**SOCIAL TRUST AND CONSUMPTION EXPENDITURE DECISIONS OF FARM-BASED BIOFORTIFIED FOODS IN SELECTED DISTRICTS OF MALAWI**

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**Abstract**

To reverse malnutrition and enhance human capital development, countries continue to invest in programs that support scaling up nutrition-sensitive agriculture like biofortification of farm-based crops. Despite the stipulated benefits, the uptake of orange fresh sweet potato (OSFP) and quality protein maize (QPM) biofortified crops remains low in Africa. To contribute to the literature on improving the uptake of OFSP and QPM, this study assesses the associated effect of social or interpersonal trust on consumption and expenditure decisions. We use the Berg, Dickhaut, and McCabe, (BDM) investment game and choice experiment to elicit social trust and willingness to pay for OFSP and QPM, respectively. Using data from three selected districts in Malawi and different econometrics tools, we observe mixed effects of different categories of social trust. People who are more likely to trust other people within their circle (in-group) are less likely to uptake consumption of OFSP and QPM. On the contrary, having trust in strangers (out-group) could positively influence the decision to consume OFSP and the extent of consuming QPM, signifying the importance of out-group trust in breaking the consumption decision hurdle. Additionally, access to nutrition education, particularly on healthy cooking practices and receiving QPM significantly influences consumption decisions, the extent of consumption and willingness to pay for OFSP and QPM. We recommend enhanced government and public interventions in disseminating information on the benefits of and best practices in processing biofortified foods to influence change among rural households.

**Keywords:** Social Trust, Willingness to Pay, Orange Fresh Sweet Potato, Quality Protein Maize, Malawi

**1.0 Introduction**

Social trust is one form of social capital that is important for influencing decisions (Coleman, 1988; Wang et al., 2021). Social capital refers to the social connections, networks, and interpersonal trust or social trust that occur in communities (Keele, 2007). The social capital theory explains that different individuals attain social trust in one another through networking, civic engagement, and socializing with friends (Coleman, J.S., 1988). Furthermore, the theory posits that persons with high social trust are optimistic about the future and confident in society, and they can trust what other people are saying for their benefit (Coleman, 1988; Tamilina & Tamilina, 2018). Day and Settersten Jr (2018) showed that social trust may enhance people’s perceptions, consumption decisions and the ability to solve social and environmental problems. Thus, social trust is key for personal and community development decisions.

Literature mainly presents social trust from an aspect of in-group and out-group social trust. Kwon (2019) defined in-group social trust as trust in family members, friends or members of the same group or association while defining out-group social trust as the generalized trust towards strangers or people outside the associated group boundaries. With in-group trust, members develop norms and values that influence behaviour compared to out-group or generalized trust. As such, understanding the individual in-group and out-group social trust could be important for assessing the personal decisions towards developmental interventions promoted across countries. Evidence shows that social trust could be associated with individual and personal decisions like consumption and expenditure. Although consumption studies often look at trust in the physical or food product (Vega-Zamora et al., 2019), the factors and the system that build such product trust remain an empirical question, especially in developing countries within Africa. Since social trust is founded on beliefs of honesty, integrity and reliability of others or “having faith in people” (Taylor et al., 2007), this study aims to understand the associated impact of social trust on consumption and expenditure decisions of rural households in selected districts within Malawi, a country in sub-Saharan Africa. We focus on locally available farm-based and nutritional-sensitive agriculture products, produced and consumed in the country.

As the world strives to achieve the Sustainable Development Goals (SDGs) by 2030, there are growing concerns about rising global hunger measured by the prevalence of undernourishment (PoU) (Unicef, 2024). The 2024 State of Food Security and Nutrition in the World report (Unicef, 2024) has put a spotlight on the reversed trends towards achieving zero hunger and undernutrition, particularly in Africa. Against other continents, the PoU for Africa continues to rise, estimated at 20.4 percent in 2023 compared to 19.9 percent in 2022. The statistics within sub-Saharan Africa are also on the rise, which is related to the persistent malnutrition problems of stunting, wasting and underweight that are affecting human capital development in the continent. Despite the reverse in global trends on malnutrition (Unicef, 2024), most of the Least Developed Countries (LDC) like Malawi remain stagnant. According to the 2024 Demographic and Household Survey for Malawi, 38% of children under age 5 are stunted compared to 37% in 2017. Additionally, of the under-five children, 2% are wasted, 10% are underweight, and 6% are overweight. With these trends, the malnutrition burden of undernutrition, micronutrient deficiencies, and overnutrition remains a concerning issue in Malawi. The last Malawi Micronutrient Survey (MNS) showed that over 56% of reproductive-age women in Malawi suffered from Vitamin A deficiency (National Statistics Office, 2017). This is exacerbated by the poor quality of diets, with only 17% of Malawians meeting the minimum dietary diversity in 2020 a reduction from 25% in 2014 (Unicef, 2023).

Considering the need to reverse the malnutrition challenges and enhance human capital development, countries continue to invest in programs that support scaling up nutrition-sensitive agriculture while aligning actions throughout agrifood systems to ensure that diverse, nutritious foods are available to all people, including vulnerable populations, through the value chain. The objective of these programs is to promote diversified food production and consumption, particularly among poor households living in remote areas with little access to markets and enhance the food supply chain from farm to table. One such intervention is the biofortification of agricultural-based food products that rural households produce or procure in local markets for household consumption. Biofortification generally refers to the biological enrichment of food crops with either macro or micronutrients using agronomic practices, conventional plant breeding, or genetic engineering (Bouis & Saltzman, 2017). Biofortification has proved to be a cost-effective means of delivering micronutrients to populations that may have limited access to diverse diets and other micronutrient interventions (ibid, 2017).

