (Kopainsky, 2009). But the relative importance of these factors depends on the specific adoption situation. Consumer's preferences for certain product attributes differ with social factors, income and products. Preferences for certain attributes might also differ between companies and consumers from business to business and business to customer relationships (Homburg et al., 2010). Defining and quantifying the preferences of the subsistence farmer for certain attributes is therefore an important step towards understanding patterns of adoption and designing polices that enhance adoption.

For this purpose we designed and implemented a household survey with 210 farmers in Malawi and used a conjoint analysis to elicit farmers' preferences for tangible and intangible attributes. We operationalized these data in Kopainsky et al. (2011) where we developed and calibrated a System Dynamics model for the case of the adoption of improved maize seed in Malawi. Simulation runs showed the importance of trust in the adpotion decision. This calls for conscious and tailored strategies for managing trust. For this purpose, we extend the analysis of Kopainsky (2011). We profile the adopters population by subdividing them into clusters of similar preference structures for trust and utility. We use these data to explore how the trust stock can be managed. Trust involves beliefs about reliability, safety and honesty. These are important components of the concept of trust that people incorporate in their

perception of trust. A way to build those perceptions is to use branding. Branding involves protection of a name to ensure recognizability and distinguishability. We use branding as a policy measure to manage the trust stock in order to enhance adoption rates of improved seed in Malawi. The results show that branding is an efficient strategy to manage the trust stock by increasing information and by controlling for counterfeit products.

# 2 Methodology

Kopainsky&Derwisch (2009) see the adoption process as essentially being the product from trust and utility. Also Li et al. (2008) acknowledges the importance of trust for adoption and „views it as the primary predictor of technology usage and a fundamental construct for understanding user perceptions of technology.“ Previous research has studied the various consumer and producer interactions that are influenced by trust as well as the role that specifically initial trust plays for product adoption (Li et al., 2008) But while empirical studies have shown that the level of trust does not necessarily develop gradually over time (Berg et al., 1995; Kramer, 1994) we develop a different view by looking at trust as a stock that can accumulate over time. Also Warren (2007) considers reputation as a stock which can be used synonymously to trust in our example. Kopainsky et al. (2011) find the existence of a trust stock confirmed by data from a farmers survey and analyses the dynamics over time that might arise from that for the adoption rate. They conducted a survy with 211 farmers in Malawi focusing on their preferences for certain attributes and analyzed them by using a conjont analysis which is a very widely used marketing research method for analyzing consumer tradeoffs (Green et al 2001). The analysis produces a set of important scores that represent the importance, or the weight of the attributes in the decision making process associated. But Kopainsky et al. (2011) look at the weight that the farmers assign to different attributes in an aggregated way. We use these data to decompose the adopters population into subpopulations and to establish a profile of the population. We also extend the model structure used by Kopaisnky et al. (2011) by adding feedback between trust and perceived yield and then use this structure to analyze the effect of branding on adoption

## *2.1 PROFILING THE ADOPTERS POPULATION*

The purpose of the adopters profile is to subdivide the adopters population to enhance the accuracy in the adoption model as well as giving better recommendations while designing policies. Because adopters population was found to differ in their preferences, simply building

the average of the entire adopters population might lead to wrong assumptions. To really determine the importance of trust disaggregating the trust stock according to differing preferences of the customer is necessary the hypothesis is that there is no homogenous pattern for weight of brand, price, yield, etc. To group the values we obtained by the conjoint analysis, we use a cluster analysis. A hierarchical cluster analysis based on proximity measures was subsequently implemented. The method applied was "within-groups linkage" using squared euclidean distance (Backhaus et al., 2008, 484). We use the data obtained by the cluster analysis then to split the adopters population and assign the weights to each sub-population.

