Journal of Finance, Management and Development (JFMD), 2025, 1 (1), PP. 55-78

Determinants of Household Graduation from the Productive Safety Net Program: The Case of Hadiya and Wolaita Zones, Southern Nations, Nationalities, and Peoples Region, Ethiopia

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ABSTRACT

Ethiopia has historically grappled with chronic poverty and food insecurity, prompting the government to implement anti-poverty initiatives, notably the Productive Safety Net Program (PSNP), in rural areas since 2005. Despite substantial government efforts to tackle these problems, food insecurity and vulnerability continue to be significant social, economic, and political concerns in the country. Therefore, it is imperative to examine the factors that determine rural households' ability to graduate from the PSNP and achieve food security. The study employed cross-sectional data and utilized both quantitative and qualitative methods. Data were collected from 186 individuals, including PSNP beneficiaries and graduated households, and a binary logistic regression model was used for analysis. Only 39.24% of households owned oxen, 12.4% utilized irrigation, and 33.33% accessed credit, with the average farmland size measured at 0.5202 hectares, below the national average of 1.33 hectares and the regional average of 1.5 hectares. Beneficiaries earned 252.52 birr less in annual farm income than did graduated households, and their off-farm income was lower by 4,169.05 birr. Model results indicated that seven variables significantly affected household graduation from the PSNP. As the education level of household heads increased from one category to another, the probability of graduation rose by 10.524%. Oxen holdings increased the likelihood of graduation by 26.0323%, while off-farm income contributed a marginal increase of 0.0018% on the log scale, and access to irrigation increased the likelihood of graduation by 23.9155%. In contrast, as family size increased, the probability of graduation decreased by 9.101%. Similarly, limited access to fertilizers reduced the probability of graduation by 23.487%, and limited access to credit decreased it by 11.832%. Qualitative analysis further revealed additional factors affecting graduation, including insufficient PSNP payments, substantial public work commitments, large family sizes, low education levels, small landholdings, limited fertilizer access, inadequate irrigable land, weak credit institutions, and high interest rates. A minimal percentage of beneficiaries owned oxen, utilized irrigation, and accessed credit, which significantly hampered their welfare. These findings highlight the crucial role of social and economic factors in improving the likelihood of program graduation. Addressing these barriers through targeted interventions is essential for enhancing the overall effectiveness of the PSNP. To improve

household graduation rates and overall food security, it is vital to implement targeted interventions that address these barriers, promote sustainable economic stability, and ensure food self-sufficiency among beneficiaries.

Keywords: *Food security, Consumption, Asset accumulation, Household graduation*

1. Introduction

The Ethiopian government launched the Productive Safety Net Program (PSNP) in 2005 to combat poverty and food insecurity (FDRE, 2005). As part of the national social protection strategy, PSNP provides cash or in-kind transfers to chronically poor households to reduce poverty and vulnerability (FAO, 2015; Bezawit et al., 2020). These safety net interventions are designed to improve access to food, enhance productive asset ownership, and expand access to essential services such as sanitation and healthcare, thereby improving food security and dietary diversity (Bezawit et al., 2020).

Despite these efforts, food insecurity remains a significant challenge in Ethiopia. According to the United Nations (2021), approximately 13.6 million people were food insecure due to compounding factors like conflict, drought, flooding, locust infestations, market disruptions, rising food prices, and the COVID-19 pandemic. The PSNP aims to stabilize consumption, prevent asset depletion, and improve household livelihoods (MOA, 2009, 2014; Bahru et al., 2020). Initially operating in 263 Woredas across Tigray, Amhara, Oromia, and SNNPR, the program has since expanded to over 300 Woredas, including Afar and Somali regions (USAID, 2012).

In the Southern Nations, Nationalities, and Peoples' Region (SNNPR), chronic food insecurity is particularly severe in eastern zones and special Woredas like Sidama, Gedeo, Wolaita, Kambata Tambaro, and Hadiyya (WFP, 2022). The region suffers from limited infrastructure, poor access to water and health services, limited productive assets, high poverty, and rapid population growth. As a result, over 1.5 million people in 64 Woredas face chronic and transitory food insecurity (DPPC, 2012). The 2017 Integrated Food Security Phase Classification (IPC) showed that about 12% of the population in SNNPR (roughly 1.39 million people) experienced severe food insecurity (Desta & Negussie, 2017).

Between 2015/16 and 2020/21, PSNP supported 1,039,959 households in SNNPR, transferring approximately 10 million ETB to primarily food-insecure families. PSNP was initially intended to run for five years, after which beneficiaries receiving consistent support and complementary interventions would "graduate" out of dependence—remaining self-sufficient except during food crises (Samuel, 2006; PSNP, 2006). Graduation is a key metric used by the Ethiopian government to assess the success of PSNP in addressing chronic food insecurity (Devereux & Taye, 2014). It is defined as the ability of a household to meet its food needs for 12 months and withstand moderate shocks without external assistance (MARD, 2007).

2. Literature Review

Numerous studies have evaluated the effectiveness of the Productive Safety Net Program (PSNP), particularly its success in achieving household graduation. Findings from Gilligan et al. (2009), the IDL Group (2010), and Berhane et al. (2011) suggest that the program has had limited success in reducing food insecurity sustainably. Graduation rates have consistently fallen short of expectations. By 2009, only 9% of beneficiary households had graduated nationally (MoARD, 2009; Devereux, 2010), and during the first five years of implementation, just 104,846 households—approximately 1.3%—graduated from the program (Devereux & Taye, 2014). Although over 400,000 beneficiaries were reported to have graduated by 2011, this figure remained modest compared to the 7.6 million enrolled in the program at the time (WFP, 2011; Hobson, 2012).

Beyond overall program performance, several studies have explored the specific determinants influencing household graduation. Scholars such as Desalegn et al. (2017), Girma and Gebre (2012), Sharp and Brown (2006), Tadele (2011), and Gilligan et al. (2009) have contributed valuable insights. For instance, Desalegn et al. (2017) identified eight statistically significant variables affecting graduation out of twelve examined. Positive influences included the sex of the household head, access to irrigation, participation in non-farm activities, effective targeting mechanisms, access to credit, and the use of agricultural inputs. In contrast, larger family sizes and drought conditions negatively impacted graduation outcomes.

