Resilience to Household Food Insecurity of Households Graduated from Productive Safety Net program Pursuing Different Livelihood Strategies in Rural Konso, Ethiopia

ABSTRUCT

This paper attempts to address household resilience to food insecurity of households graduated from productive safety net program (PSNP) who pursued different livelihood strategies in rural Konso. The objective of the study is to measure the level of resilience of households to food insecurity by using the resilience approach that analyzes the present characteristics of household's ability or the way a household copes with, withstands and recover from shocks based on the options available in terms of capabilities, assets and activities. For this study resilience index (RI) is defined as function of income and food access, asset possession, adaptive capacity, access to basic services, and agricultural practices and technologies. The estimation of each latent variable was made separately using different multivariate techniques, where the result becomes covariates in the measurement of resilience index. Factor analysis using principal component factor was employed to examine the components of resilience and the percentage variance explained by each of the components. The factor variance obtained for each factor from the analysis was multiplied by the generated factor to develop the RI of each household. Accordingly, factor loadings of each observed variables and their correlation to their respective latent dimensions were found high except in the case of observed variables such as farm land, periodic maintenance of conservation measures, artificial insemination services for asset possession, adaptive capacity, and agricultural practices and technologies respectively. The relative size of factor loading of each variable has important policy implication. However, less factor loadings and correlation doesn't mean that these observed variables are less important but since the sample households were graduates of PSNP with less land or nearly land less, maintenance of conservation measures are capital and labor intensive indicating that these households do not have capacity to afford maintenance expenses. The study also found that resilience index across different livelihood strategies has shown significant differences implying that households who diversified their livelihoods were relatively resilient. Therefore, the government should give due attention for developing other rural development packages as like to agricultural technology packages in its rural development strategies intended to transform rural non-farm economy.

Key words,

Resilience, food insecurity, household, livelihood strategy, factor loadings, Konso

1. INTRODUCTION

Ethiopia is one of the fastest growing economies in Sub-Saharan Africa (SSA) with growth rates averaging 11 percent over the last decade which is about double of the average growth rate for SSA (UNDP, 2014). Alemayehu and Addis (2014) have also confirmed this inspiring achievement in their economic appraisal that the growth of the economy was in fact quite

impressive with an average growth rate of about 9 percent per annum since 2000. According to these authors, if the abnormal first three years are left out and the growth rate is computed from the year 2003, the average annual growth rate is about 11 percent for consecutive 9 years. While the economy continues to grow impressively, poverty and food insecurity still remains to be a major challenge in rural areas in both highland and lowland contexts making the country highly vulnerable to a wide range of climate change induced natural as well as man-made disasters (MoA, 2012).

Consequently, Ethiopia is one of the poor countries that heavily depend on external food support, receiving about 5% of the total food aid given to Africa (Berhan, 2010). Food insecurity can be said to be the identification of Ethiopia in terms of recurrent food crisis and famines, and responses to food insecurity have conventionally been dominated by emergency food-based interventions. However, the past decades of large scale food aid deliveries have done little to prevent households' asset depletion because of ignorance of incorporating these aids with natural resource management (Devereux *et al*., 2006). As one of its resilience strategies, Ethiopian government has designed and established Productive Safety Net Program (PSNP) in 2005 as part of the national social protection policy to address the underlying causes of chronic food insecurity in the rural communities.

Drought and food insecurity coupled with poverty in most fragile rural communities of Ethiopia in general and Konso in particular, appear to be very frequent. Due to this frequent drought that has characterized the study area coupled with land fragmentation due to ever continuing population growth, the government declared Konso as one of the drought prone and food insecure area and hence since 2005 the chronically food insecure rural people of study area have been getting predicted transfer from the PSNP in return for public works beneficiaries and direct for the direct support beneficiaries (WoA, 2015).