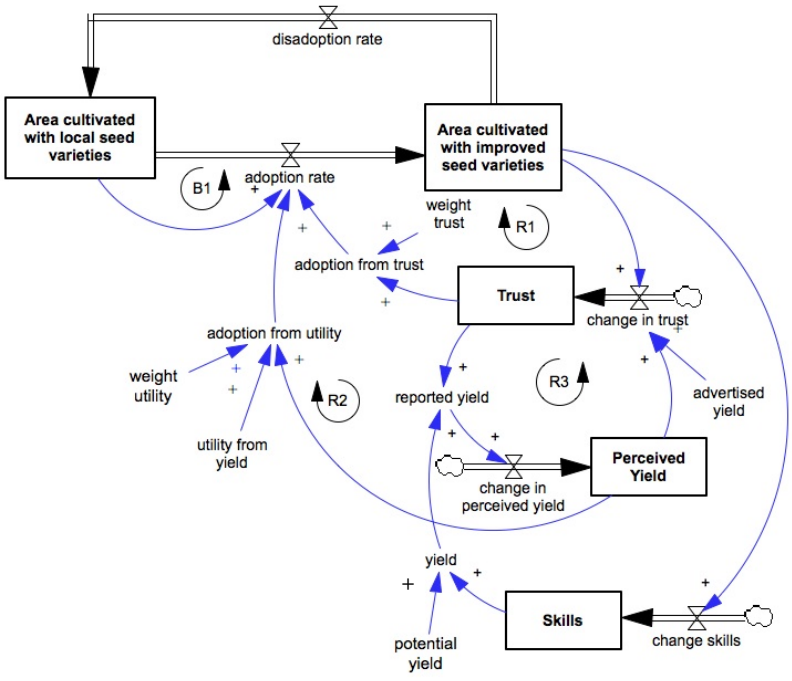
## *2.2 Modelling framework*

Trust involves beliefs about reliability, safety and honesty. These are important perceptions of trust that people form an opinion about and incorporate in their operationalization of trust. A way to build such an opinion is to use branding. Branding involves the protection of a name to ensure recognizability and distinguishability. Other components that create brand value are product quality (reliable), brand enforcement (credible) and other intangible values (desireable). (WIPO, 2011) The erosion of trust is most of all influenced by what we call the performance gap. If we consider a brand as the promise of a future performance (Deighton 1992) then we see that the dynamic behaviour of the trust stock will essentially be influenced by how a brand meets this promise and how it can keep this promise over time. Thus, branding can effectively be used to build up trust and prevent the erosion of the trust stock. To show the effect of branding on adoption of improved seed varieties in Malawi we use the model established by Kopainsky et al. (2011) which is based on a previous literature review about the adoption of improved seed varieties (Kopainsky & Derwisch 2009) and the acceptance dynamics framework described in Ulli-Beer et al (2010).

The basic structure, illustrated in figure 1, consists of a two stock model of the area cultivated with local varieties and the area cultivated with improved varieties with a discard rate where farmers may decide to go back to local varieties. Following Kopainsky (2011) the stocks of the area cultivated with local varieities and the area cultivated with improved varieties are measured as percentages of the total area cultivated with maize, i.e., as percentage of total maize area cultivated with local seed varieties and percentage of total maize area cultivated with improved seed varieties. Other indicators like the amount of produced maize grain, which, or the number of farmers cultivating improved maize seed varieties are too sensible to

climatic variability or do not consider actual farm sizes. Therefore the percentage of the area cultivated with improved maize seed is a more stable indicator of adoption. (Kopainsky, 2011) The decision to adopt improved seed is characterized in the model by two components. The first is the evaluation of utility of seed that is determined by the profitability of improved seed relative to the profitability of the old technology. The profitability is determined by the yield that farmers perceive they can realize by using improved varieties. The yield depends on the skills that are needed to cultivate improved seed varieties which are a function of the area cultivated with improved seed varieties. The second component is a structure of social learning whereby trust is build by a feedback between the adopters stock and the trust stock. The adoption rate is then the sum of the adoption potential from the farmers evaluation of utility multiplied with the weight that farmers assign to utility and and their evaluation of trust multiplied with the weight that farmers assign to trust. A reinforcing loop is added to this structure that is formed between the perceived yield and the Trust in improved seed. The netwflow to the perceived yield is determined by the real yield of improved seed, which is multiplied by trust. This relationship represents the delay of updating perceptions in the case of e.g. brand loyality. The netflow of the trust stock is determined by the comparison of the advertised yield and the perceived yield, so the comparison between what companies promise they deliver and what customers perceive they deliver. Figure 1 illustrates this reinforcing feedback loop between the trust stock and the stock of perceived yield, which is displayed as loop R3.