Sharp and Brown (2006) highlighted that weak targeting mechanisms—such as diluted transfers and partial family targeting—undermined the program's effectiveness by reducing transfer amounts and discouraging self-sufficiency among beneficiaries. Similarly, Girma and Gebre (2012) emphasized drought as the most critical natural shock affecting PSNP households. In regions such as Tigray, Amhara, Oromia, and SNNPR, 57% of households reported losing assets or facing food shortages due to drought. Other contributing factors included crop failure, frost, illness, and family separation, all of which further deepened household vulnerability.

Tadele (2011) focused on the use of chemical fertilizer and found that plot size and livestock ownership positively influenced fertilizer use, while off-farm income had a negative impact. Additionally, variables such as the age and education level of the household head, landholding size, distance to plots, and soil fertility had either negative or mixed effects on input use and overall productivity.

Furthermore, Gilligan et al. (2009), using propensity score matching, found that the average impact of PSNP was limited, primarily due to insufficient transfer levels. However, households that received at least half of the intended transfers experienced improvements in food security. Those who also accessed complementary agricultural

support were more likely to adopt improved technologies, engage in non-farm businesses, and borrow for productive purposes. Importantly, these households did not show reduced labor supply or private transfers. Nevertheless, the program had no significant impact on asset accumulation.

Despite the PSNP's continued implementation in high-need areas of SNNPR, such as Hadiya and Wolaita zones, the specific factors enabling or constraining household graduation have not been comprehensively studied. A deeper understanding of these determinants is essential to inform more effective targeting, improve program design, and ultimately enhance the PSNP's contribution to long-term food security and resilience.

3. Materials and Methods

3.1. Description of the Study Area

The study was conducted in Hadiya and Wolaita Zones of the Southern Nations, Nationalities, and Peoples' Region (SNNPR) in Ethiopia. SNNPR, bordered by Kenya, South Sudan, Gambela, Oromia, and Sidama, is divided into 14 zones and four special Woredas, with a predominantly rural population (about 90%). Based on the 2007 Census, the region had over 14.9 million people, rising to approximately 20 million by 2019, representing about 20% of Ethiopia's total population. The population is largely young, with about 14% under five years old and nearly half under 18. Covering roughly 105,887 square kilometers, the region has diverse environments including highlands, midlands, lowlands, and pastoral rangelands. Agriculture dominates the economy, producing coffee, cassava, sweet potatoes, teff, wheat, barley, maize, and sorghum. The area is ethnically diverse, home to over 56 indigenous groups, creating a rich cultural mosaic that also poses governance and resource management challenges.

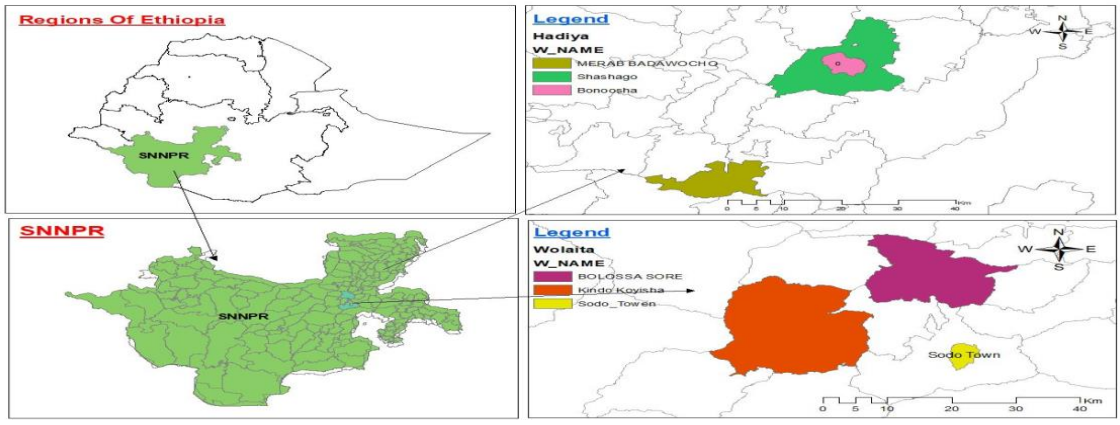

Figure 1: Map of the Study area; Source: Ethiopia mapping Agency (2023)

3.2. Types and sources of data

This study employed a cross-sectional data design, combining both quantitative and qualitative methods to gather data. This mixed research approach allowed the study to gain a comprehensive understanding of the research topic by leveraging the strengths of both quantitative and qualitative techniques. The quantitative data were collected from 186 households using structured questionnaires. To collect qualitative data, the study used focus group discussions (FGDs) and key informant interviews. In each Kebele, one FGD was conducted, resulting in a total of eight FGDs across the four Woredas. Additionally, three key informant interviews were conducted with respective Woredas, resulting in a total of twelve interviews across the Woredas.

Primary data was gathered directly from the sample households, encompassing both beneficiaries and graduated households, whereas secondary data was obtained from a variety of sources, including published and unpublished materials such as academic articles, books, formal reports, and other relevant documents.

3.3. Sampling Design

This study employed a mixed sampling approach, combining both probability and non-probability methods to ensure a comprehensive and representative sample. The study area was selected through purposive sampling methods. The study areas were chosen based on their extensive coverage of the PSNP and the vulnerability of their communities to food insecurity. The selection was deliberate, considering the widespread implementation of the PSNP and the high number of beneficiaries in these zones. Woredas and Kebeles were selected based on the number of beneficiaries, prioritizing those with a high concentration of beneficiaries and those located in geographically kola areas, which are more vulnerable to food insecurity. To identify the Kebeles to be surveyed, the Agriculture Office at the Woreda level was visited to obtain a list of PSNP beneficiary Kebeles, along with the total number of households and PSNP participants in each Kebele.

3.4. Sample Size Determination

The two study zones (Hadiya and Wolaita) were selected using purposive sampling methods due to their chronic levels of food insecurity, higher caseloads, and many years of support provided through the emergency and productive safety net programs (SNNPR Regional Agricultural Bureau, 2022). The sample beneficiary households were drawn from the public works component only, using a simple random sampling method.