2. RATIONALE FOR RESILIENCE APPROACH

Productive Safety Net Program is the main focus of the country. The government has been seriously looking after PSNP and carryout assessment to see its effectiveness and performance. At national level, several assessment and studies were made on productive safety net program. To list a few, Gilligan *et al*. (2008) and Anderson *et al*.(2009). Ministry of Agriculture has

conducted enhanced social assessment and consultation to draw lessons from the previous phases and ensure that the design of PSNP 4 is inclusive and equitably supports the most vulnerable and underserved populations in Ethiopia and expected to realize its advanced objective saying, 'resilience to shocks and livelihoods enhanced and food security and nutrition improved for rural households vulnerable to food insecurity' (MoA, 2014). Some authors discussed the key strengths of PSNP in covering very large number of beneficiaries and its unique institutional coordination (Klaus *et al*., 2013; Hermela, 2015). These authors also appreciated the strong monitoring and evaluation and its capacity to improve itself through different feedback practices. However, they questioned the resilience aspects of PSNP. "Are PSNP and HABP really graduating resilient clients out of chronic food insecurity? This study is, therefore, intended to see the level of resilience of households graduated from the PSNP pursuing their respective livelihood strategies that would lead to different level of household resilience to food insecurity. Operationally, resilience is defined as the capacity of the households to absorb the negative effects of unpredictable shocks and long term stresses. It is a relatively new concept in development discourse and has captured the attention of many audiences (Constas *et al*, 2014).

Social Safety Net Program is an international concern like Ethiopia. There are several studies on social safety net like productive safety net program of Ethiopia in different developing countries. To mention a few of these works carried out in Nigeria, Bangladesh and Pakistan by Olarinde and Kuponiyi (2005); Khan (2013) and Khan *et al*. (2013) respectively. Nevertheless, none of these studies said anything about resilience aspect of their respective safety net programs. Moreover, in Ethiopia extensive studies were carried out on the contribution of PSNP in addressing the underlying causes of chronic food insecurity while said little about household resilience to food insecurity. Hermela (2015) in her study assessed the role of PSNP in helping households to build resilience to food insecurity. Nevertheless, though her effort is appreciated, it is more of qualitative and lacks the quantitative measurement of resilience employed by Alinovi *et al.* (2008 ; 2010). The rationale of this study is therefore to bring up what is lacking or gaps of previous studies that failed to present quantitative assessment of households resilience to food insecurity.

Food security researches often employee vulnerability approach. Although forward-looking models, all statistical methods of vulnerability analysis have been static and are unable to predict future events for it has both conceptual and empirical problems (Alinovi *et al*., 2009). According to Walker *et al*. (2002) as cited in Guyu and Muluneh (2015) an alternative approach to vulnerability analysis is resilience that maintains the capacity of a system to cope with the shock whatever the future brings (i.e. at a given cost) when undergoing changes. Resilience is such an approach that has emerged as a plausible framework for substantially improving the capacity of people to withstand future shock and stresses (Frankenberger and Nelson, 2013).

3. RESEARCH METHODOLOGY

3.1 Description of the Study Area

Konso woreda is located in the Segen Area Peoples Zone in Southern Nations Nationalities and Peoples Region, and is situated about 600km south of the nation's capital, Addis Ababa. 96% are rural dwellers and the settlement is concentrated in mid altitude. 70% of the area fall under hot low land agro-ecological zone whereas the remaining 30% fall under mid altitude. Topographically, comprised of rugged landscape which is predominantly composed of many hills and is part of volcanic-sedimentary region characterized by a relief of medium mountains, between 1400 - 2000m above sea level.

Konso is known for its industrious people who endowed with extraordinary skill and knowledge especially, in soil and water conservation practices. Pleasantly, the terraces are unique and have striking features which have almost covered the whole middle altitude areas of the district. They managed to survive in the marginal environment using indigenous knowledge and skills that enabled them to make optimal use of unfavorable terrain and climatic conditions in innovative manner as a survival strategy over centuries. This creative and noble work culture has qualified Konso people in 1995 for UN prize among the best fifty communities all over the globe and surprisingly, they deservingly won the award.