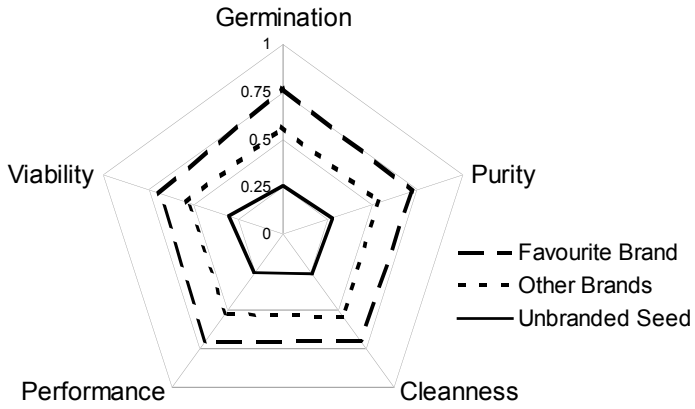
*Figure 1: Stock and Flow structure of the adoption model with the reinforcing feedback loop R3.*



### 2.2.1 The effect of branding on building trust

Branding contributes to building of trust by delivering information about a product and ensuring its distinguishability from other products. Based on the assumption of information economics that markets are characterized by imperfect and asymmetrical information (Spence 1974, Stump&Heide 1996), we argue that branding reduces byer information costs and byer perceived risk (Erdem&Swait, 1998). To quantify the amount of trust that was build up by the branding strategy (as an inflow to the trust stock), we quantify how farmers compare the perceived quality of 5 attributes of their favourite brand to any other brand and non-branded products. Farmers were asked to rank the likelihood that one of these products would match their expectations. The results are presented on a dimentsionless scale whereby 1 represents the highest and 0 the lowest likelihood that a product matches the farmer`s expectations. Figure 2 presents the averages of the respondents classification for each attribute.

*Figure 2: Spider web diagram comparing the means of farmers expectations for their favourite brand, other brand and unbranded seed over the five attributes*




The homogenous distribution of averages among all attributes and the fact that the averages between the three product categories differ significangtly corroborates our hypothesis that branding actually has an effect on farmers. We interpret the difference between the favourite brand and the unbranded seed as the amount of trust that has been build via branding. We use this difference in the simulation to quantify the impact that branding has had on the adoption of improved seed varieties. This enables us to run a scenario in which we assess the effect of a lack of trust due to a lack of branding on the adoption of improved seed in retrospective. That way we can estimate the importance of branding for adoption of improved seed.