The orange-fresh sweet potato (OFSP) and quality protein maize (QPM, often referred to as yellow maize) are two of the biofortified farm-based crops being promoted across Africa, including in Malawi. The OFSP is a sweet potato dosed with vitamin A while QPM is a mutant maize with elevated levels of lysine and tryptophan (Kaphaika et al., 2023; Nyakurwa et al., 2017). The biofortification of these crops aligns with high consumption associated with maize being a staple food across Africa with sweet potato as the alternative starch food crop to maize. Evidence shows that consumption of OFSP and QPM can potentially improve human nutrition (Kaphaika et al., 2023; Nyakurwa et al., 2017; Ofori et al., 2022). However, uptake is affected by the acceptance of biofortified crops by farmers and consumers (Ofori et al., 2022; Talsma et al., 2017). Studies have assessed how factors associated with breeding, agronomy, socio-economic, institutional, psychological and cognitive have contributed to this low uptake to produce and consume biofortified crops like OFSP and QPM in Malawi and across Africa (Chambukira et al., 2025; Nyakurwa et al., 2017; Ofori et al., 2022; Samuel et al., 2024).

From the above evidence, more research has been done on OFSP compared to QPM, which could be related to the consumption patterns, variety release time and availability of the crops. To our knowledge, the papers we have reviewed on psychological and cognitive factors are more related to individual perceptions of biofortified foods product trust. Furthermore, studies on institutional factors have mainly assessed governance structures like policies, seed systems and extension channels that facilitate the availability of biofortified foods at the household level. No study was observed to have assessed how social or interpersonal trust – which is key for forming perceptions based on interpersonal connections – influences the production or consumption of biofortified foods, especially on farm-based crops like OFSP and QPM. This paper aims to fill that empirical gap, using data from three purposively selected districts in Malawi.

The contribution of our study is two-fold. Firstly, we contribute to the limited literature on the uptake of QPM assessed together with OFSP uptake. Secondly, we integrate the understanding of the effect of elicited social or interpersonal trust in rural household consumption decisions, an important behavioural factor in determining development decisions. The study uses the Berg, Dickhaut, and McCabe Investment game (BDM, 1995) to elicit individual social trust (Johnson & Mislin, 2011). Building on the literature that biofortification is cost-effective, the other objective of the paper is to assess the willingness to pay for OFSP and yellow maize among low-income communities.

The rest of the paper is organized as follows, section 2 presents the key concepts of social trust and the conceptual framework, section 3 outlines the methodology and briefly presents the incentive investment experiment used in this study. Section 4 outlines the descriptive statistics and analytical results before discussing them in section 5. The paper is concluded in section 6, which also provides policy recommendations.

**2.0 Conceptual and Theoretical Frameworks**

We draw our conceptual framework from the social capital theory (Coleman, 1988). We define social trust in line with Kwon (2019), who defines interpersonal trust as “individuals’ expectations of other members of society to act and behave in a way that is beneficial to these individuals or at least not detrimental to them”. These are subjective perceptions of how reliable or trustworthy other people can be without legal commitment, which is associated with the ability to expose oneself to risk and uncertainty (Holden & Tilahun, 2021; Kwon, 2019). Szreter and Woolcock (2004) categorize social trust into “bonding” and “bridging” social trust compared to “linking” social trust, which is trust in institutions. The authors define “bonding social trust as “trusting and cooperative relations between members of a network who see themselves as being similar in terms of their shared social identity.” This is in line with the in-group trust. On the other side, the authors define “bridging” social trust as relations of respect and mutuality between people who know that they are not alike in some socio-demographic (social identity) sense (differing by location, age, ethnic group, class, etc)”. This is in line with the out-group trust. The extent to which in-group and out-group trust correlate remains a context-specific empirical question.

For this paper, we conceptualize the impact pathways of social trust in line with Kwon (2019) and Holden and Tilahun (2021). Figure 1 shows the conceptual framework adapting to the school of thought that trust is based on individual characteristics and societal factors. From the figure, social trust is a factor of moral values that people learn from their parents and are passed on across generations. In Larzelere and Huston (1980) as presented by Kwon (2019) morally based trust is associated with optimism, honesty, cooperation, reciprocation, respect, and benevolence personal characteristics. The second theory is based on experience or societal factors. As one grows up, people encounter and experience different economic, social and environmental, and governance factors. Therefore, the intrinsic social trust shapes the way people trust those within their circles (in-group) and strangers (out-group).

**Morality Theory** or **Individual characteristics**

(Age, gender, education)

**Experience theory** or **Society factors**

(economic, social, environmental and governance factors)

Social trust

In-group trust

Out-group trust

Economic preferences (Risk)

Individual or household decision

Figure 1: Social trust and individual or household decisions

The in-group and out-group trust, thus influences the observed individual or household decisions. Related to the experience theory, people also develop economic preferences like risk, that relate to social preferences like social trust, which also influence individual or household decisions (Holden & Tilahun, 2021). In this paper, our focus is on the consumption expenditure decisions of OFSP and QPM among rural households in selected districts of Malawi. We elicit the individual social trust of the household head or spouse to assess how such in-group and out-group trust affects consumption decisions. The respondent was also asked to respond to some questions on the willingness to pay.