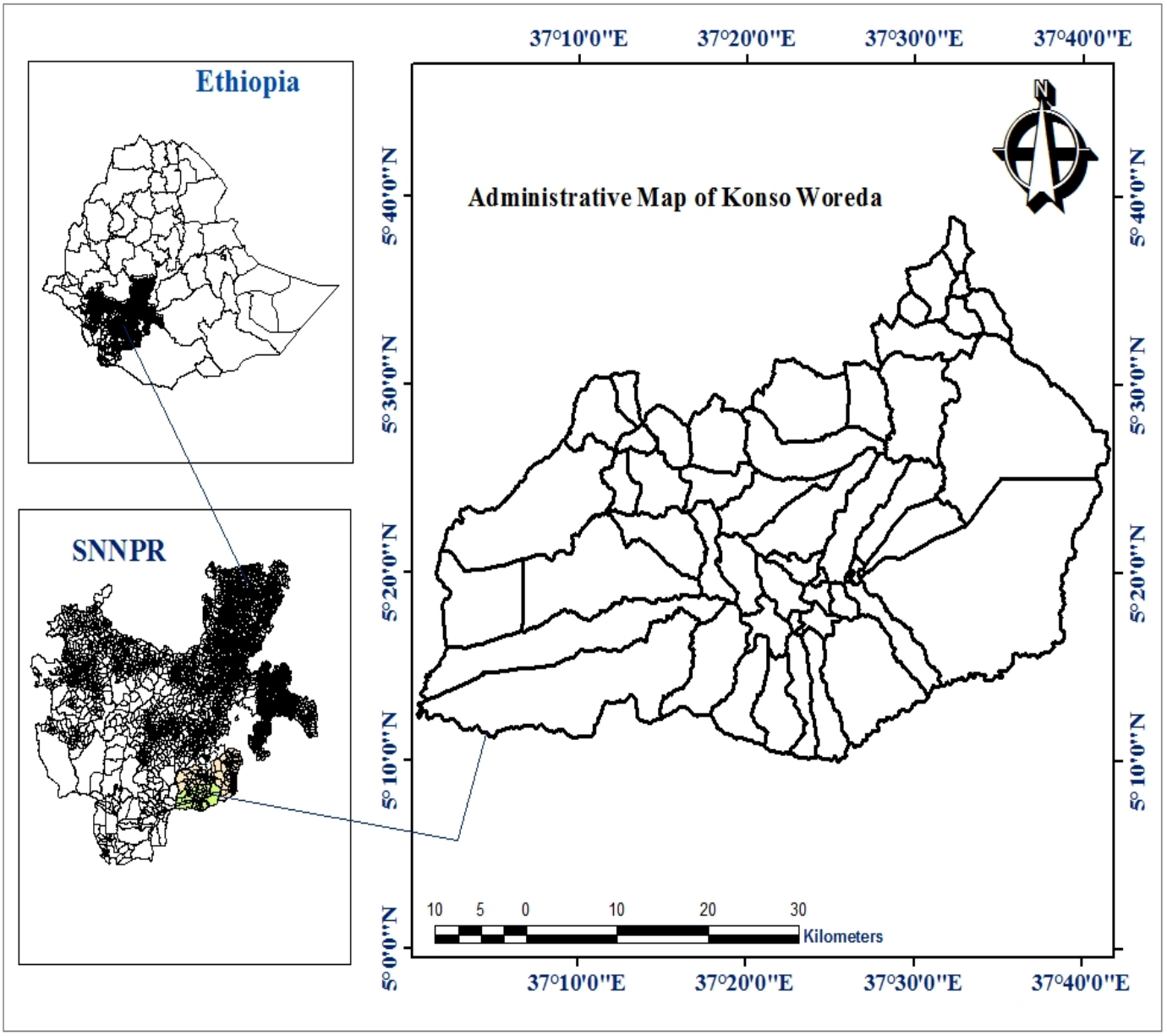

Figure 1. Map of the study area

Source: CSA, 2007

3.2 Sampling and Data Description

In this study, both primary and secondary data were collected. Primary data collection was mainly based on a survey. Probability and non-probability sampling was employed to select respondents for qualitative data collection.

A multi-stage sampling technique was employed with clear description for purposive sampling of the study area. At the first stage, Segen Area Peoples Zone was purposely selected from the existing zones of the region. At the second stage, Konso district was purposely selected for the study for the following main reasons. Firstly, it is known for its drought proneness among the existing other districts of the zone and officially disclosed by the government as the chronically food insecure district. Secondly, PSNP beneficiary concentration is very high (50.3% of total zone share) as compared with other districts in the zone.