### 2.2.2 The effect of branding on trust erosion

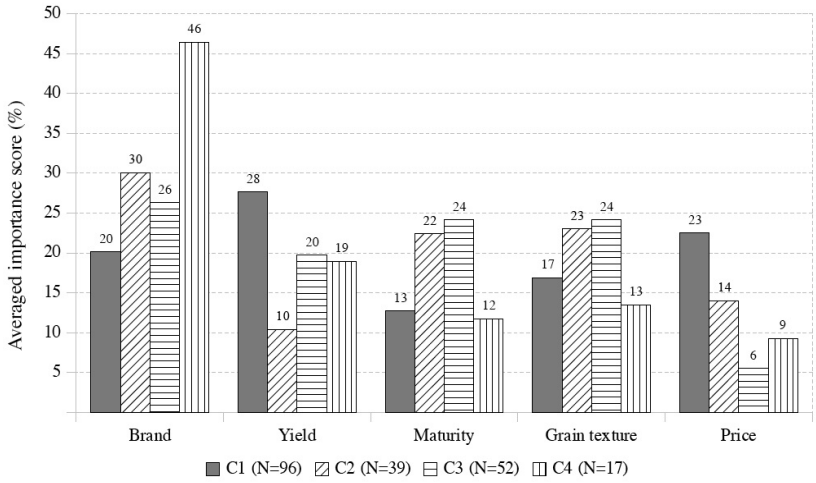
To illustrate the effect of an outflow of trust, we use the example of counterfeit seed. Counterfeiting is a problem in many product categories (OECD, 2008) and can be a problem also in the seed market. Counterfeit seed means that grain is packaged and labelled as seed, promising a quality in terms of purity and germination that the product cannot honor. In Tanzania e.g. up to one third of commercial seed on the market may be counterfeit (Seed Company, in personal interview with the researcher, 2010). That may have considerable impact on the trust of consumers. We show the impact of counterfeit goods offered on the market influences trust and adoption in the Malawi case in our simulation model. Therefore, we use two scenarios: We first assume that there will be a constant and gradual decrease in product quality, represented by a decrease in yield of improved seed. This corresponds to a scenario in which counterfeit goods appear on the market, but infringers will not be pursued for prosecution. We model this by using a ramp function that simulates a decrease in yield by 30% until the year 2015. We then model a scenario in which counterfeit goods appear on the market and infringers will be pursued for prosecution because there is a trademark associated with the seed and law enforcement is in place. Therefore we assume that there will be a temporary decrease in seed quality of about 5%, which will be adjusted after 3 years and it will take the providers of the commercial seed another 3 years until the average quality of the commercial seed is where it was before the infringement. We model this scenario by using a ramp function that decreases yield gradually for three year by 5%, and a second ramp function that increases yield bringing it to the original level within 3 years.

# 3 Results

## *3.1 Results of the adopters profile*

While investigating the results of the separated conjoint analysis according to the clusters a pattern becomes noticable. Yield and price were the most important attributes for cluster one (C1) whereas brand ranked only on the fourth place, indicating that farmers of this group are highly price sensitive. They had a strong focus on yield and assigned to brand less importance. By contrast, to farmers in group two, or cluster two, three and four (C2, C3, C4), brand was the most important attribute and price was only of minor importance. Farmers of these groups appeared highly brand sensitive with only weak focus on yield or even price. (Tröger, 2010). Figure 3 shows the distribution of preferences of the four clusters as well as their sizes.

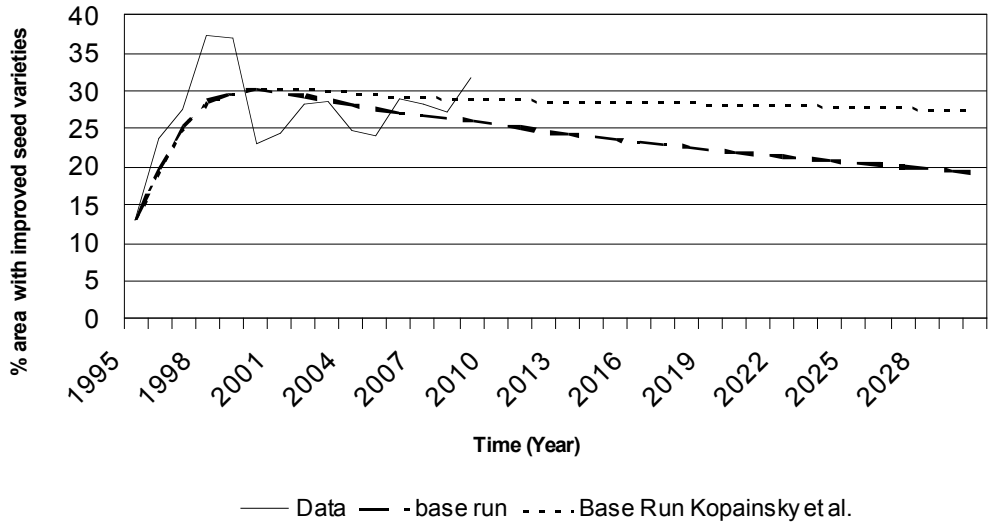
*Figure 3: Comparison of the preference scores of the four cluster (Source: Tröger, 2010)*




