



## Risk-related perceptions for rural household decisions to grow Vitamin A bio-fortified sweetpotatoes in Uganda

S. NDAULA<sup>1\*</sup>, B. F. MATSIKO<sup>1</sup> and H. SSEGUYA<sup>1,2</sup>

<sup>1</sup>Department of Extension and Innovation Studies, College of Agricultural and Environmental Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda

<sup>2</sup>International Institute of Tropical Agriculture, Regional Hub for East Africa, Dar-es-Salaam, Tanzania

\*Corresponding author: ndaulasulah@gmail.com

### ABSTRACT

The vitamin A bio-fortified sweetpotato, commonly known as the Orange-Fleshed Sweetpotato (OFSP) is an important food for fighting vitamin A deficiency in Uganda, particularly in rural households, although its use remains low. This study investigated the role of risk perceptions in rural households' decisions to grow OFSP. Data were derived from a cross-sectional questionnaire survey of 341 male and female household heads randomly selected from two rural districts of Uganda. Scaling and factor analyses verified data reliability and construct validity, after which multiple regression analyses tested hypothesized relationships. Gender differences were tested. Results found that risk perceptions encouraged rural household heads to grow the OFSP ( $F=3.937$ ,  $p<.001$ , Adjusted  $R^2= 0.102$ ). Further, perceived risks were motivators and perceived effectiveness of control might be the feasible path to sustained cultivation. Although male and female farmers differed, a stronger estimation was obtained when the entire sample was tested. In sum, information dissemination programmes targeting household heads using media campaigns should disseminate messages to at-risk households regarding the feasibility of OFSP cultivation and consumption to reduce vitamin A deficiency.

Keywords: Gender, Orange-Fleshed Sweetpotato, risk perceptions, rural households, Uganda

### RÉSUMÉ

La patate douce bio-enrichie à la vitamine A, communément appelée patate douce à chair orange (OFSP), est un aliment important pour lutter contre la carence en vitamine A en Ouganda, en particulier dans les ménages ruraux, bien que son utilisation reste faible. Cette étude a examiné le rôle des perceptions de risque dans les décisions des ménages ruraux de cultiver l'OFSP. Les données ont été tirées d'une enquête transversale auprès de 341 chefs de ménage masculins et féminins sélectionnés au hasard dans deux districts ruraux de l'Ouganda. Les analyses d'échelle et des facteurs ont vérifié la fiabilité des données et la validité de la construction, après quoi des analyses de régression multiples ont mis à l'essai des relations hypothétiques. Les différences entre les sexes ont été testées. Les résultats ont révélé que les perceptions du risque encourageaient les chefs de ménage rural à cultiver l'OFSP ( $F=3,937$ ,  $p<.001$ ,  $R^2$  ajusté= 0,102). De plus, les risques perçus étaient des facteurs de motivation et l'efficacité perçue du contrôle pourrait être la voie possible vers une culture durable. Bien que les agriculteurs hommes et femmes différaient, une estimation plus forte a été obtenue lorsque l'échantillon entier a été testé. En résumé, les programmes de diffusion de l'information ciblant les chefs de ménage au moyen de

campagnes médiatiques devraient diffuser des messages aux ménages à risque concernant la faisabilité de la culture et de la consommation de vitamine A par l'OFSP pour réduire la carence en vitamine A.

Mots-clés : Genre, Patate douce à chair orange, perceptions de risque, ménages ruraux, Ouganda

## INTRODUCTION

Vitamin A deficiency (VAD) is one of the four major types of hidden hunger in developing countries. The other three major types of deficiencies are iodine, iron, and zinc (Asare-marfo *et al.*, 2013). The prevalence of VAD in sub-Saharan Africa is the highest in the world, at 48%, which has been the case for three decades, and is more acute in children and women than in men (Stevens *et al.*, 2015). In Uganda, VAD incidence increased from 20% to 38% in children under five years old and from 19% to 36% among women of reproductive age between 2006 and 2011 (Wirth *et al.*, 2017). More troublesome, some regions of Uganda have sustained high prevalence rates above 50% (Uganda Bureau of Statistics, 2011). The areas, most vulnerable to VAD are rural areas that are difficult to access and experience cyclic poverty (World Bank, 2016). The main cause of VAD is habitual dependence on low-nutrient staple foods, such as cassava and white-fleshed sweetpotato, coupled with seasonal access to micronutrient-rich foods, such as fruits and vegetables (Asare-marfo *et al.*, 2013).

Vitamin A is a vital nutrient for maternal health and child survival, and its deficiency leads to acquired blindness and compromised body immunity among affected groups (Klemm *et al.*, 2016). Children who survive with VAD tend to experience irreversible mental retardation, which limits their potential for adult productivity (UNICEF, 2007). In affected women, VAD causes antenatal and postnatal problems, particularly miscarriage, underweight newborns, and relatively long recovery periods after child birth (UNDP, 2012). In general, VAD undermines children's likelihood of survival and their future potential, which threatens societies' productivity,

economic growth, and development (World Bank, 2011; 2016).