Scholars have used two approaches to place a value on goods and services: the revealed preference for goods with a market and the stated preference for goods that do not have an existing market (Alberini, 2019). According to Lancaster (1966), consumers would rather pay for a bundle of attributes of a good than a bundle of goods and pay an amount corresponding to the value they have placed on the good. For revealed preferences, the price for which a consumer buys a good should reveal the value the consumer places on the good. On the other hand, for stated preferences, the term willingness to pay (WTP) denotes the maximum amount a potential consumer is willing to pay in exchange for the good or service in question, considering that there is no existing market (Alberini, 2019). Several studies have used different methods to assess WTP (Chowdhury et al., 2018; De Steur et al., 2017; Hamukwala et al., 2019; Jada & van den Berg, 2024; Liao et al., 2023; Oswalt et al., 2024). Our paper uses the choice experiment for consumers to reveal how much to pay for a certain amount of OFSP and QPM based on their intrinsic value for the associated attributes.

In line with the conceptual framework, the paper applies the household utility maximization theory (Sadoulet & de Janvry, 1995). The household model describes a farm household as an institution that integrates production, consumption, and marketing decisions over time. As a farm household, they produce own food using own labour and sell the surplus produce and/or labour. The income from the sales, the farm households partly use that to buy other food and non-food products. This makes them net buyers of food since production is partly for consumption and partly for income. When all markets work well, farm households can make separate production from consumption decisions. However, if markets fail or are incomplete in most countries across the globe, household production and consumption decisions are now non-separable (Sadoulet & de Janvry, 1995). The non-separability of the production and consumption decisions implies that one can assess both consumption and production decisions among farm households to understand price decisions, risk behaviour, and on and off-farm agricultural decisions. We, therefore, assess farm household consumption decisions that are non-separable from production decisions in Malawi.

1. **Methodology** 
   1. **Sampling and Data**

The study used a multi-stage sampling technique. Primary household data was collected from three purposively selected districts in Malawi. The study used a semi-structured questionnaire programmed in Survey Solution to collect data from Dowa, Mchinji, and Kasungu districts, within the central region of Malawi. These districts were selected because they are among the highest producers of both OFSP and QPM while also being net buyers of food crops. Although QPM is not widely produced like OFSP, NGOs have been implementing projects to support the production of QPM in the selected districts. Within the districts, we randomly selected Traditional Authority (TA) areas, a localized governance structure that groups blocked villages. Furthermore, we randomly selected villages. Probability Proportional Sampling (PPS) was used to allocate the number of individuals interviewed per village. The total household sample was 421 with 37, 27, and 36 percent from Kasungu, Mchinji and Dowa districts. The data was collected in June 2024. May to July is the harvest for most crops in Malawi hence the time people should give true value to the product without thinking of constrained supply.

To elicit social trust, we used the simple Berg, Dickhaut, and McCabe, (BDM) investment game as detailed in the questionnaire shared as an annex. The game involves two participants playing as both a sender (trustor) and receiver(trustee). As a sender, each person was given a certain amount of money of MK1000 (USD0.58) and could send any amount or none to the receiver, categorized as in-group or outgroup. The sender was asked how much they would be ready to send if the other individual a) was an unknown person within their village (ingroup) and b) was an unknown person in another community within the same district(outgroup). For any amount that the sender was sending to either in-group or out-group members, the game design was to triple the amount and give it to the receiver (the trust amount). The receiver then could send any amount of the money she/he has received back to the sender (the trustworthiness amount). The game ends after the sender and the receiver have sent their chosen amounts. We rolled a six-sided die to determine the real game outcome between in-group and outgroup members. This outcome is what determined the generalized trust since it was a random outcome from either in-group or out-group. As an incentivized game, participants were paid their outcome decision amounts based on the initial endowment, sent and received amount. To assess social trust, we looked at the share of the initial endowment sent to either ingroup or outgroup members, which we define as in-group or out-group social trust, respectively. Based on the real game outcome, we calculated the share of the sent amount to get the generalized trust. This paper the trustworthiness of individuals.

To collect data on willingness to pay, we showed the respondents a picture of 10 Kgs of QPM in a bucket and a picture of 7 pieces of medium-sized OFSP placed on a selling bench. The bucket was used because it is a common tool used in the marketplaces within the country. Based on the provided context, the respondents answered the minimum and maximum bid amount in Malawi Kwacha but also provided the actual value they would be willing to pay for the associated amount. The analysis does not include those who are not willing to pay any amount to avoid statistical noise in the analysis.

**3.2 Empirical Strategy**

The study used different methods to respond to the two objectives. The first objective was to determine the effect of social trust on consumer decisions of OFSP and QPM. To achieve this objective, we hypothesize that (H1) higher social trust of household decision-makers increases the likelihood of households consuming OFSP and yellow maize, and (H2) higher social trust of household decision-makers increases the extent of households consuming OFSP and yellow maize.

The study used the Maximum Likelihood Bivariate Probit Model and two Tobit estimation models. The underlying is that two decisions to consume are correlated and the error terms for the two equations follow a bivariate normal distribution. However, the extent of consumption for each product is independent of the other. We run two Tobit models.