Cochran (1965) suggests that for large and finite populations, employing a simple random sampling technique is preferable over other methods. In this research, the sample size was determined using the simple random sampling formula, which involved a 0.5 estimated proportion of respondents, a 95% confidence interval, and a 0.05 margin of error. The formula used for selecting the sample size in this study was as follows:

$$n_o = \frac{p(1-p)z^2}{e^2}$$

Where n_0 = sample size, P = estimated proportion of respondents: 0.5, and Z = the number of standard errors corresponding to 95% CI which is 1.96. e = margin of error: 0.05 margin of error was selected.

$$n_o = \frac{0.5(1-0.5)1.96^2}{0.05^2} = 384$$

Therefore, using the finite population sample size determination formula the total number of samples included in the study was = 384. Using finite population sample size determination formula:

$$n = \frac{no}{1+\frac{(n-1)}{N}} = n = \frac{384}{1+\frac{(384-1)}{361}} = 186$$

In this study, a total of 186 households were selected using a simple random sampling method. The sample was divided among beneficiary and graduated households using a proportionate sampling method to ensure fair representation. Among the selected households, 144 (77.4%) were from beneficiary households, and 42 households (22.6%) were from graduated households.

3.5. Methods of Data Analysis

Descriptive statistics were employed to test the association between dummy/discrete explanatory variables and to test the mean difference between continuous variables. The descriptive statistics used included means, standard deviations, percentages, t-tests, and chi-square tests.

Logistic regression models were used to identify the determinants of household graduation from the PSNP. This model is a non-linear regression model specifically designed for a binary response dependent variable. The dependent variable was expressed as a dummy variable, where "1" indicates a household that has graduated from the PSNP and "0" indicates otherwise. Different explanatory variables were identified based on empirical studies. Based on literature review, thirteen explanatory variables were recognized as factors that may affect household graduation from the PSNP. These variables include sex, age, marital status, family size, education level, experience in the PSNP, farmland size, oxen holdings, farm income, off-farm income, access to fertilizers, access to irrigable land, and access to credit.

3.6. Model Specification

To identify the key determinants of household graduation from the PSNP, a binary logistic regression model was employed. This model was chosen due to the binary nature

of the dependent variables, which can be categorized as either "yes" or "no." The dependent variable in this study was a dichotomous variable, where a value of "1" indicated households that graduated from PSNP and "0" indicated otherwise. When deciding between the logit and probit models, the choice was based on statistical grounds, as there were no compelling arguments to favor one over the other in real-world applications. The fundamental distinction between the two models was that the logit model had slightly fatter or heavier tails, meaning that it approached the axes more quickly than the probit model (Norton & Dowd, 2017).

The logistic model was preferred for two main reasons (Hosmer et al., 2013). Firstly, it was mathematically grounded and extremely flexible, making it easily used. Secondly, it had a logically meaningful interpretation. The logit model was easier to estimate than the probit model. The following logistic distribution function was used to explain the model (Gujarati, 2004). The logistic model mathematical formula used:

$$Pi = E\left(\frac{1}{Xi}\right) = \frac{1}{1+e^{-(\beta 1+\beta 2\, Xi)}} \text{ ---------- (1)}$$

In the logistic regression model, *Pi* is the dependent variable representing the probability of a response by an individual, and *xi* is the independent variable data for observation *i*. When the linear combination $\beta 1+\beta 2Xi$ is denoted as Zi in Equation 1, the equation can be simplified as:

$$Pi = \frac{1}{1+e^{Zi}} \text{ ---------- (2)}$$

If Pi, the probability that a given household has graduated from PSNP, is given by equation 2, then (1 - Pi), the probability of a household not graduated from PSNP, is given by:

$$1 - Pi = \frac{1}{1+e^{Zi}} \text{ ---------- (3)}$$

Equation 4 is obtained by dividing the graduates by non-graduated households. Therefore, the odds ratio can be written as:

$$\frac{Pi}{1-Pi} = \frac{1+e^{Zi}}{1+e^{-Zi}} = e^{Zi} \text{ ---------- (4)}$$

Now $\frac{Pi}{1-Pi}$ is simply the odds ratio in favor of graduating from PSNP- the ratio of the probability that a household would be influenced by the program to the probability that

they are not influenced. Finally, taking the natural logarithm of both sides of the equation written in equation (4) results in equation 1 which is the logistic model as indicated below.

$$Li = ln\left(\frac{Pi}{1-Pi}\right) = \boldsymbol{ln}\ ln\left[e^{Zi}\right] = e^{Zi} = \beta_1 + \beta_2 X_i \text{---------- (5)}$$

Thus, a logistic regression model is liberalized based on both its parameters and variables. "L'' is called "logit'' and models such as this are called "logit models'' (Gujararti, 2004). '**Li**' is natural. The logarithm of the odds ratio is not only linear in variable X but also linear in the parameters. Thus, when there is more than one independent variable, (X_1, X_2..... X_K) in a binary or logistic models, equation 6 is used for proper transformations:

$$Pi = E\left(\frac{1}{Xi}\right) = \frac{1}{1+e^{-(\beta 1+\beta 2\, Xi)}} \text{ ---------- (6)}$$

Where, Zi is a function of 'n' explanatory variables (X_i) which can also be expressed as

$$Zi = \beta_0+\beta_{X1}+ \beta_{X2+}..... +\beta nX_n \text{ ---------- (7)}$$

Where, Zi is the dependent variable (household graduation from the PSNP), β_0 is the intercept of the regression model and β_1, β_2… βn are partial slopes or regression coefficients of the independent variables in the model. **'Xi'** is a vector of explanatory variables for household **'i'**. Finally, incorporating the disturbance term μ_i such that $\mu_i \approx \delta^2$ $(0, \delta^2)$, the complete binary logit model is specified as follows:

$$Zi = \beta_0 + \beta_1X_1+ \beta_2X_{2+}... +\beta_nX_n+ U_i \text{ ---------- (8)}$$

The final estimable binary logit model is given as

Zi (household graduation from the PSNP)= β_0 + β1(sex)+ β2(age)+ β3(marital status) + β4(family size) + β5(education level) + β6(experience) + β7(Land size) + β8(oxen holding) + β9(farm income) + β10(off farm income) + β11(access to fertilizer) + β12(irrigation) + β13(access to credit) + Ui.