Uganda has tried to combat VAD with numerous interventions for children, of which biannual dietary supplementation of commercial therapeutic vitamin A products has been key. This strategy requires well-networked healthcare facilities, road connectivity, and application every six months, which is expensive and logistically unsustainable (UNICEF, 2007). A second strategy of fortifying foods with vitamin A is equally untenable because fortified foods mostly are available in urban areas and they are expensive, making them inaccessible to rural households (Tanumihardjo *et al.*, 2016). Furthermore, rural households operate in a non-market food system, and most of a family's food is grown in household fields (Graeub *et al.*, 2016).

The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) of the United Nations in 2016, endorsed bio-fortification—a strategy that enriches the micronutrient concentrations of staple crops via conventional or transgenic breeding techniques—as one of the most strategic ways to fight micronutrient deficiencies in developing countries (Garcia-Casal *et al.*, 2017). The orange-fleshed sweetpotato (OFSP) is one of the vitamin A bio-fortified staples, which is enhanced with  $\beta$ -carotene, a precursor that supplies vitamin A (Low *et al.*, 2017). The other staples enriched with  $\beta$ -carotene are yellow cassava, orange maize, and golden-rice varieties. Several studies suggest that these bio-fortified varieties could potentially alter the prevalence of vitamin A deficiency, if accepted by VAD affected communities (Sharma *et al.*, 2016; Low *et al.*, 2017).

Unlike the other approaches, which might have life-threatening outcomes if excessive vitamin A were consumed by ingesting multiple fortified food sources (Tanumihardjo *et al.*, 2016),  $\beta$ -carotene (a precursor to vitamin A) poses no such danger. However, consumption of bio-fortified staples is limited because it is not clear whether farmers will accept and grow the new crop varieties. Asare-Marfo *et al.* (2013) proposed that, to feasibly increase the adoption of bio-fortified varieties on a large scale, promoters should deliver bio-fortified crops only to those communities already using a local variety of that crop as a main staple, with the goal of progressively replacing it with the bio-fortified version.

In Uganda, the white-fleshed sweetpotato (WFSP) has been targeted for replacement by the bio-fortified OFSP (Low *et al.*, 2017). The WFSP is popular among rural households in Uganda because of its short growing season and gradual harvesting over a long harvesting period (Mwanga and Ssemakula, 2011). Ugandan households serve WFSP as a main course, side dish, or as 'morning bread' with a hot beverage, and WFSP storage roots are sundried to preserve them for later use. The crop is vegetatively propagated, with vines obtained via social exchange and from harvests (Yanggen and Nagujja, 2006). Many OFSP varieties and delivery efforts have been implemented in Uganda since the late 1990s. A wide and diverse group of stakeholders have been involved in these efforts to ensure that the OFSP varieties are accepted by the people (Low *et al.*, 2017).

Several studies have confirmed the safety of the new varieties for human consumption and their efficacy for combating VAD (e.g., de Brauw *et al.*, 2015), and acceptance studies have found that consumers feel as or more positive about the cultivation and dietary characteristics of the OFSP varieties compared to the WFSP varieties (e.g., Chowdhury *et al.*, 2009; Saltzman *et*

*al.*, 2017). However, most nutritional studies on food acceptance in developing countries, including Uganda, concern willingness to pay and the enrolment of female respondents (e.g., Chowdhury *et al.*, 2009; Okello *et al.*, 2014; Mogendi *et al.*, 2016), which is not entirely useful to assessing the bio-fortification strategy. As stated above, rural households grow their food in household gardens, and gender differences in decision-making are likely to influence the types of food grown in those plots.

Some previous studies examined behavioural intentions because OFSP adoption has been low (e.g. Sun *et al.*, 2006; Talsma *et al.*, 2013). Many useful insights might be gained by focusing on the decisions of the main household decision-makers regarding food intervention, particularly when the problem is a hidden health challenge, such as VAD. Therefore, this study assessed the perceptions of the female and the male decision-makers in a sample of rural households regarding VAD as a health risk and the effectiveness of OFSP to counteract that risk. The goal was to determine whether perceptions of risk were vital in rural households' decisions to cultivate OFSP varieties as a food-based solution that counters the micronutrient deficiency.

**Theoretical/Conceptual framework.** The Health Belief Model (HBM) and Stages of Change (SoC) model are psychosocial explanations of health-related behavioural change. The HBM explains behaviour as an outcome of individual perceptions of exposure to health risks combined with the known available strategies for mitigating that health risk (Janz and Becker, 1984). The HBM assumes that there are meaningful contextual factors, such as educational attainment and exposure to information, in the background that might encourage or discourage individuals from responding to their perceptions of risk (Ajzen, 1991). The SoC model explains behavioural change as a five-stage process:

pre-contemplation, contemplation, preparation, action, and maintenance (Prochaska, 2008). DeVet *et al.* (2007) present the SoC stages as pseudo stages that characterize the vital aspects of a continuous behavioural change outcome.