The model will be specified as follows:

(1)

(2)

Where and represent Consumption decisions for QPM and OFSP respectively; ST represents social trust.

To assess the associated effect of social trust on consumer Willingness to Pay for OFSP and QPM, we hypothesize that (H3) Higher social trust increases the extent of Willingness to Pay for OFSP and yellow maize among rural households. The equations are similar to those presented in equations 1 and 2 with the dependent variable being willingness to pay. We used interval regression using the lower and upper bid values.

**4.0 Results and Discussion**

4.1 Descriptive Statistics

The seven-day recall shows that an average of 25 percent of the sampled households consumed QPM while 48 percent consumed OFSP. We observed a high consumption rate in Dowa district followed by Kasungu and Mchinji. On average, households consumed 2.2Kgs of QPM and 3.0 Kgs of OFSP per week based on the full sample. Among those that consumed, the average amounts were 9Kgs for QPM and 6.2Kgs for OFSP as shown in Table 1a. When we consider the type of household as either headed by adult males or adult females, we observe that 6 percent higher consumption percent for households headed by adult males than adult females in QPM with this difference being higher in consumption of OFSP as observed in Table 1. The quantity consumed was also higher among adult male households compared to adult female households.

Table 1: Consumption of QPM and OFSP: (7-day recall -June 2024) by District

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Full sample | | | | | Those that consumed | | | |
| District | QPM grain and flour | OFSP | QPM grain and flour | Quantity OFSP | HH | QPM grain and flour | | OFSP | |
|  | Percent | Percent | Kg | Kg | No | Kg | HH No | Kg | HH No |
| 1. Kasungu | 24% | 41% | 1.6 | 3.0 | 155 | 6.8 | 37 | 7.4 | 64 |
| 2. Mchinji | 19% | 55% | 1.5 | 3.4 | 113 | 7.7 | 22 | 6.2 | 62 |
| 3. Dowa | 30% | 50% | 3.4 | 2.6 | 153 | 11.4 | 46 | 5.2 | 76 |
| Total | 25% | 48% | 2.2 | 3.0 | 421 | 9.0 | 105 | 6.2 | 202 |
|  | | | | | | | | | |
| Adult Male Headed HH | 27% | 52% | 2.5 | 3.3 | 308 | 9.2 | 84 | 6.4 | 160 |
| Adult Female Headed HH | 19% | 37% | 1.5 | 2.0 | 113 | 8.2 | 21 | 5.5 | 42 |
| Total | 25% | 48% | 2.2 | 3.0 | 421 | 9.0 | 105 | 6.2 | 202 |

Table 2 gives a summary of share of social trust as a fraction of total initial endowment Since we are using a share, our values range from 0 to 1, with 0 being complete trust and 1 being low trust. That is, the higher the share, the lower the level of social trust. From Table 2, we note that on average, people are less trusting towards outgroup members or strangers and more likely to trust ingroup members. As observed in other studies, people shared almost 50 percent of the given money while adult female households were less trusting than adult male-headed households (Holden & Tilahun, 2021).

Table 2: Generalized trust elicited from the Trust game by district

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| District | Ingroup trust (MK) | Outgroup trust (MK) | Generalised trust amount (MK) | Generalised trust share | Ingroup trust share | Outgroup trust share | HH No |
| 1. Kasungu | 525.16 | 476.13 | 492.90 | 0.50 | 0.47 | 0.52 | 155 |
| 2. Mchinji | 515.04 | 438.94 | 495.58 | 0.50 | 0.48 | 0.56 | 113 |
| 3. Dowa | 558.17 | 486.27 | 549.02 | 0.45 | 0.44 | 0.51 | 153 |
| Total | 534.44 | 469.83 | 514.01 | 0.48 | 0.47 | 0.53 | 421 |
|  | | | |  | | | |
| Adult Male Headed HH | 544.16 | 470.78 | 513.64 | 0.49 | 0.46 | 0.53 | 308 |
| Adult Female Headed HH | 507.96 | 467.26 | 515.04 | 0.48 | 0.49 | 0.53 | 113 |
| Total | 534.44 | 469.83 | 514.01 | 0.49 | 0.47 | 0.53 | 421 |

On household characteristics, the completed education level of education is the primary school for most household heads. The average age of household heads is 44 years, with 74 percent of adult male household head represented in the sample. Following the discussion by Díaz-Gómez et al. (2017), food processing is crucial for maximizing the nutritional benefits of biofortified crops, especially the vitamin A in OFSP. Our analysis includes the variables related to enhancing food processing to ensure nutritional benefits. The first variable is access to general nutritional education captured as a dummy. The second and third variables are based on the specific type of nutritional education, which are access to education on healthy diets and access to education on healthy cooking practices. These are also captured as a dummy. Overall, 67 percent of the sampled households had access to nutrition education with almost 83 percent getting specific education on healthy diets and healthy cooking practices. Among the districts, 76 percent of respondents in Dowa had received general nutrition education compared to 66 percent and 58 percent in Kasungu and Mchinji districts. There were no significant differences in access to specific nutrition education across the districts. Additionally, almost all households indicated to have access to under five clinic services where there is need.