4. Results and Discussion

4.1. Results

4.1.1. Descriptive results analysis

Sex of the Sample Households: The sex of the sample household head was one of the important variables that determine household graduation from the PSNP. As shown in Table 1, out of the total 186 sample households, 132 (70.97%) were male-headed, and 54 (29.03%) were female-headed. A chi-square test was conducted to assess the association between beneficiary and graduated households. The chi-square analysis revealed that

there was no statistically significant association between beneficiary and graduated households concerning sex, with a chi-square value of $\chi^2 = 0.7182$ and a p-value of 0.397.

Marital Status of the Sample Households: It was classified into four categories: Single, Married, Divorced, and Widowed. A chi-square test was conducted to determine if there was a statistically significant association between the marital statuses of sample households. The results presented in Table 1 showed no statistically significant association among the families of sample households based on their marital status, with a chi-square value of $\chi^2(186) = 0.517$ and a p-value of 0.075.

Family Size of the Sample Households: It is a categorical variable, which is categorized into three groups based on family size: small (1-3 family members), medium (4-6 family members), and large (more than 6 family members). A chi-square test was performed to determine if there was a statistically significant association between family size groups. The results presented in Table 1 indicated that there was no significant association between beneficiary families and graduated households, with a chi-square value of χ^2 (186) = 2.53 and a p-value of 0.28.

Table 1. Descriptive Statistics of Dummy variables (Demographic characteristics of respondents)

Variables	scale	Graduated		Beneficiaries		Total		χ^2	P value
		No	%	No	%	No	%		
Sex of household heads	Male	32	76.2	100	69.44	132	70.97	.7182	0.397
	Female	10	23.8	44	30.56	54	29.03		
	Total	42	100	144	100	186	100		
Marital status	Married	137	95.1	185	94.9	322	95.0	5.17	0.075
	Divorced	3	2.1	0	0	3	0.9		
	Widowed	4	2.8	10	5.1	14	4.13		
Family size	Small	3	2.1	9	4.6	12	3.5	2.53	0.28
	Medium	78	54.2	113	57.9	191	56.3		
	Large	63	43.8	73	37.4	136	40.1		
Education level	Unable to read and write	55	38.2	62	31.8	117	34.5	3.99	0.262
	Primary school	74	51.4	99	50.8	173	51.0		
	Secondary school	9	6.3	18	9.2	27	8.0		
	Above secondary school	6	4.2	16	8.2	22	6.5		
Experience	5-10 years	92	63.9	22	52.4	114	61.3	1.815	

of PSNP	Above 10 years	52	36.1	20	47.6	72	38.7		0.209

Source: Own survey results (2023)

Educational Status of the Sample Households: Educational status is a crucial factor affecting household graduation from the PSNP. The analysis was conducted using a chi-square test to determine whether there was a statistically significant association among educational groups. The respondents were categorized into four groups based on their educational attainment: unable to read and write, primary school completed, secondary school completed, and above secondary school completed. The survey results presented in Table 1 indicated a statistically insignificant association between beneficiaries and graduated households concerning education status, with a chi-square of $X^2(186) = 3.99$, $p = 0.262$.

Experience of the Sample Household in the PSNP: The experience of the household plays a crucial role in determining the likelihood of successful graduation from the PSNP. The data reveal that most households have 5 to 10 years of experience in the PSNP. The majority of beneficiaries (63.9%) have 5 to 10 years of experience, while the remaining 36.1% have more than 10 years of experience. Similarly, among the graduated households, 52.4% have 5 to 10 years of experience, and 47.6% have more than 10 years of experience. This suggests that most households in the sample have significant experience, with a majority having 5 to 10 years of experience (see Table 1). The survey results indicated a statistically insignificant association between beneficiaries and graduated households concerning experience, with a chi-square of $X^2(186) = 1.815$, $p = 0.209$.

Oxen holding: Ox holding is a critical factor influencing household graduation from the PSNP. Households that own oxen tend to graduate faster due to the multiple benefits oxen provide, including plowing farmland, generating income from selling oxen, providing traction power for farm work, and serving as collateral for rural credit. The study found that 69.05% of graduated households owned oxen, compared to 30.6% of beneficiary households, indicating a significant difference in ox holding between the two groups. The chi-square test revealed a statistically significant association between beneficiaries and graduated households at a 1% significance level, indicating a high level of significance concerning ox holding (see Table 2).

Access to fertilizers: Fertilizers were distributed in different forms, such as seeds, urea, and DAP. As indicated in Table 2, 88.2% of beneficiary households used fertilizers, while 11.8% did not. Among graduated households, 80.95% were fertilizer users, and 19.05% did not use fertilizers. These results indicate that there was no significant difference between beneficiary and graduated households in terms of fertilizer usage.

This suggests that both groups utilized fertilizers at a high level to enhance their agricultural productivity.

Table 2. Descriptive Statistics of Dummy variables (Access parameters)

Variables	Responses	Beneficiaries		Graduated		Total		χ^2	P-value
		No	%	No	%	No	%		
Ox holding	Yes	44	30.6	29	69.05	73	39.24	20.205	0.001***
	No	100	69.4	13	30.95	113	60.75		
Use of Fertilizers	Use	127	88.19	34	80.95	161	86.56	1.466	0.302
	Not Use	17	11.80	8	19.05	25	13.44		
Access to Irrigation	Use	13	9.03	10	23.8	23	12.4	6.556	0.016**
	Not use	131	90.97	32	76.2	163	87.6		
Access to credit service	Yes	48	33.33	14	33.33	62	33.33	0.000	1.000
	No	96	66.67	28	66.67	124	66.67		

Source: Own survey result (2023). Note: ** shows a level of significance 5% significance level.

Access to irrigation: Irrigation plays a crucial role in increasing agricultural productivity by allowing farmers to produce crops multiple times per year. The survey results, as presented in Table 2, indicated that only 12.4% of sample households used irrigation, while the remaining 87.6% did not. Among the beneficiary households, 9.03% used irrigation, compared to 23.8% of the graduated households. This figure highlights that most farmers in the study area did not use irrigation. The chi-square test revealed a significant association between beneficiary and graduated households in terms of irrigation use at a 5% significance level.