This study combined aspects of the HBM and SoC premised on the hypothesis that households' farming activities are largely determined by decisions made by household heads through weighing perceived net benefits of the outcomes against the perceived appropriateness of the activities undertaken to achieve those outcomes. The HBM was employed to assess the potential of OFSP to help households to cope with the perceived health risks of VAD. In particular, it borrowed the notion of perceived risk as measured by the perception of susceptibility and severity and perceived effectiveness of control, which relates to perceived costs/barriers and benefits (Morris *et al.*, 2012).

The SoC was used to determine the measurement of the dependent variable as a three-value

continuous variable. The SoC's first and second stages (pre-contemplation and contemplation) were combined as the 'under consideration' stage, the third and fourth stages (preparation and action) were combined into a 'trial action' stage that ideally leads to the third stage ('maintenance') (DeVet *et al.*, 2007). By combining the conceptual models, the HBM deals with household-level factors, such as educational attainment, that might constrain decision-makers' intentions and actions (Janz and Becker, 1984), and the SoC addresses a relatively broad context of behavioural decisions. Thus, based on these models, this study tested the six hypotheses (H1 through H6) illustrated in Fig. 1, also detailed as: H1: household dynamics positively relates to stages of acceptance of OFSP; H2: household dynamics relate to perceived risk; H3: household dynamics relate to perceived effectiveness of control; H4: perceived risk positively relates to perceived effectiveness of control; H5: perceived risk positively relates to stages of acceptance of OFSP; H6: perceived effectiveness of control relates to stage of acceptance of OFSP.

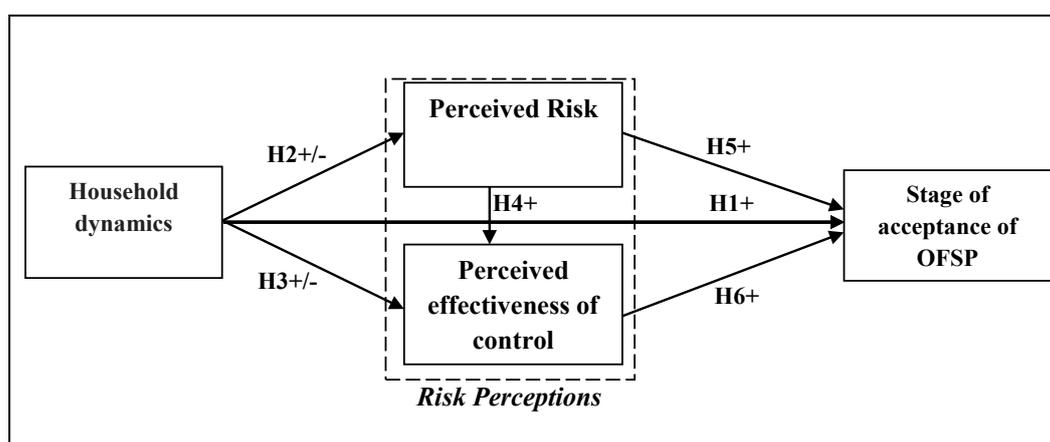


Fig. 1. Schematic illustration of the conceptual framework and the six hypotheses

## METHODOLOGY

**Study site.** The study was conducted in the HarvestPlus (H+) regions of operation in Uganda, an initiative of the Consultative Group on International Agricultural Research's program on agriculture for nutrition and health led by the International Food Policy Research Institute. Between 2012 and 2016, OFSP vines were distributed to 409,711 households under the Developing and Delivering Biofortified Crops (DDBC) project. The DDBC involved large-scale delivery of OFSP seeds, nutritional information, and marketing advice (Menon, 2017). The DDBC's objectives were to encourage widespread use of bio-fortified crops, evaluate the feasibility of various adoption methods, and identify the major constraints to sustained implementation of the bio-fortified crops. By 2013, four regions (13 districts) had been covered through partnerships with nongovernmental organizations (NGOs) in

the regions. The strategy used to achieve assimilation of best practices as part of continuous learning and project improvement efforts included centralized reviews, uniform targets, and sharing of experiences.