## *3.2 Base Run*

The short term fluctuations in adoption in the past are a consequence of annual modifications in the input subsidy scheme (Kopainsky et al., 2011) (for a historical overview of food security policies in Malawi see Harrigan (2008). The simulation model does not capture these short term changes, but is able to follow the trend in the data, which is confirmed by the results of the Theil statistics. The Theil statistics decomposes the overall root mean square percentage error (RMSPE) into the error due to bias ($U^M$ = 0.055), error due to unequal variation between data and simulation ($U^S$ = 0.025) and error due to unequal covariation ($U^C$ = 0.92). As the error is concentrated in unequal covariation and the model purpose is to study long term development patterns (rather than of cycles in the data), the error can be considered unsystematic (Sterman 2000). Figure 4 shows the base run for our model as well as for the simulation from Kopainsky et al (2011). The difference between these two simulations becomes clear when consider the structural explanation of the observed behaviour.

*Figure 4: Historical data until year 2009 and the simulation run until year 2030 of the area cultivated with improved seed varieties for the base run from Kopainsky et al (2011) and this study*




The growth of the adoption rate is driven initially by the utility evaluations of the product. This is mainly due to the impact of input prices, which concerns fertilizer and seed and output prices, which concerns the price for grain. In the second half of the 1990s, input costs were rising moderately while at the same time the seed-to-grain price ratio decreased markedly. This seems to have stimulated adoption initially. Since the early 2000s, adoption stagnated in the order of 30%. (Troeger, 2010) The trust feedback structure has initially a low impact in the adoption rate since the initial trust stock is low. The adoption rate stagnates from the year 2000. That is the consequence of a complex interplay of counteracting forces:

- Initially, adoption was boosted through declining seed-to-grain-price ratios.
- Beneficial fertilizer-to-grain-price ratios also lead to an increase in the degree of fertilization and thus in the realized yield of improved seed which had a beneficial impact on adoption.
- At the same time, the increase in the degree of fertilization also increased the total input costs of improved seed as fertilizer was applied increasingly. This reduced the relative attractiveness of improved seed and thus decreased adoption. (Kopainsky et al., 2011)

Over the second half of the historical time period these processes started to balance each other out as indicated by the fairly stable development of area dedicated to improve maize seed varieties. But trust is building up over time as the stock of adopters is increasing. At the same time the relative importance of perceived yield and attractiveness is decreasing. Thus the reinforcement between adoption and trust caused the adoption level to rise to the level

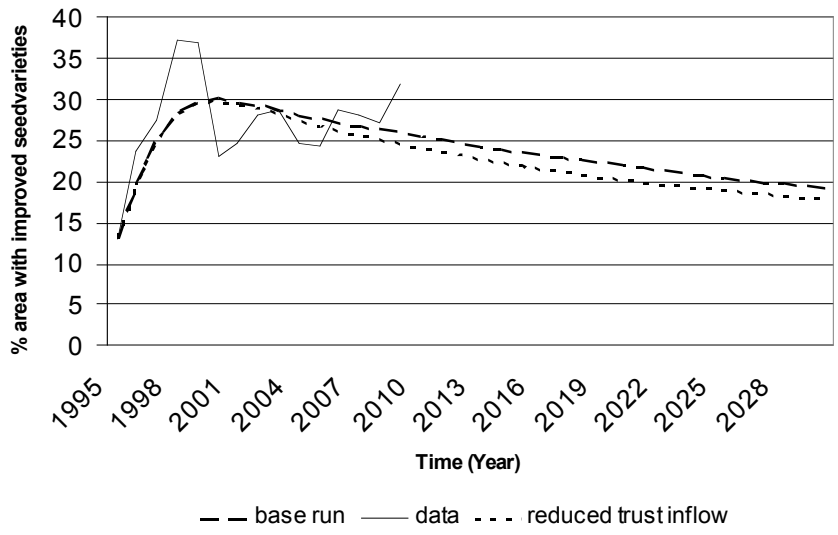
recorded in the data. The importance of the trust stock also explains the difference between the simulation from Kopainsky et al. (2011) and the result that we obtained. By splitting the adopters population into four sub-populations and using the four different preference values for yield and brand instead of one averaged value the simulation differs especially in the projection of the adoption rate to the year 2030. It appears that Kopainsky et al. (2011) overestimated the impact of trust adoption because there are few adopters with a high weight for the brand factor in their decision making and a low weight for yield and price (Cluster 4) and because the majority of the adopters population has a more balanced weight on brand and yield in their decision to adopt improved seed. Because the impact of the trust stock increases as it grows over time, the difference between the preference structures of the four clusters regarding trust becomes important after the year 2000. Another reason for the difference that we observe is the feedback that we added from perceived yield to trust, illustrated as loop R3 in figure 1. Reinforced by that feedback, fluctuations in yield can trigger the erosion of trust and influence negatively the perceived yield.