Access to credit service: Access to credit services is crucial for farmers to purchase essential inputs such as fertilizers, seeds, and food. In the study area, access to credit was limited. As indicated in Table 2, only 33.33% of sample households had access to credit, while the remaining 66.67% did not. Among beneficiary households, 33.33% had access to credit, while 66.67% did not. Similarly, among graduated households, 33.33% had access to credit, while 66.67% did not. The chi-square test revealed no statistically significant association between the beneficiary and graduated households regarding credit access.

On the other hand, the descriptive analysis of continuous variables was conducted using mean, standard deviation, and t-test as shown below.

Age of the Households: This is a crucial factor influencing household graduation from the PSNP. In Table 3, the mean age of beneficiary household heads was 38.54 years, with a standard deviation of 8.65, while the mean age of graduated household heads was 40.74 years, with a standard deviation of 6.99. The age range of sample household heads varied from 20 to 56 years. There was a statistically significant difference between the ages of beneficiaries and graduated households, with a t-value of -1.51 and a p-value of 0.045. This highlights the importance of age as a determinant of graduation success in the PSNP.

Farm income of the households: The farm income of households in the study area varied significantly, ranging from a minimum of Birr 0.00 to a maximum of Birr 15,400. The results in Table 3 reveal that the mean annual farm income of graduated households was Birr 5,654.04, while that of beneficiary households was Birr 5,401.53. The t-test results indicate that there was no statistically significant mean difference in annual farm income between the two groups. This suggests that there was no significant difference in mean farm income between beneficiary and graduated households.

Off-farm income of the households: Off-farm income was a significant source of income for rural households in addition to farm income. The main off-farm activities in the study area were temporary labor, small-scale trade, wage labor, small businesses, and charcoal making. Income from these sources ranged from a minimum of Birr 0.00 to a maximum of Birr 12,000. The results presented in Table 3 showed that the mean annual income from off-farm activities for beneficiary households was Birr 2,516.18, while for graduated households it was Birr 4,169.05. The t-test analysis revealed no statistically significant difference in mean annual off-farm income between beneficiary and graduated households. This indicates that there was no significant difference in off-farm income between beneficiary and graduated households.

Table 3. Descriptive Statistics of Continuous variables

Variables	Beneficiaries HH		Graduated HH		Mean Diff.	min	max	t - value	P-value
	Mean	Std. Dev.	Mean	Std. Dev.					
Age	38.54	8.65	40.74	6.99	-2.196	20	56	-1.51	0.045**
Farm income	5401.53	3980.32	5654.05	3647.47	-252.52	100	15400	-0.368	0.550
Off-farm income	2516.18	3194.89	4169.05	3506.36	-1652.86	250	12000	-2.885	0.145
Farmland size(ha)	0.5243	0.30913	0.5060	0.31953	0.01835	0.25	1.5	.336	0.767

*Source: - Own Survey result (2023), Note: ** shows significance at 5% significance level*

Land size: Land is a crucial asset for rural households in Ethiopia, as well as in the study area. The average farmland size for sample households was 0.5202 hectares, with a

standard deviation of 0.31. The minimum landholding was 0.25 hectares, while the maximum was 1.5 hectares. The average landholding in the study area is below the national average of approximately 1.33 hectares per household and the Southern Nations, Nationalities, and Peoples' region average of approximately 1.51 hectares per household (Leta et al., 2021). However, it is important to note that land distribution in Ethiopia is highly unequal, with some households owning much larger plots of land than others (Doe, 2020). The descriptive results in Table 3 showed that the average land holding of beneficiary households was 0.5243 hectares, while for graduated households was 0.5060 hectares. The t-test analysis revealed that there was no significant difference between the beneficiary and graduated households concerning land holding.

4.1.2. Econometrics results

A binary logistic regression model was employed to analyze the effect of independent variables on the dependent variable (households graduation from PSNP) as modeled in equation (8). The logistic regression results show that the pseudo R-squared value is 0.3049. It is important to note that pseudo R-squared values should not be interpreted in isolation or compared across different datasets. Unlike ordinary least squares (OLS) regression, logistic regression does not have a direct equivalent to the R-squared statistic.

The LR chi-square value of 60.59 with 13 degrees of freedom tests whether the full model with the 13 predictors fits significantly better than a null model with no predictors. A high LR chi-square value relative to the degrees of freedom generally indicates that the model explains more variability in the outcome than the intercept-only model. If the associated p-value is below a significance threshold (commonly 0.05), this suggests that at least one predictor significantly contributes to explaining the dependent variable. In this context, the LR chi-square result implies that the combined effects of the independent variables explain the outcome variable significantly well.

The log-likelihood value of -69.06 measures the fit of the model with the predictors included. Although this value alone is not directly interpretable, it is useful for comparing nested models (models where one is a subset of another). A higher (less negative) log-likelihood value indicates a better fit. Comparing this with the log-likelihood of the null model helps calculate the LR chi-square.

Moreover, four different methods, namely the Hosmer-Lemeshow test, the Omnibus tests of model coefficients, Cox & Snell R-square, Nagelkerke R-square values, and the area under the ROC curve were used to assess model fit. As shown in the lower panel of Table 4, the Hosmer-Lemeshow goodness-of-fit test indicated a p-value of 0.439, which is greater than 0.05, and thus statistically insignificant, signaling a good fit. The Omnibus test is also significant at the 1% level, suggesting that the model is a good fit. However, both the Cox & Snell R-square and Nagelkerke R-square values were not statistically significant, with p-values of 0.305 and 0.464, respectively. Finally, the area under the ROC curve was evaluated, yielding a value of 0.8563, which indicates excellent

discrimination. Overall, these results suggest that the binary logistic regression model is indeed a suitable choice for this analysis.