**Sampling and the sample.** To purposively select two regions (the central region, which was at the low end of the VAD incidence continuum, and the eastern region, which was at the high end of that continuum), the analysis used data on national VAD incidence (Uganda Bureau of Statistics, 2011). The goal was to sample households enrolled in the first growing seasons (March to July) and the second season (August to December) of 2013. Of the two eligible project districts in each of the regions, Kyotera (central) and Buyende (eastern) were randomly selected, from which Kirumba and Bugaya sub-counties were randomly selected, respectively (Fig. 2)

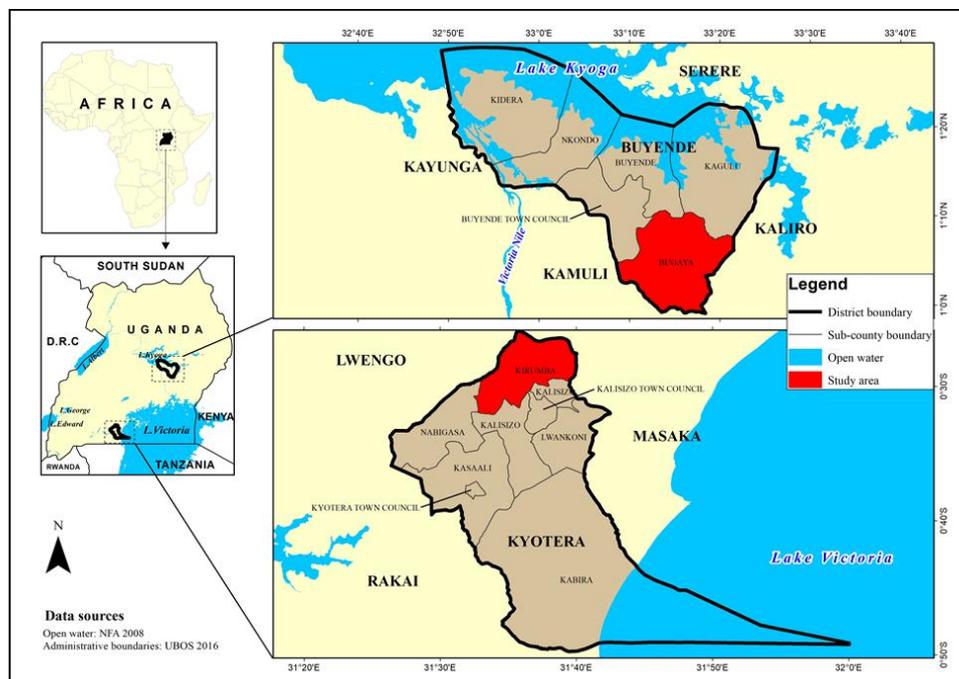


Figure 2. Study site

During the first growing season, particularly in the month of April and May of 2017, 341 respondents (55% female and 45% male) from a sample of 400 smallholder farmers, selected using multi-stage random sampling from the two districts, participated in a cross-sectional survey, yielding an 85% response rate. To ensure access to comparable data, the sample was obtained from the communities targeted by the DDBC project over three consecutive years and each district was given a quota of 100 households to interview. The participants were the two main decision-makers (female and male) of each of the households in the sample that were obtained from the registry of the farmers' groups through which households accessed OFSP packages. Table 1 describes the sampling process.

**Data collection and variables.** A structured three-part questionnaire was used to collect the data. The first part concerned the respondents' assessments of two perceptions of risk: perceived risk and perceived effectiveness of control. In the context of the present study, the perception of effectiveness of control were measured with perceived benefits (28 items) whereas perceived susceptibility to risk (six items) and severity

(30 items), were used as combined measures of perceived risk. These items were adapted from previous studies using HBM (Weissfeld *et al.*, 1990; Soleymanian *et al.*, 2014) and previous studies on OFSP diffusion (e.g. Yanggen and Nagujja, 2006). The respondents were asked to respond to each item on a seven-point scale, of ascending level of importance.

The second part concerned the dependent variable, which was a three-value continuous variable that condensed the SoC's first and second stages (pre-contemplation and contemplation) as 'under consideration', the third and fourth stages (preparation and action) as 'trial action', and used the fifth stage of 'maintenance'. Each of the five stages was represented in the questionnaire by an item adapted from Prochaska and DiClemente (1982). The respondents chose the option that best described the stage they were in regarding OFSP agriculture. They also provided information on the portion of their garden's total sweetpotato mounds under OFSP cultivation to reduce self-reporting errors through crosschecking for consistency. Part three asked questions about household dynamics, that is education attainment of decision-makers, status of sweetpotato in households diets, wages

**Table 1. Sampling frame**

Sampling characteristic	District		Gender representation				Number of eligible households/individuals	
	Kyotera	Buyende	Kyotera (n= 593)		Buyende (n= 325)		Kyotera	Buyende
			Female	Male	Female	Male		
Breakdown by district <sup>a</sup>								
Population by cluster	16 Contact groups	10 Contact groups	397	196	186	134	100 Households	100 Households
Number of sampled individuals	16	10	67	33	57	43	200	200
Sampling method	Full coverage	Proportional random sampling by gender				Two household decision-makers		

<sup>a</sup>Kyotera was low VAD and Buyende was high VAD on the VAD continuum.

in USD and knowledge of vitamin A deficiency, to obtain data on independent variables relevant to the study (Widyanti *et al.*, 2009).