Table 3: Household characteristics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Total** | **Kasungu** | **Mchinji** | **Dowa** | **p-value** |
| Gender HH (Female) | 109 (26%) | 42 (27%) | 26 (23%) | 41 (27%) | 0.729 |
| Gender HH (Male) | 310 (74%) | 112 (73%) | 86 (77%) | 112 (73%) | 0.729 |
| No formal education / pre-primary education | 38 (9%) | 13 (8%) | 13 (12%) | 12 (8%) | 0.623 |
| Primary school | 253 (60%) | 94 (61%) | 63 (56%) | 96 (63%) | 0.623 |
| Secondary school | 126 (30%) | 47 (31%) | 35 (31%) | 44 (29%) | 0.623 |
| Technical or vocational school | 1 (0%) | 0 (0%) | 0 (0%) | 1 (1%) | 0.623 |
| College or university | 1 (0%) | 0 (0%) | 1 (1%) | 0 (0%) | 0.623 |
| Age HH Head | 44.32 (13.00) | 42.26 (12.42) | 42.51 (12.06) | 47.73 (13.59) | <0.001 |
| Married | 338 (81%) | 130 (84%) | 89 (79%) | 119 (78%) | 0.472 |
| Single | 2 (0%) | 1 (1%) | 1 (1%) | 0 (0%) | 0.472 |
| Divorced | 43 (10%) | 13 (8%) | 14 (13%) | 16 (10%) | 0.472 |
| Widowed | 36 (9%) | 10 (6%) | 8 (7%) | 18 (12%) | 0.472 |
| Access to reproductive health services for under-five children (No) | 20 (5%) | 5 (3%) | 4 (4%) | 11 (7%) | 0.205 |
| Access to reproductive health services for under-five children (Yes) | 401 (95%) | 150 (97%) | 109 (96%) | 142 (93%) | 0.205 |
| Access to nutrition education (No) | 137 (33%) | 53 (34%) | 47 (42%) | 37 (24%) | 0.010 |
| Access to nutrition education (Yes) | 284 (67%) | 102 (66%) | 66 (58%) | 116 (76%) | 0.010 |
| Access to education on Healthy diets (No) | 66 (16%) | 23 (15%) | 14 (12%) | 29 (19%) | 0.325 |
| Access to education on Healthy diets (Yes) | 355 (84%) | 132 (85%) | 99 (88%) | 124 (81%) | 0.325 |
| Access to education Healthy cooking practices (No) | 72 (17%) | 21 (14%) | 22 (19%) | 29 (19%) | 0.333 |
| Access to education Healthy cooking practices (Yes) | 349 (83%) | 134 (86%) | 91 (81%) | 124 (81%) | 0.333 |

Figure 2 below shows the distribution of the average willingness to pay (WTP) for OFSP across the three districts. Dowa shows a distinct peak around MK800 compared to MK1,000 in Kasungu. The distribution peak in Mchinji was around MK1,200, the highest among the districts, showing that households here are generally more willing to pay for OFSP, with an extended right tail suggesting the presence of households with significantly higher WTP. The overlapping of the curves at lower values suggests common lower WTP trends across all districts. However, Mchinji distinctly leads in WTP as values increase, possibly due to differing socioeconomic factors, trust, or market perceptions. The distribution in Figure 3 shows that households in all three districts predominantly exhibit lower WTP for QPM, with Dowa showing the lowest peak, followed closely by Kasungu and Mchinji. The similarity in the peak of WTP values across the districts suggests shared perceptions of QPM value or economic conditions that shape purchasing decisions. The graph for Mchinji also shows the presence of households with higher WTP, which may reflect differences in income, preferences, or perceived benefits of yellow maize among certain groups. From Figure 4, adult female headed households showed a higher WTP in Kasungu district with no observable differences in the other districts.

A graph of a graph

Description automatically generated with medium confidence A graph of a number of data

Description automatically generated with medium confidence

*Figure 2 OFSP WTP by District Figure 3 QPM WTP by District*

A graph of a number of people with their age

Description automatically generated with medium confidence A graph of a number of houses

Description automatically generated

Figure 4: Willingness to Pay by District and Household Head

**4.2 Analytical Results**

**4.2.1 The effect of social trust on consumer decisions of OFSP and QPM**

Tables 4 and 5 present the bivariate probit and Tobit model results related to assessing the factors that influence consumption of OFSP and QPM based on seven-day recall. The focus of the study was on the impact of social trust on consumption decisions. From the bivariate Probit model, we observe that the generalized trust does not significantly influence consumption decisions for QPM or OFSP.