Table 4. Binary Logistic Regression Results

Log-likelihood = -69.058504			Several obs. =		186
			LR chi^2(13) =		60.59
			Prob. > chi^2 =		0.0000
			Pseudo R^2 =		0.3049
Variables	**Coefficient**	**Std. errs.**	**P>z**	**Odds ratio**	**dy/dx**
Sex	-0.3319	0.0681	0.568	0.7176	-0.0389
Age	0.0268	0.0033	0.337	1.0272	0.0031
Marital status	-1.8348	0.1942	0.269	0.1597	-0.2148
Family size	-0.7773	0.0410	0.026**	0.4596	-0.0910
Education level	0.8989	0.0263	0.000***	2.4568	0.1052
Experience in PSNP	0.8309	0.0537	0.070	2.2954	0.0973
Farmland size	-0.7264	0.0827	0.304	0.4837	-0.0850
Ox holding	2.2234	0.0546	0.000***	9.2391	0.2603
Farm income	-0.0044	0.0010	0.599	0.9956	-0.0005
Off-farm income	0.0002	0.0000	0.018**	1.0002	0.0000
Access to fertilizer	-2.006	0.0715	0.001**	0.1345	-0.2349
Access to irrigation	2.0426	0.0699	0.001**	7.7109	0.2392
Access to credit	-1.0106	0.0596	0.047**	0.3640	-0.1183
_cons	1.2476			3.4819	
Hosmer-Lemeshow		0.439			
Omnibus test		0.000			
Cox & Snell R-square value		0.305			
Nagelkerke R-square values		0.464			
Area under the ROC curve		0.8563			

*Source: Own survey result, (2023); Note: ** & *** which are associated with the p-value statistics represent that predictors are statistically significant at 5% and 1% respectively.*

Odd ratios: The data presented in Table 4 illustrate the estimation of explanatory variables influencing household graduation from the PSNP. These variables can have either positive or negative effects on the graduation process of beneficiary households from the PSNP. The odds ratio column in Table 4 indicates that coefficients greater than 1 suggest a positive effect on the household's probability of graduating from the PSNP. Conversely, coefficients less than 1 indicate a negative effect on the probability of graduation. A positive coefficient signifies an increase in the probability of graduation with the corresponding explanatory variable, while a negative coefficient implies a

decrease in graduation probability. Among the 13 variables included in the model, six explanatory variables had odds ratios greater than 1, indicating a positive effect on graduation, while seven variables had odds ratios less than 1, indicating a negative effect.

Of the 13 included explanatory variables, six have a positive effect on household graduation. These include the age of the household head, education level, household experience, oxen holding, off-farm income, and access to irrigation, all of which have odds ratios greater than one, indicating a positive effect on household graduation. Conversely, the odds ratios for the remaining seven variables—sex, marital status, family size, farmland size, farm income, access to fertilizers, and access to credit—are less than one, suggesting a negative effect on household graduation.

Marginal effects: These are the partial derivatives of the household graduation concerning a predictor of interest. Another direct measure is the change in the probability of household graduation for a change in the explanatory variables. The dy/dx column in Table 4 indicates the marginal effect of the independent variables on the dependent variable (which is measured by the dummy variables changing from 0 to 1), and for continuous variables, it reflects the marginal effect when they change by one unit at their mean. Table 4 presents this relation concerning selected explanatory variables.

The likelihood of graduation from the PSNP was potentially affected by seven explanatory variables: family size, educational level, oxen holding, off-farm income, access to fertilizer, access to irrigation, and access to credit. The household's probability of graduation might increase if the sign of the marginal effect of an independent variable at its mean value is positive, whereas the probability of graduation might decrease if the marginal effect of a given independent variable sign is negative at its mean value. For example, the marginal effect of household off-farm income was 0.000018, meaning that an increase of one birr in off-farm income results in a 0.0018% increase in the probability of the household graduating from the PSNP, all else being equal. This is because additional incomes smooth household food consumption. The same interpretation applies to the remaining continuous variables. Unfortunately, there were no other significant variables that had negative marginal effects for continuous variables.

However, when dealing with discrete or dummy variables in logistic regression, there is a slight difference in interpretation compared to continuous variables. For discrete variables, the interpretation is defined as the change from "0" to "1" or from "no" to "yes" (or vice versa), instead of the unit change at the mean value as in the case of continuous variables. For example, in the case of access to irrigation, households who have access to irrigation experience improved productivity. This means that if a household head's access to irrigation shifts from "no" to "yes," the probability of graduation will increase by 18.66%, and vice versa. The marginal effect of all the remaining discrete or dummy variables will be interpreted in the same manner, with their respective factors presented in Table 4.

Finally, results of Key informant interviews (KIIs) and Focus Group Discussion (FGD) are summarized in Appendix 1. These results serve to triangulate the findings obtained from the binary logistic regression model.

4.2. Discussion

The logistic regression results indicate that seven variables significantly affect household graduation. These significant variables are discussed briefly below.

Family size: It has a significant negative impact on the probability of graduation from the PSNP. The study found that the marginal effect of family size is negatively and statistically significant at the 5% level, indicating that households with larger family sizes have a lower probability of graduating from the PSNP compared to those with smaller family sizes. The marginal effect for family size is -0.091, suggesting that an increase in household size from medium to large leads to a 9.1% decrease in the probability of graduation compared to households with smaller family sizes. This result reveals that as household size increases, the probability of graduating from the PSNP decreases. Larger and medium-sized households may require additional food consumption to meet their needs, making it more challenging for them to successfully graduate from the social assistance program.

The Key informant interviews (KIIs) also highlight that weak family planning is one of the significant challenges to graduation from the PSNP in the study areas (see Appendix 1). Many households struggle to manage their family size effectively, leading to an increased demand for food and resources. This challenge is often exacerbated by cultural beliefs that view children as a source of wealth. In some communities, there is a strong cultural belief that children are a source of wealth, leading to a lack of family planning and contributing to the challenges faced by households in graduating from the PSNP. Weak family planning can have significant implications for food security, as households with large families often struggle to provide adequate food for all members, leading to increased food insecurity and decreased ability to graduate from the PSNP.

This result is consistent with multiple studies. Yibrah (2013) found that each additional unproductive household member decreased the probability of graduation. Desalegn et al. (2017) and Hayalu (2014) also found that each additional household member reduced the probability of graduation by 0.625 at the 5% significance level. Across these studies, the consistent finding is that larger family size is a significant barrier to graduating from the PSNP program.