The questionnaire was piloted (n = 16 households) in Nsambya, a remote village in Rakai, to assess the reliability and validity of the instrument. Nsambya was part of the DDBC areas enrolled in 2012, but it was distant from study area to avoid contaminating the main sample. Items in composite variables with Cronbach’s alphas greater than 0.70 were retained in the finalized questionnaire, which was administered in the respondents’ native language (s) using trained interviewers, which was done because the sample members lived in areas with a known prevalence of high illiteracy.

**Ethical considerations.** Before conducting the study, written endorsements for access to the study sites were obtained from relevant NGOs (H+ at the national level, Community Enterprises Development Organization in Kyotera, and Volunteer Efforts for Development Concerns in Buyende). All of the respondents were informed of the study’s purpose, his or her rights, and assured that the information they shared would be confidential. Every respondent signed a consent letter before the interview. All information that could identify the respondents

was destroyed.

**ANALYSIS**

The analysis tested the six hypotheses through four major steps. First, Cronbach’s alpha coefficients were computed to assess the internal consistency and reliability of the composite items: perceived susceptibility to risk (six items), severity (30 items), and effectiveness of control (28 items). The response options were on seven-point scales. A coefficient between 0.80 and 0.90 is the most recommended (Tavakol and Dennick, 2011). Table 2 presents the results of these tests, indicating that all of the variables passed the reliability test ( $\alpha > .80$ ).

Second, principal component analysis was used to reduce the number of items and the variables measuring household dynamics into a parsimonious dataset. Particularly for household dynamics, before the principal components analysis was done, its indicators (education attainment, status of sweetpotato in diets of households, wages in USD and VAD experience) were normalized to bring them within a comparable range using the formula below;

$$a_{ji}^* = (a_{ji} - x_i) / S_i \dots\dots\dots (1)$$

**Table 2. Factor analysis results using principal component analysis: varimax with Kaiser normalization**

Factors <sup>a</sup>	Number of items	Mean (SD)	Cronbach’s alpha	Bartlett’s test (KMO)	Eigenvalue	% Variance explained
Household dynamics	5			116** (.507)	1.48	29.7
Perceived effectiveness of control	28	87.4 (15.5)	0.846	2684** (.797)	5.80	20.7
Perceived susceptibility to risk	6	22.3 (7.1)	0.830	1160** (.729)	3.37	56.1
Perceived severity	30	140.5 (27.0)	0.931	9964** (.852)	10.97	17.9

<sup>a</sup>All variables employed seven-point scales where 1 = extremely unlikely to 7 = extremely likely  
 \*\* = p< .01

where  $a_j^*$  is the normalised score of the  $j$ th variable in the  $i$ th household,  $a_j$  is the indicator score being normalised and  $\bar{a}_j$  is the mean and  $s_j$  standard deviation of the indicator score. According to Hair et al. (1998), the Kaiser–Meyer–Olkin (KMO) test of sampling adequacy and Bartlett’s test of sphericity are the two important indicators of extraction principal components as measures of a construct. Table 2 presents the KMO statistics of the extracted constructs as greater than the 0.5 threshold (Hair et al., 1998). Bartlett’s test of sphericity significance values were less than the 0.05 standard on all of the variables (Field, 2009). The first extracted component of each factor was further considered by percent of variance explained and by Eigenvalues (Table 2). The first component is always the linear index of all of the items that capture the most information common to them in that construct (Deressa et al., 2008).

Third, descriptive statistics, bivariate correlations, and preliminary independent sample t-tests were computed to describe the variables, appraise conceptual relationships, and assess the mean distributional differences in variables by gender.

Fourth, multiple regression analyses was performed using the statistical program STATA to test the hypothesized relationships (Baron and Kenny, 1986). The model was specified as below:

$$Y = \beta_0 + \beta_1 (X_1) + \beta_2(X_2)..... + \beta_n(X_n) + E$$

..... (2)

Where:

Y = dependent variables (stage of acceptance of OFSP, perceived effectiveness of control and perceived risk)

$\beta_0$  = intercept

( $\beta_1$  .....  $\beta_n$ ) = parameters to be estimated

( $X_1$  .....  $X_n$ ) = vectors of the explanatory variables (household dynamics, perceived effectiveness of control and perceived risk)

E = The error term

The gender differences in OFSP acceptance were analysed as a three-step process in which the overall sample was tested followed by separate analyses of the females and the males.

## RESULTS

Table 3 presents the proportional distributions of the measures of household dynamics, demographic characteristics, and the dependent variable. Table 4 shows the bivariate correlations of the dependent variable, the key independent variables, and household dynamics, and Table 5 presents preliminary analytical results on gender differences in the dependent variable, the key independent variables, and household dynamics (independent samples t-tests).