Table 4: Bivariate Probit Model Margins on Factors Affecting the Extent Of Consumption of QPM and OFSP (7-day recall)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **OFSP Consumption** | | | | | | **QPM Consumption** | | | | | |
|  | **Bprobit1** | **Bprobit2** | **Bprobit3** | **Bprobit4** | **Bprobit5** | **Bprobit6** | **Bprobit1** | **Bprobit2** | **Bprobit3** | **Bprobit4** | **Bprobit5** | **Bprobit6** |
| Generalized share of trust | -0.019 | -0.031 | -0.028 |  |  |  | -0.064 | -0.066 | -0.064 |  |  |  |
|  | (0.08) | (0.08) | (0.08) |  |  |  | (0.07) | (0.07) | (0.07) |  |  |  |
| Share of ingroup trust |  |  |  | -0.103 | -0.084 | -0.108 |  |  |  | -0.073 | -0.048 | -0.069 |
|  |  |  |  | (0.10) | (0.10) | (0.10) |  |  |  | (0.09) | (0.08) | (0.08) |
| Share of Outgroup trust |  |  |  | 0.031 | 0.009 | 0.009 |  |  |  | -0.016 | -0.024 | -0.024 |
|  |  |  |  | (0.11) | (0.10) | (0.10) |  |  |  | (0.09) | (0.09) | (0.09) |
| Age of Household head (years) |  | -0.000 | -0.000 |  | -0.000 | -0.000 |  | -0.001 | -0.000 |  | -0.001 | -0.001 |
|  |  | (0.00) | (0.00) |  | (0.00) | (0.00) |  | (0.00) | (0.00) |  | (0.00) | (0.00) |
| Education of Household head (level completed) |  | 0.022 | 0.034 |  | 0.023 | 0.036 |  | 0.035 | 0.043 |  | 0.035 | 0.043 |
|  |  | (0.04) | (0.04) |  | (0.04) | (0.04) |  | (0.03) | (0.03) |  | (0.03) | (0.03) |
| Household size |  | -0.009 | -0.011 |  | -0.009 | -0.011 |  | -0.006 | -0.007 |  | -0.006 | -0.007 |
|  |  | (0.01) | (0.01) |  | (0.01) | (0.01) |  | (0.01) | (0.01) |  | (0.01) | (0.01) |
| **Household type (1=Headed by Adult Male)** |  | **-0.131\*\*** | **-0.115\*\*** |  | **-0.129\*\*** | **-0.111\*\*** |  | -0.060 | -0.043 |  | -0.058 | -0.041 |
|  |  | **(0.06)** | **(0.06)** |  | **(0.06)** | **(0.06)** |  | (0.05) | (0.05) |  | (0.05) | (0.05) |
| **Access to nutrition education (1=Yes)** |  | **0.157\*\*\*** | **0.186\*\*\*\*** |  | **0.155\*\*\*** | **0.184\*\*\*** |  | **0.229\*\*\*\*** | **0.251\*\*\*\*** |  | **0.227\*\*\*\*** | **0.250\*\*\*\*** |
|  |  | **(0.05)** | **(0.06)** |  | **(0.05)** | **(0.06)** |  | **(0.05)** | **(0.05)** |  | **(0.05)** | **(0.05)** |
| Access to education on healthy diets (1=Yes) |  |  | -0.071 |  |  | -0.074 |  |  | -0.041 |  |  | -0.008 |
|  |  |  | (0.07) |  |  | (0.07) |  |  | (0.06) |  |  | (0.05) |
| **Access to education on healthy cooking practices (1=Yes)** |  |  | **0.173\*\*\*** |  |  | **0.179\*\*\*** |  |  | **0.138\*\*** |  |  | **0.142\*\*** |
|  |  |  | **(0.07)** |  |  | **(0.07)** |  |  | **(0.06)** |  |  | **(0.06)** |
| District (1=Kasungu) |  |  |  |  |  |  |  |  |  |  |  |  |
| **2. Mchinji** |  | **0.129\*\*** | **0.144\*\*** |  | **0.130\*\*** | **0.144\*\*** |  | -0.036 | -0.024 |  | -0.034 | -0.023 |
|  |  | **(0.06)** | **(0.06)** |  | **(0.06)** | **(0.06)** |  | (0.05) | (0.05) |  | (0.05) | (0.05) |
| 3.Dowa |  | 0.064 | 0.064 |  | 0.062 | 0.062 |  | 0.033 | 0.034 |  | 0.035 | 0.035 |
|  |  | (0.06) | (0.06) |  | (0.06) | (0.06) |  | (0.05) | (0.05) |  | (0.05) | (0.05) |
| N | 421 | 419 | 419 | 421 | 419 | 419 | 421 | 419 | 419 | 421 | 419 | 419 |