In summary, family size has a significant and negative impact on graduation from the PSNP. Larger households have a lower probability of graduating due to increased demand for food and resources. The marginal effect for family size suggests that an increase in household size leads to a 9.1% decrease in the probability of graduation

compared to households with smaller family sizes. This finding is consistent with previous studies and is attributed to increased demand for food, which poses a challenge for households to meet their food security needs. Weak family planning, often driven by cultural beliefs, is a significant barrier to effective family planning and contributes to the difficulties faced by households in graduating from the PSNP.

Educational status of the Sample Households: The educational background of the household head was one of the significant variables and the most important factor in our model, having a positive effect on household graduation from the PSNP. Households with higher levels of education have a greater chance of graduating from the PSNP.

The descriptive statistics revealed a significant association between beneficiaries and graduated households concerning educational levels. The educational status of the household head positively influences the probability of graduation from the PSNP. The results indicate that changes in education level categories lead to an increase in the probability of graduation by 8.28% compared to households that are unable to read and write. This emphasizes the importance of education in enhancing household decision-making, resource management, and social capital, ultimately contributing to improved food security and a greater likelihood of graduation.

Furthermore, the key informant interviews (KIIs) and focus group discussions (FGDs) reveal that a major challenge to education participation is the high demand for educational resources, particularly in households with large family sizes. Many families struggle to fulfill these needs due to limited resources, leading to a lack of access to quality education. Households face insufficient funds for school fees, uniforms, and other materials, exacerbated by small PSNP transfers that often do not cover basic needs. Large family sizes further stretch resources, preventing adequate education for all children.

Similar findings were reported in other studies. Mesfin (2018) found similar results, indicating that the educational level of the household significantly affects food security, which is closely related to graduation from the PSNP, and that education influences agricultural extension use, which has a significant effect on food security at the 10% level of significance. Also, Desalegn et al. (2017) found similar results in their study on the determinants of graduation from the PSNP in the Babile district, Oromia region, Ethiopia, revealing that education was a significant factor in determining household graduation, with the binary logistic regression results showing that a unit increase in education level increased the likelihood of graduating from the safety net program by 43.6%. Furthermore, Hayalu (2014) found similar results in his study on the determinants of graduation from PSNP in the Raya Azebo District of Tigray Region, reporting that education had a significant and positive impact on graduation, with each additional year of education increasing the probability of graduation by 5% at the 5% level of significance.

In summary, the educational background of the household head significantly influences graduation from the PSNP, with higher education levels increasing the probability of graduation by 8.28%. However, challenges such as limited resources and large family sizes hinder access to quality education, affecting households' ability to meet educational needs. Similar studies support the finding that education is crucial for improving food security and enhancing household decision-making, further contributing to successful graduation from the PSNP.

Oxen holding: Ox ownership has been another crucial factor for household graduation from the PSNP, and affects household graduation positively. The descriptive statistics show a significant association between beneficiaries and graduated households concerning ox holding, significant at the 1% level. Of the total sample, only 73 (39.24%) households were ox holders, while the remaining 113 (60.75%) households did not own oxen. In the econometric results, the ox holding of the household has an odds ratio of 9.23907, which is greater than one, indicating that ox holding has a positive effect on household graduation from the PSNP. The marginal effect of ox holding is 0.260323, suggesting that an increase in tropical livestock units leads to a 26.03% increase in the probability of graduation from the PSNP, holding other factors constant. This means that households that own oxen have a 26% higher probability of graduating compared to those without oxen.

According to the KIIs and FGDs, households in the study area also reported facing significant challenges in owning oxen primarily due to the limited amount of PSNP transfer they receive. Even though households that own oxen generally have better livelihoods compared to those without oxen, their income is still very constrained, making it difficult for them to acquire these valuable livestock assets.

The KII responses emphasize the crucial importance of owning oxen for households in the study area, as oxen are essential for agricultural activities like plowing. Households that own oxen have a higher probability of graduating from the PSNP compared to those without livestock assets. Owning oxen enables households to engage in more productive activities, which can lead to improved food security and increased income. However, the FGD responses indicate that the small size of the PSNP transfer received by households is a major obstacle in acquiring oxen. This challenge is exacerbated by the fact that the transfer amounts provided through the PSNP are often insufficient to meet the basic needs of households, let alone allow them to invest in productive assets such as oxen.

This study supports the findings of Yibrah (2013), which indicates that livestock holding was a significant factor in determining household graduation from the PSNP in Eastern Tigray, Ethiopia. The binary logistic regression results showed that households that owned livestock had a 28% higher probability of graduating compared to those without livestock, significant at the 1% level. Similarly, the study by Gebresilassie (2013) in Tigray, Ethiopia, also found that ox holding had a positive effect on graduation.

In summary, ox ownership is a critical factor in enhancing the likelihood of graduation from the PSNP, with households that own oxen having a 26.03% higher chance of graduating. Despite this positive correlation, systemic barriers, particularly limited financial resources and insufficient PSNP transfers, challenge households' ability to invest in and maintain livestock.

Off-farm income of the Sample Households: Off-farm income plays a vital role in enhancing the livelihoods of households participating in the PSNP. It provides an additional source of income that helps diversify household assets and reduces reliance on the program. Households with access to off-farm income are better positioned to meet their basic needs, invest in productive activities, and accumulate assets, which are essential for graduating from the PSNP. Although descriptive statistics indicated no significant mean difference in off-farm income between beneficiaries and graduated households, the positive odds ratio suggests that participation in off-farm activities positively affects graduation. Specifically, a one-unit increase in off-farm income is linked to a marginal effect of 0.0018% in the likelihood of graduation.

KIIs and FGDs results (see Appendix 1) emphasize that off-farm income is crucial for supporting food consumption among households in the study area. Respondents noted that off-farm income supplements their resources, enabling them to meet food needs. However, several factors influence the availability and magnitude of off-farm income, including access to markets, employment opportunities, and the education and skills of household members. Households with better market access and diverse employment opportunities tend to generate higher off-farm income, which positively impacts their probability of graduating from the PSNP.