Table 6 shows the results of the regression analyses of the hypothesized relationships shown above (Fig. 1). The relationships were tested for statistical significance in the overall sample and separately for the male and the female household decision-makers using three regressions models. All of the models were statistically significant at the 99% level of confidence, except for the males’ Model 1 ( $p < .05$ ). The variance inflation factors of all of the independent variables in all of the regression models indicated little multicollinearity among the constructs. The regression analyses followed through four steps, to adequately test the hypotheses:

First, model 1 was used to test H1 (household dynamics positively relate to stage of acceptance of OFSP). As expected, H1 was supported in the overall sample and for females (positive and statistically significant ( $p < .001$ )). The relationship was positive, but it was not statistically significant among the males, indicating that household dynamics did not matter in the acceptance of OFSPs among male household heads.

Second, model 3 estimated the relationship that tested H2: Household dynamics relates to perceived risk. The effects of household dynamics

**Table 3. Numbers of cases and proportional distributions of the dependent variable, gender, demographic characteristics, VAD experience, and household sweet potato characteristics**

Variable	Number of cases (%)		Variable	Number of cases (%)	
<i>Dependent variable (stage of acceptance of OFSP)</i>			<i>Vitamin A Deficiency Experience</i>		
Under consideration	40	(12)	Household		
Trial decision	63	(19)	No	227	(67)
Maintenance	238	(70)	Yes	114	(33)
Gender			Community		
Female	187	(55)	No	191	(56)
Male	154	(45)	Yes	150	(44)
<i>Educational attainment</i>			<i>Dietary priority of sweet potatoes</i>		
None	24	(7)	First	266	(78)
Primary	226	(66)	Second	23	(7)
Secondary	69	(21)	Third	52	(15)
Post-secondary	21	(6)	or higher		
<i>Average monthly income (USD)</i>			<i>Percentage of OFSP sweet potato cultivation</i>		
<1	51	(15)	Zero	93	(27)
1–3.9	114	(33)	0.1–5.0	68	(20)
4–7.9	81	(24)	5.1–10.0	22	(7)
8–11.9	31	(9)	10.1–20.0	38	(11)
12–30	53	(15)	20.1–40.0	55	(16)
>30	11	(3)	40.1–60.0	35	(10)
			60.1–100	30	(8)

**Table 4. Correlation matrix showing co-efficiencies for OFSP acceptance, socio demographic and risk perception**

Variable	1	2	3	4	5	6
1. Stage of acceptance of OFSP						
2. Household dynamics	.237**					
3. Perceived effectiveness of control	.169**	-.016				
4. Perceived Risk	-.167**	-.233**	.224**			
5. Perceived Susceptibility to Risk	-.087	-.239**	.218**	.750**		
6. Perceived Severity	-.166**	-.113*	.127*	.750**	.124*	

\* =  $p < .05$ , \*\* =  $p < .01$ , two-tailed tests of significance

on perceived risk were weak but statistically significant (overall ( $\beta = -.214$ ,  $p < 0.001$ ), females ( $\beta = -.224$ ,  $p < 0.01$ ), and males ( $\beta = -.216$ ,  $p < 0.01$ )), supporting Hypothesis 2 regarding significance, and the direction of the relation. No major gender differences were found in this relationship.

Third, model 2 estimated the relationships that tested H3 (household dynamics relates to perceptions of effectiveness of control) and H4 (perceived risk positively relates to perceptions of effectiveness of control). The effects of household dynamics on perceived effectiveness control were different by gender. Although none of the estimates were statistically significant, it was negative for the females and positive for the males and for the sample as a whole. Therefore, H3 was not supported, suggesting that these perceptions were independent of household dynamics. However, H4 was supported because the effects of perceived risk on perceptions of effectiveness of control were positive and statistically significant overall, for females, and for males ( $\beta = .529$ ,  $p < 0.001$ ,  $\beta = .417$ ,  $p < 0.05$ , and  $\beta = .688$ ,  $p < 0.001$ , respectively). The effect was stronger among the males than among their female counterparts.

Last, model 1 was used to test H5 (perceived risk positively relates to stage of acceptance of OFSP), and H6 (perceived effectiveness of control positively relates to stage of acceptance of OFSP). The effect of perceived risk on stage of acceptance of OFSP was significant but negative, and, therefore, H5 was not supported. However, H6 was supported overall ( $p < .001$ ) and separately for males ( $p < .01$ ) and females ( $p < .05$ ). The gender difference was significant in the overall estimation. All the two hypotheses were supported in the female sample and the entire sample, but only perceived effectiveness of control was statistically significant for the males. Perceived risk did not matter to the males decision-making regarding acceptance of OFSP.

The estimations using the entire sample were the strongest explanations of stage of acceptance of OFSP, and they are the basis of the discussion that follows.