## *3.3 Simulating the effect of branding*

### 3.3.1 Simulating the effect of branding on trust building

Applying the reduction in trust building caused by the lack of branding we observe that in the beginning, until the year 2000 there is very little impact of less building up of the trust stock. From the year 2000 onwards the lack of information and trust from branding reduces adoption of commercial seed by 7% to 18% points compared to the base run. This is illustrated in figure 6. The reason for this behaviour is that in the beginning of the simulation, the trust stock is very low and adoption is driven mainly by the utility derived from the yield. Later on, as the trust stock builds up, trust is much more important and, therefore, a lack of trust affects adoption much stronger.

*Figure 6: Comparison of of the area cultivated with improved seed varieties between base run and the scenario with a reduced inflow into the trust in improved seed stock*

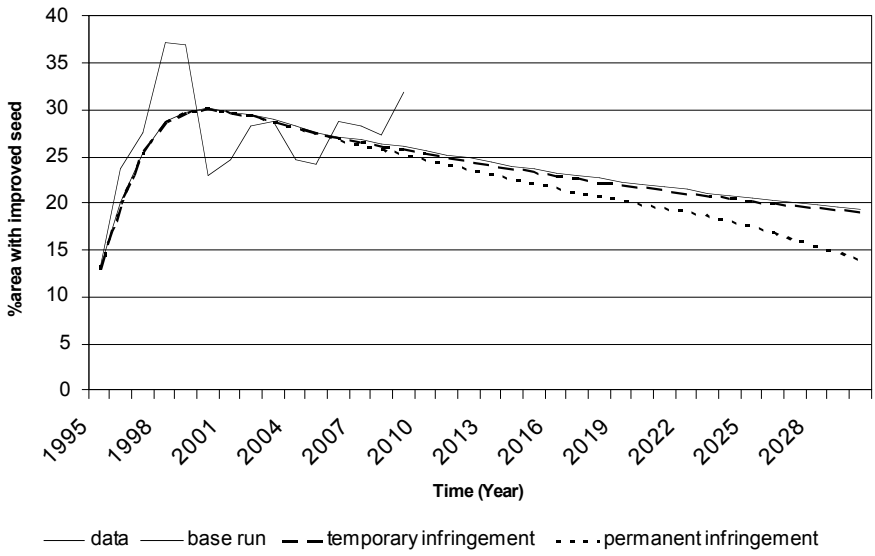



## 3.3.2 Simulating the effect of branding on trust erosion

In the scenario of infringement without persecution and a permanent decrease in quality, represented in figure 7, we observe initially little reduction in the area planted with improved seed. From 2025 onwards there is a sharper decrease of the area planted with improved seed. The reason for this delayed reaction of farmers to a decrease in seed quality is caused by the perception delay for yield as well as by the trust stock that causes brand loyality and thus further delays the reaction of farmers to decreasing quality. But as yield decreases further, perceived yield decreases and triggers the erosion of the trust stock by the feedback from the loop R3. The overall decrease of adopters area in 2030 in this scenario is 28% in relative terms.