Similar findings are reported in various studies. Yibrah (2013) found that off-farm income significantly impacts graduation, with a one-unit increase leading to a 0.371 marginal effect on the likelihood of graduation. Desalegn et al. (2017) reported a similar finding, where a one-unit increase in off-farm income resulted in a 0.42 marginal effect on graduation likelihood. Sabates-Wheeler et al. (2012) also confirmed that households with higher off-farm income are more likely to graduate. Furthermore, Arene and Anyaeji (2010) indicated that increased engagement in off-farm activities correlates with greater food security, with a marginal effect of 0.0000122, suggesting that an increase in off-farm income by 1,000 birr raises the likelihood of graduation by 0.122%.

In summary, off-farm income significantly enhances the likelihood of households graduating from the PSNP by providing a supplementary income source. This diversifies assets, reduces reliance on the program, and enables households to meet basic needs and invest in productive activities, which are crucial for graduating from the PSNP.

Access of the Households to fertilizers: Access to fertilizers is an important variable affecting household productivity and can facilitate graduation from the PSNP. The descriptive statistics revealed that 161 (86.56%) households had access to fertilizers,

while the remaining 25 (13.44%) did not. The binary logistic regression results indicate that limited access to fertilizers has a significant negative impact on the likelihood of graduation, with households having less access having a 0.239155 lower marginal effect on the probability of graduation compared to those with greater access.

KIIs and FGDs highlight that a critical challenge faced by households in the study area is limited access to fertilizers due to repayment problems. This challenge is particularly significant for households relying heavily on agriculture and transfers as their primary source of income. The limited access to fertilizers has a substantial impact on agricultural productivity, leading to reduced crop yields and income, which exacerbates poverty and limits the household's ability to graduate from the PSNP.

Similar findings are reported in other studies. Yibrah (2013) found that households with limited access to fertilizers had a lower probability of graduating from the PSNP compared to those with better access. Desalegn et al. (2017) also highlighted the importance of access to fertilizers in graduation, with households lacking access facing challenges in meeting the graduation criteria.

In summary, access to fertilizers is a critical factor influencing household productivity and graduation from the PSNP. Limited access, often due to repayment problems, negatively impacts agricultural yields and income, hindering households' ability to meet graduation criteria and exit the program.

Access of the Households to Irrigation: Access to irrigation is a crucial factor influencing household productivity and graduation from the PSNP. The study indicates that irrigation significantly enhances crop growth and agricultural productivity, helping farmers mitigate risks related to climate variability and drought. Specifically, the descriptive statistics revealed a significant association between beneficiaries and graduated households regarding access to irrigation. Out of the total sample, only 23 (12.4%) households utilized irrigation, while 163 (87.6%) did not. The logistic regression analysis showed that access to irrigation has a substantial positive effect on household graduation, with an odds ratio of 7.71092, suggesting that households with access to irrigation are more likely to graduate from the PSNP. The marginal effect indicates that an increase of one hectare in irrigated land increases the probability of graduation by 23.9155%, holding other factors constant.

KIIs and FGDs corroborate these findings, indicating that households engaged in irrigation activities experience improved livelihoods and a higher likelihood of graduating from the PSNP. Participants emphasized that irrigation is essential for controlling water supply to crops, thereby ensuring optimal growth and yield. However, challenges such as limited land size, land siting, and water access hinder many households from utilizing irrigation effectively.

These findings align with similar previous studies in the field. For instance, Hashemi and Montesquieu (2011) noted that community infrastructure, particularly irrigation, enhances households' pathways to food self-sufficiency. Berhane et al. (2013) also highlighted that access to irrigation significantly affects productivity and food self-sufficiency. Additionally, Desalegn and Yu (2017) reported that community-based equipment, especially irrigation facilities, improves food self-sufficiency among households.

Thus, access to irrigation plays a fundamental role in enhancing agricultural productivity and improving household livelihoods, which is essential for graduation from the PSNP. The significant positive impact of irrigation on graduation likelihood underscores the need for improved access to irrigation facilities.

Access to credit: Access to credit is a critical factor influencing household food security and graduation from the PSNP. Credit enables farmers to invest in agricultural inputs like seeds, fertilizers, and irrigation, increasing productivity and crop yields. It also helps diversify livelihoods and smooth consumption during lean periods. Descriptive statistics revealed no significant difference between beneficiary and graduated households regarding credit access; 33.33% had access, while 66.67% did not. Logistic regression showed a negative correlation between credit access and graduation, with an odds ratio of 0.364, indicating an 11.83% reduced probability of graduation at 5% significance. KIIs and FGDs highlighted challenges of limited credit, high interest rates, and collateral requirements. Informal lenders charge exorbitant rates, complicating repayments and forcing reliance on PSNP transfers, straining finances. Collateral demands restrict credit access for asset-poor households. Participants noted credit is often used for daily expenses rather than investment, depleting emergency funds. Similar studies (Berahne et al., 2013; Arega, 2012) report negative or insignificant impacts of credit on PSNP graduation, attributing this to high interest, collateral, repayment difficulties, and lack of trust. In summary, access to credit negatively correlates with graduation probability, hindered by credit constraints that limit effective investment.

5. Conclusion and Recommendations

The objective of this study was to identify the determinants of household graduation from the PSNP. A cross-sectional survey was employed, utilizing both quantitative and qualitative research approaches, with a binary logistic regression model for analysis. The regression results show that seven variables, namely family size, education level, holdings of oxen, off-farm income as well as access to fertilizers, irrigation, and credit affect household graduation from the PSNP significantly. Furthermore, qualitative data gathered from key informant interviews (KII) and focus group discussions (FGD) revealed additional factors influencing household graduation: insufficient payments from the PSNP, the considerable time required for public work, weak formal credit institutions, and high interest rates. To address these issues, promoting family planning services and conducting awareness campaigns can help manage family size effectively. Increasing

access to agricultural inputs, such as fertilizer subsidies and irrigation infrastructure, is crucial for boosting productivity. Supporting off-farm income through skill development and microfinance can diversify income sources. Additionally, strengthening financial institutions to provide accessible credit and offering financial literacy training will enable better financial management. Addressing these factors can enhance the effectiveness of the PSNP and promote sustainable livelihoods for beneficiaries. This study provides valuable insights for policymakers and program implementers.

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