## **DISCUSSION**

Figure 3 illustrates the results of the regression analyses performed to test H1 through H6. This study explored the role of perceived risk and perceived effectiveness of control for the extent to which rural households grow OFSP varieties to alleviate VAD, and the study aimed to identify gender differences in factors that explain the extent to which rural households grow OFSP. Overall, 70% of the households had reached the maintenance stage, 19% were in the trial stage, and 12% were considering OFSP (Table 3). Only 18% of the sample was cultivating more than 40% of their sweetpotato areas with OFSP, and about 47% were cultivating zero to five per cent with OFSP. The decisions to consider, try, or sustain OFSP might be partly explained by the household decision-makers' risk-related beliefs and gender differences. Because a multi-stage stratified sampling strategy was used to select the sample, the results could be representative of the target population. Thus, the findings could explain OFSP farming among similar rural households. Almost all of the households in this study depended on income from agriculture, earned less than USD 30 per month, and, for 85% of the sample, the sweetpotato was a major dietary component.

This study assumed that perceptions of risk could be effectively assessed in terms of perceived risk and perceived effectiveness of control. In this study, the extent of the participants' perceptions of a risk of VAD was expected to motivate them to act, and their perceived effectiveness of control was expected to open a path to action, which conforms to Rosenstock (1974). This study's findings confirmed that, unless an individual who perceived a significant risk also perceived that there was a feasible and efficacious action

**Table 6. Results of hypothesis tests: multiple regression analyses**

Sample (n = 341)									
Variables	Model 1: Stage of acceptance of OFSP (H1: Household dynamics positively relates to stage of acceptance of OFSP; H5: Perceived risk positively relates to stage of acceptance of OFSP); H6: Perceived effectiveness of control relates to stage of acceptance of OFSP)			Model 2: Perceived effectiveness of control (H3: Household dynamics relates to perceived effectiveness of control; H4: Perceived risk positively relates to perceived effectiveness of control)			Model 3: Perceived risk (H2: Household dynamics relates to perceived risk)		
	$\beta$	t-value	VIFa	$\beta$	t-value	VIF	$\beta$	t-value	VIF
Perceived risk	-.110**	-3.08	1.12	.529***	4.27	1.06			
Perceived effectiveness of control	.061***	3.98	1.05						
Household dynamics	.119***	3.72	1.06	.083	0.73	1.06	-.214***	-4.40	1.00
Adjusted R <sup>2</sup>	.102***				.046***		.052***		
<i>Female household decision-makers (n = 188)</i>									
Variables	$\beta$	t-value	VIF	$\beta$	t-value	VIF	$\beta$	t-value	VIF
Perceived risk	-.102*	-2.34	1.09	.417*	2.53	1.06			
Perceived effectiveness of control	.044*	2.32	1.06						
Household dynamics	.168***	4.02	1.04	-.043	-0.27	1.06	-.224**	-3.18	1.00
Adjusted R <sup>2</sup>	.127***	.027*	.047**						
<i>Male household decision-makers (n = 153)</i>									
Variables	$\beta$	t-value	VIF	$\beta$	t-value	VIF	$\beta$	t-value	VIF
Perceived risk	-.112	-1.88	1.16	.688***	3.62	1.07			
Perceived effectiveness of control	.082**	3.35	1.09						
Household dynamics	.078	1.58	1.08	.226	1.40	1.07	-.216**	-3.22	1.00
Adjusted R <sup>2</sup>	.087***			.069**			.058**		

available with which she or he could respond to that risk, that individual would not be likely to change behaviour and cultivate OFSP (Janz and Becker, 1984). Similar to Rosenstock (1974), this study found negative and significant effects of perceived risk on the stage of acceptance of OFSP overall and among the female participants. However, perceived risk did not matter to the males' decision-making regarding acceptance of OFSP.

Sun *et al.* (2006) found a similar negative effect of perceived risk on behavioural intentions to buy fortified soy sauce among rural Chinese women that was not found among their urban counterparts. However, some studies on acceptance (e.g., Fanoufogny *et al.*, 2011; Talsma *et al.*, 2013; Mogendi *et al.*, 2016) found that perceived risk positively and directly explained behaviours. These studies mostly sampled women or caregivers and focused on intentions to buy or consume nutritional foods. This study focused on gender differences and, as shown in Table 6, males' perceived risk was not significantly related to their stage of cultivation of OFSP, whereas it was explanatory for the female participants.

The effects of perceived risk on the effectiveness of

control were positive and statistically significant, although previous studies had not analysed it despite its long history of scholarly attention. For example, Rosenstock (1974, p. 332) argued that, in the absence of barriers, perceived risk motivates action and perceived benefits provide a preferred path of action. Moreover, the effect of perceived risk on perceived effectiveness of control was strong ( $\beta = .53$ ) in the overall sample. The effects of perceived risk on perceived effectiveness of control support the results of previous studies (e.g., Okello *et al.*, 2014; deBrauw *et al.*, 2015).