In the scenario of infringement with persecution and a temporary decrease in quality we observe a temporary and delayed decrease in adoption. The area planted with improved seed varieties starts decreasing in 2006 and reaches the level of the base run towards 2030. There is a temporary reduction in the area planted with improved maize of about 1.5% in relative terms. This scenario is very dependent of the efficiency of the court system. The reaction time of 3 years to fix the problem is rather short, and yet we observe the delayed and prolonged impact of infringement. This is caused by the fact that the trust that exists is reduced temporarily and needs time to recuperate and the feedback that exists between the trust stock and the perceived yield.

*Figure 7: Comparison of of the area cultivated with improved seed varieties between base run, the scenario with a reduced inflow into the trust in improved seed stock and the scenario with continous and pulse outflow of the trust in improved seed stock.*



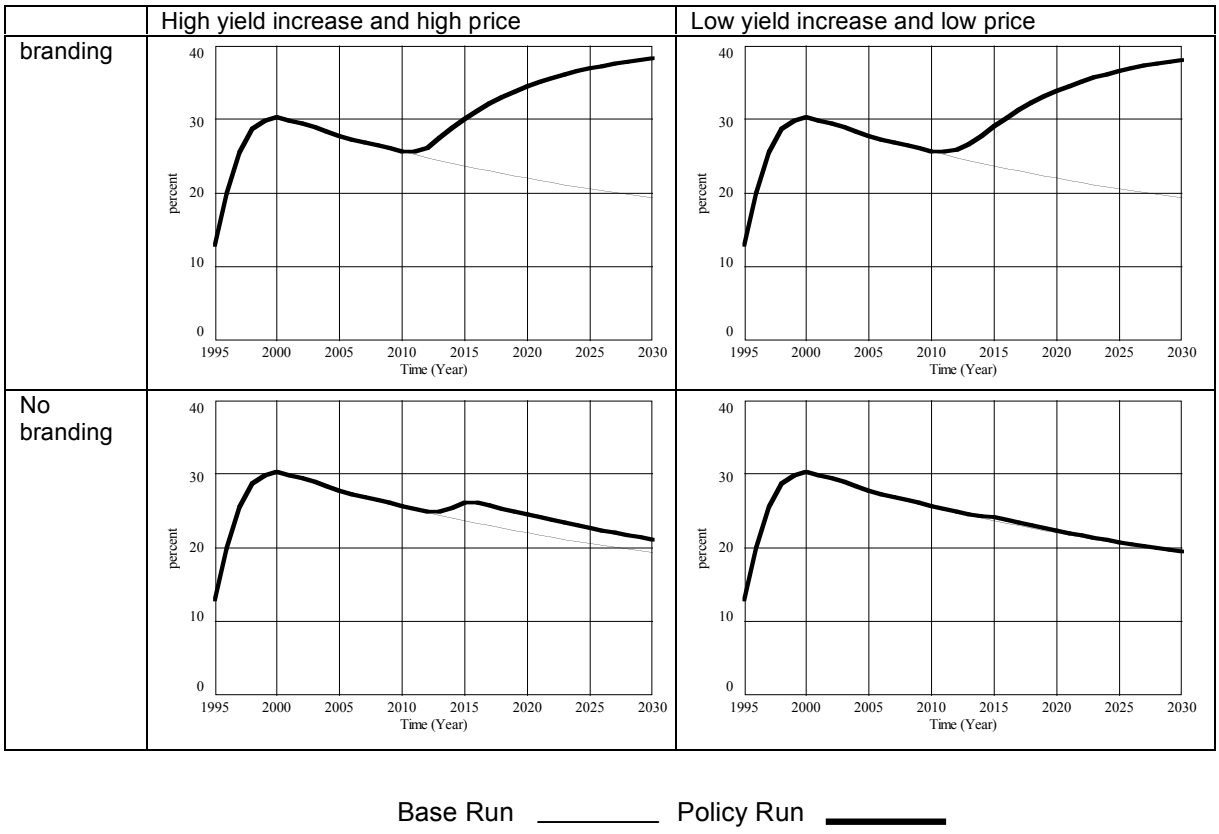

## *3.5 Policy design*

Since adoption is at levels of about 30% of the agricultural land cultivated with maize, there is still great potential for the adoption of improved seed. The question is how to activate this potential. We adress this question by a combination of product categories and additional branding strategies. As we find a heterogenous importance of trust and utility depending on the cluster we observe the impact of the combination of different combinations of trust and utility. We assume that from the year 2011 on the farmer can have the choice between varieties with low yield increases and low price increases (30%) and seed varieties that have a higher yield increase but also a higher price increase (60%). We combine these products with additional branding strategies. The results are presented in the matrix in figure 8.

We observe that the highest improvement in adoption can be achieved by the combination of high yielding varieties with branding. Adoption rises from 19 to 38 % of the area. The importance of trust increases after the year 2000 so that additional branding results into higher adoption both for the low yield and the high yield scenario. Yield is for the majority of the farmers in the sample, the clusters 1, 2 and 3, the most important attribute. Since the price elasticity is very low, we observe the highest increase in adoption in this scenario. But also the low yield scenario with branding shows higher adoption than the no branding scenarios. Adoption rises from 19 % to 38 % of the area. Adoption of improved seeds in the no branding

scenario is still higher with high yielding and high priced crops (increase by 9 %) than with low yielding and low priced crops (increase by 1 %).

*Figure 8: Results of the policy combinations between higher yielding and higher priced and ower yielding and lower prices seed varieites and additional branding*