Standard errors in parentheses

\* p<0.1 \*\* p<0.05 \*\*\* p<0.01 \*\*\*\* p<0.001

Table 5: Tobit Model Margins on Factors Affecting Extent of Consumption of QPM and OFSP (7-day recall)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable name** | **Quantity of QPM consumed** | | | | | | **Quantity of OFSP consumed** | | | | | |
|  | **Tobit 1** | **Tobit 2** | **Tobit 3** | **Tobit 4** | **Tobit 5** | **Tobit 6** | **Tobit 1** | **Tobit 2** | **Tobit 3** | **Tobit 4** | **Tobit 5** | **Tobit 6** |
| Generalized share of trust | -1.721 | -1.570 | -1.517 |  |  |  | **-1.687\*** | **-1.518\*** | **-1.446\*** |  |  |  |
|  | (1.27) | (1.25) | (1.24) |  |  |  | **(0.86)** | **(0.84)** | **(0.84)** |  |  |  |
| **Share of ingroup trust** |  |  |  | **-3.208\*** | -2.974 | **-3.070\*** |  |  |  | -1.054 | -0.674 | -0.824 |
|  |  |  |  | **(1.92)** | (1.88) | **(1.85)** |  |  |  | (0.88) | (0.88) | (0.89) |
| Share of Outgroup trust |  |  |  | 1.792 | 1.808 | 1.912 |  |  |  | -1.557 | -1.453 | -1.299 |
|  |  |  |  | (1.78) | (1.78) | (1.79) |  |  |  | (1.03) | (1.02) | (1.04) |
| Age of Household head (years) |  | 0.019 | 0.019 |  | 0.022 | 0.022 |  | 0.006 | 0.007 |  | 0.006 | 0.007 |
|  |  | (0.02) | (0.02) |  | (0.02) | (0.02) |  | (0.02) | (0.02) |  | (0.02) | (0.02) |
| Education of Household head (years) |  | 0.160 | 0.249 |  | 0.136 | 0.239 |  | 0.206 | 0.336 |  | 0.201 | 0.336 |
|  |  | (0.42) | (0.44) |  | (0.42) | (0.44) |  | (0.56) | (0.56) |  | (0.55) | (0.55) |
| Household size |  | 0.114 | 0.112 |  | 0.114 | 0.110 |  | 0.157 | 0.150 |  | 0.161 | 0.153 |
|  |  | (0.14) | (0.14) |  | (0.14) | (0.14) |  | (0.16) | (0.16) |  | (0.16) | (0.16) |
| Household type (1=Headed by Adult Female) |  | -0.718 | -0.692 |  | -0.638 | -0.593 |  | **-1.069\*\*** | **-0.976\*\*** |  | **-1.044\*\*** | **-0.946\*\*** |
|  |  | (0.55) | (0.59) |  | (0.54) | (0.56) |  | **(0.47)** | **(0.46)** |  | **(0.47)** | **(0.46)** |
| **Access to nutrition education (1=Yes)** |  | **1.889\*\*\*\*** | **1.853\*\*\*** |  | **1.812\*\*\*\*** | **1.805\*\*\*** |  | **1.626\*\*\*** | **1.714\*\*\*** |  | **1.577\*\*\*** | **1.665\*\*** |
|  |  | **(0.53)** | **(0.56)** |  | **(0.51)** | **(0.57)** |  | **(0.55)** | **(0.66)** |  | **(0.54)** | **(0.65)** |
| Access to education on healthy diets (1=Yes) |  |  | -0.963 |  |  | -1.044 |  |  | -1.195 |  |  | -1.224 |
|  |  |  | (1.22) |  |  | (1.21) |  |  | (0.76) |  |  | (0.75) |
| **Access to education on healthy cooking practices (1=Yes)** |  |  | 0.777 |  |  | 0.955 |  |  | **1.434\*\*** |  |  | **1.461\*\*** |
|  |  |  | (1.11) |  |  | (1.07) |  |  | **(0.67)** |  |  | **(0.68)** |
| District (1=Kasungu) |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Mchinji |  | 0.038 | 0.116 |  | -0.004 | 0.086 |  | 0.529 | 0.667 |  | 0.585 | 0.720 |
|  |  | (0.53) | (0.53) |  | (0.52) | (0.52) |  | (0.77) | (0.76) |  | (0.77) | (0.76) |
| 3.Dowa |  | 1.513\*\* | 1.522\*\* |  | 1.505\*\* | 1.509\*\* |  | -0.762 | -0.746 |  | -0.707 | -0.700 |
|  |  | (0.75) | (0.75) |  | (0.74) | (0.74) |  | (0.74) | (0.74) |  | (0.74) | (0.74) |
| N | 421 | 411 | 411 | 421 | 411 | 411 | 421 | 411 | 411 | 421 | 411 | 411 |

Standard errors in parentheses

\* p<0.1 \*\* p<0.05 \*\*\* p<0.01 \*\*\*\* p<0.001

Additionally, the share of social trust for ingroup and outgroup members does not significantly affect the decision to consume. We can only observe the differences in signs where outgroup social trust is positive while ingroup trust is negative for OFSP. This could be associated with the point that people within the same group are less likely to influence change from within based on trust. However, trusting people outside the social circle can result in experiencing new things like the consumption of OFSP and QPM. These results could be related to the significance of nutrition education variables. For instance, access to nutrition education can increase the probability of consuming QPM or OSFP by almost 15 percent and 25 percent, respectively. Education on healthy cooking practices is also significant and likely to increase consumption by 17 percent and 14 percent, respectively. Across the districts, the probability of consumption of OFSP is higher in Mchinji compared to the other districts. There were no observable differences across the districts on QPM. Interestingly, households headed by a male are, on average 12 percent less likely to consume OFSP compared to female headed households. This is an interesting dynamic that could be related to cost effectiveness and perceptions towards OFSP. The sex of household head was not significant in the QPM model, but the sign is negative, similar to the OFSP model.

On the extent of consumption, the Tobit models in Table 5 show that the generalised trust is negatively associated with the extent of consumption, significant at 10 percent. A unit increase in generalised trust reduces the consumption of QPM by 1.5 units on average. The effect was not significant for the OFSP model. It was the share of in-group trust that was significant at 10 percent and negative in the OFSP model. The results imply that one unit increase in trust within a social group (in-group), and the probability of taking up QPM can reduce by 3 units. Contrary to the bivariate probit model, out-group social trust is positive but not significant for the extent of consuming QPM. Like the bivariate model, the sex of household head access to nutrition education, and healthy cooking practices significantly influence the extent of consumption among rural households.

**4.2 Assessing Social Trust and Consumer Willingness to Pay for OFSP and QPM**

Results in Table 6 show the significant role of trust in information sources, the importance of nutrition education in increasing, and the impact of market location for biofortified foods on consumer willingness to pay for OFSP and QPM. The interval regression table reveals that information from extension workers and researchers significantly decreases consumer willingness to pay for OFSP and QPM. Specifically, consumers who receive information from extension workers and researchers are willing to pay substantially less, by at least MK550 in OFSP and MK2500 for QPM. Conversely, having nutrition education positively influences willingness to pay by MK297.64, highlighting the importance of educating consumers about the nutritional benefits of OFSP. The effect is not the same with QPM.