This study also found interesting negative and significant effects of household dynamics on perceived risk and stage of acceptance of OFSP in overall and among female participants. But household dynamics did not matter to the males decision-making regarding acceptance of OFSP. These findings are similar to those of relevant psychosocial studies. Abrahamse and Steg (2011) proposed that contextual factors shape decision-makers' actual or perceived capabilities and constraints for adopting new behaviours in which opportunities are nested. This suggests that some household factors might encourage (or discourage) new behaviours even when a path of action is not perceived (Janz and Becker,

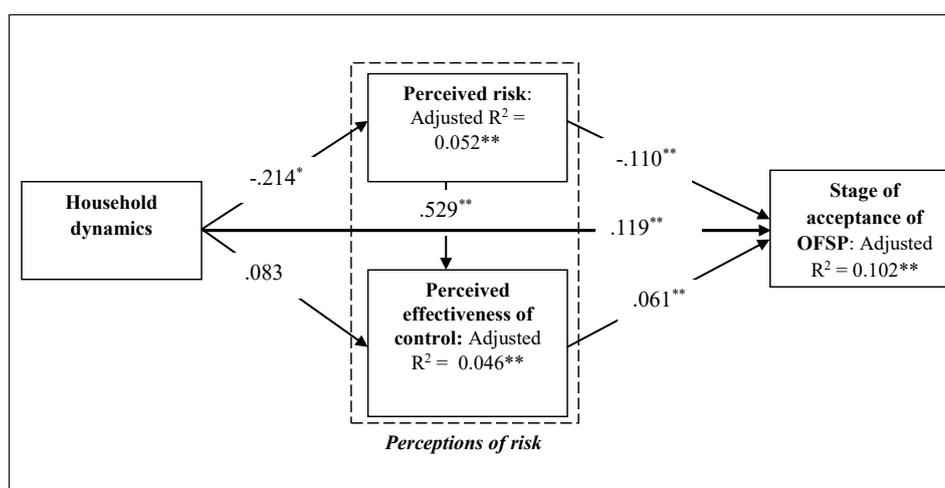


Figure 3. Study results for the entire sample (n = 341), \* = p < .01, \*\* = p < .001

1984; Ajzen, 1991), which was found herein. The effect of household dynamics on stage of acceptance of OFSP was positive, statistically significant, and without a meaningful gender difference. The finding also seems to support the conclusions drawn by OFSP field experiment acceptance studies (i.e. Chowdhury *et al.*, 2009; Oparinde *et al.*, 2014).

## CONCLUSIONS

The OFSP is a vital crop in Uganda's fight against VAD in its rural areas, where households routinely farm for their household food. However, to benefit from OFSP, these households must sustainably grow the new varieties. Previous studies on acceptance mainly examined factors predicting market readiness to buy and consume the new sweetpotato varieties. Therefore, this study adds to the acceptability literature by considering household heads' beliefs about risk that might explain their decisions to sustainably grow the OFSP varieties to reduce VAD. Perceived risk, effectiveness of control, and household dynamics were significant predictors of cultivating OFSP. First, certain factors might directly promote movement towards farming OFSP while discouraging household decision-makers from perceiving VAD as a risk. Second, perceived risk motivates progress towards sustained growing of OFSP while perceived effectiveness of control seems to be the best way to encourage action. Third, the effects of background factors were generally different by gender, and a better explanation was obtained when the sample was analysed as a whole.

### **Theoretical and practical implications.**

Theoretically, this study's findings support the argument that existing theories fall short of explaining nutritional behaviours or behavioural change (Sun *et al.*, 2006). The results suggest that the gap in existing theories might be caused by inappropriately combining constructs that have competing predictive contributions to explaining nutritional behaviours. It might

be useful to analyse distinct construct(s) from competing theories or to disassemble constructs for refinement and recombination into a new theory or sets of propositions to predict nutritional behavioural change (see Achterberg and Miller, 2004).

From a practical perspective, this study provides many concrete implications. First, effectiveness of control could be the only path for constructively using risk arousal to encourage Ugandan rural households to sustainably grow OFSP. In the absence of perceived risk, effectiveness of control is not important and risk arousal becomes a wasted effort by itself. In other words, when messages on nutrition are disseminated, households are likely to switch to new varieties when the risk messages are linked to effectiveness of OFSP to reduce the VAD health risk. If these messages on risk were directly linked to the OFSP decision, and, subsequently, OFSP were argued to improve health, the risk messages might fail. This conclusion puts a new twist on an important study by deBrauw *et al.* (2015), which recommended a serialized cutback of nutritional messages on OFSP delivery strategies because there was a lack of evidence that the messages were contributing to OFSP adoption. Furthermore, it is important to include all of a household's decision-makers when designing, implementing, and evaluation OFSP delivery programs. Therefore, this study's results are useful for practitioners who want to improve intervention targeting and social marketing.

### **Limitation of the study.**

This was a within-subjects study that might have limited generalization of its results beyond the sample, despite the stratified sampling strategy employed, because of sampling bias. A second limitation of this study was that it dealt with household dynamics as a construct, which supports parsimonious models, but loses specificity and precision regarding the effects

of specific factors on decisions to grow or not grow OFSP and on risk perceptions of VAD. Therefore, additional research is necessary for precise identification of these factors.

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#### STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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S. NDAULA *et al.*

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