# 4 Discussion and conclusions

The objective of this study was to assess how consumers trust can be managed by branding. Building on the results of Kopainsky et al. (2011) and Troeger (2010) we show the importance of the trust in the decision making of farmers to buy improved seed. Trust plays an important role and building and maintaining trust and is imperative to sustain or even increase adoption rates of improved seed. Maintaining trust can be secured by branding which is an effective measure to stabilize the trust stock in case counterfeit seed appears on the market. The results of the simulation model show the positive impact that branding has had on the trust stock and on adoption of new seed varieties. Branding was building expectations for improved seed varieties as empirical data show and has stimulated adoption. The combination of branding with different product categories of improved seed have show the potential to sustain and enhance adoption of improved seed in the future.

To tailor the combination of branding and product categories to the different preferences of farmers for differing product attributes, these differing preferences need to be taken into account in the adoption model. In our analysis we therefore combined an adopters profile with an adoption model. In this way we were able to make statements about the strategies with which an increase in demand can be triggered. Consumers preferences of the four clusters show that the importance of yield and price versus brand over the entire sample is fairly balanced. Adressing alone branding by trust building measures will therefore not yield optimal results. As farmers are not very sensible to the price of varieties but to the yield potential, the highest adoption results were achieved in a scenario in which additional marketing was combined with high yielding varieties offered on the market. To address farmers preferences for high yielding varieties branding is important as it secures quality in a case when counterfeit seed might appear on the market and erode the positive image of improved varieties.

These findings are important for the public sector as they highlight that adoption cant be achieved only by distributing varieties of high yield but as trust building measures need to be taken in order to make farmers adopt these varieties. Branding and marketing strategies can here enhance the spread of public varieties. Also the fact that a trademark gives a legal measure to prevent that counterfeit seed erodes trust is important as the NERICA example shows. NERICA, short for new rice for Africa, is a new rice variety that was introduced by the west african rice research center. As the variety gained popularity NERICA became in some regions of Westafrica a generic term for rice varieties, thus making the original varieties indistinguishable. A branding strategy that builds on information and enforcement can prevent such problems as our analysis shows.

Stimulating and sustaining demand for improved seed is important as the market potential triggers companies to enter the market of local entrpreneurs to extend their activities. Thus by applying trust branding and marketing strategies and enforcing them the public and the private sector contribute to the development of a sustainable seed industry that is able to deliver farmers with high quality inputs and contributes to food security.

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