Table 6: Interval regression results for OFSP and QPM

|  |  |  |
| --- | --- | --- |
| **Variables** | **Coef. - OFSP** | **Coef. - QPM** |
| Share of Outgroup trust | -93.405 | -0.581 |
| Access to education on healthy cooking (1=Yes) | -228.211\* | -1182.33 |
| Access to extension services | -552.529\*\*\* | -2828.67\*\*\* |
| Age of household head | 6.136 | -1.494 |
| Education of Household head (years) | -28.01 | 1045.66 |
| Household size | -16.821 | 50.17 |
| Access to education on healthy diets (1=Yes) | 297.642\*\* | 0.602 |
| Information from researchers | -653.847\*\* | -2536.23\*\* |
| Radio Information |  | -2087.56\*\*\* |
| Relatives Information |  | -2291.36\*\*\* |
| Leadership position(1=Yes) |  | -2521.65\*\*\* |
| District |  | 147.683\*\*\* |
| Yellow maize gift |  | 2238.346\*\*\* |
| Constant |  | 10129.81\*\*\* |

Standard errors in parentheses

\* p<0.1 \*\* p<0.05 \*\*\* p<0.01 \*\*\*\* p<0.001

From the table, receiving yellow maize as a gift positively influences the willingness to pay by MK2238.35, highlighting the effectiveness of direct exposure to the product by other people, which can influence consumption. Additionally, getting nutrition education on cooking healthy diets marginally reduces willingness to pay, possibly due to perceived difficulties or negative experiences associated with preparing OFSP. The demographic factors were not significant. The model has revealed the critical role of trust and information sources in shaping consumer willingness to pay for biofortified OFSP and QPM, especially on the need to promote and expose consumers to biofortified food to enhance acceptance and market potential. These findings are similar to those of other studies, which found that information sources and direct exposure significantly enhance consumer willingness to pay for biofortified foods (Acheampong et al., 2024; De Groote et al., 2011; Oparinde et al., 2016; Wongnaa et al., 2024). Studies in Mozambique and South Africa also highlighted regional differences in consumer preferences and market dynamics, leading to varying levels of willingness to pay for biofortified crops like maize (Pillay et al., 2011; Stevens & Winter-Nelson, 2008). Additionally, the non-significant effects of household size, age, and education level observed are consistent with findings from other research, which suggest that demographic factors often have limited influence compared to more direct factors like trust in information and nutritional knowledge (Chowdhury et al., 2011; De Steur et al., 2017). Lastly, on cooking issues, results from other studies indicate consumers may be hesitant to adopt biofortified foods due to perceived difficulties in preparation or unfamiliarity with the product (Stevens & Winter-Nelson, 2008).

**Conclusion and Recommendations**

As the world strives to achieve the Sustainable Development Goals (SDGs) by 2030, there are growing concerns about rising global hunger. Considering the need to reverse the malnutrition challenges and enhance human capital development, countries continue to invest in programs that support scaling up nutrition-sensitive agriculture while aligning actions throughout agrifood systems to ensure that diverse, nutritious foods are available to all people, including vulnerable populations, through the value chain. The objective is to promote diversified food production and consumption, particularly among poor households living in remote areas with little access to markets and enhance the food supply chain from farm to table. One such intervention is the biofortification of agricultural-based food products that rural households produce or procure in local markets for household consumption. The orange-fresh sweet potato (OFSP) and quality protein maize (QPM, often referred to as yellow maize) are two of the biofortified farm-based crops being promoted across Africa, including in Malawi.

The first objective was to determine the effect of social trust on consumer decisions of OFSP and QPM. To achieve this objective, we hypothesize that (H1) higher social trust of household decision-makers increases the likelihood of households consuming OFSP and yellow maize, and (H2) higher social trust of household decision-makers increases the extent of households consuming OFSP and yellow maize. The second objective was to assess the associated effect of social trust on consumer Willingness to Pay for OFSP and QPM, we hypothesize that (H3) Higher social trust increases the extent of Willingness to Pay for OFSP and yellow maize among rural households. Using the Berg, Dickhaut, and McCabe, (BDM) investment game and choice experiment to elicit social trust and willingness to pay for OFSP and QPM, respectively.

Using data from three selected districts in Malawi and econometrics tools like the bivariate probit, Tobit and interval regression models, we observe mixed effects of different categories of social trust. People who are more likely to trust other people within their circle (in-group) are less likely to uptake consumption of OFSP and QPM. On the contrary, having trust in strangers (out-group) can positively influence the decision to consume OFSP and QPM. However, the effect is likely negative on the extent of consumption and willingness to pay, signifying the importance of out-group trust in breaking the first hurdle of consumption decision. Thus, we partially reject all the hypotheses.

Additionally, access to nutrition education, particularly education on healthy cooking practices significantly influences consumption decisions, the extent of consumption and willingness to pay for OFSP and QPM. Receiving the QPM as a gift and the education level of the household were some of the factors that increased consumers' willingness to pay. Therefore, we recommend enhanced government and public interventions in disseminating information on the benefits of and best practices in processing biofortified foods to influence change. This could be the outside effect -trust in information sources by outsiders - that is needed among rural households.

**Contribution:**

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