At third stage, six PSNP targeted kebeles (smallest unit of government structure) were randomly selected, which were distributed over the existing agro-ecologies of the district. The district has two agro-ecological zones, 70% is low land and the remaining 30% is mid altitude. Accordingly, four PSNP targeted kebeles were selected from low land and the remaining two PSNP targeted kebeles were selected from mid altitude. For each selected kebele, sampling frame of PSNP graduated households was prepared by their respective kebele agriculture office upon the request from the researcher. Finally, at the fourth stage, systematic random sampling technique was employed to select PSNP graduated households by assuming that the livelihood strategies that PSNP graduated households pursued in each kebele is heterogeneous. As result, Proportionate Probability Sampling (PPS) technique was employed to get proportionate samples from each kebele as per their population size for both male and female headed households graduated from PSNP.

3.3 Data Analysis

In this study household resilience to food insecurity was assessed. Resilience is not observable per se and hence considered as latent variable. Similarly, its latent dimensions are also latent because they cannot be directly observed in a given survey and hardly possible to estimate but it is possible to estimate them through multivariate techniques. The data collected from each observed variables of each latent dimension of the resilience was analyzed by using factor

analysis. For this purpose, two steps of analysis were undertaken. At first stage, relevant multivariate analysis was run using available indicators of each latent dimension separately as done in Alinovi *et al* (2008, 2009 & 2010). Then, relevant observed variables were selected based on the factor loadings and other statistical criteria such as KMO-statistics of sampling adequacy, Bartlett's test of sphericity, communalities, and variance explained by the factor generated. At the second stage, these selected variables were used to estimate the respective final latent dimensions that are later used to estimate the overall resilience index.

Hence, the resilience index for a household i is expressed as follows:

$$RI_i = f\,(IFA_i\,,\ AP_i\,,\ ABS_i\,,APT_i\,,AC_i\,)$$

Where: RI = Resilience Index; IFA = Income and Food Access; AP = Asset Possession;
ABS = Access to Basic Services; APT = Agricultural Practices and Technologies;
AC = Adaptive Capacity;

A PCA was used to examine the components of resilience and the percentage variance explained by each of the components. According to the approach proposed by Alinovi *et al*. (2010), the factor variance obtained for each factor from the PCA was multiplied by the generated factor to develop the RI of each household. The formula is described as follows:

$$RI = V_1*F_1 + V_2*F_2 + V_n*F_n$$

4. RESULTS AND DISCUSSION

4.1 Income and Food Access

This latent dimension is directly related to household's capacity to absorb shocks. Food access is the economic capacity of a household to afford food, which requires a household to have income for food consumption expenditure. Average dietary energy consumption is included to take caloric adequacy at household level, which is calculated from average kilo calorie intake per adult equivalent per day. Household food insecurity access scale and coping strategy index that looks at the perception and behaviors exercised by the PSNP gradated households is also included in order to cope with a food deficit.

193 Table 1. Eigen values of each fact0r

Factor	Eigen value	Difference	Proportion	Cumulative
Factor 1	3.38250	2.59259	0.6765	0.6765
Factor 2	0.78991	0.45966	0.1580	0.8345
Factor 3	0.33025	0.02642	0.0660	0.9005
Factor 4	0.30383	0.11030	0.0608	0.9613
Factor 5	0.19352		0.0387	1.0000

194 LR test: independent vs. saturated: chi2(10) = 874.32 Prob>chi2 = 0.0000, source: factor
195 analysis result (2017)

196 Kaiser criterion suggests to retain those factors with eigen values equal or higher than 1.
197 Accordingly, for this dimension factor one is retained which explains about 67.7% of the total
198 variance. The factor produced is quite meaningful and can be considered as the underlying latent
199 variable for food and income access (Table 1). The KMO measure of sampling adequacy is 0.81
200 indicating that the sample size was adequate for running factor analysis and indicating a reliable
201 first principal component representing IFA (Table of KMO values is not presented). This well
202 fits the suggestion of Field (2005) that KMO statistics should be greater than 0.5 if sample size
203 and the proportion of variance in variables that might be caused by underlying factors are
204 adequate for running factor analysis. The result of this study shows that Bartlett's test was
205 significant (p = 0.000) and Chi-square =588.92) suggesting that the factor analysis was
206 appropriate with the data available for this study (Table is not shown).

207 Table 2. Factor loadings, uniqueness and correlation with income and food access (IFA)

Variables	Factor 1	Uniqueness	IFA
Income (INC)	0.8119	0.3408	0.8308
Expenditure (EXP)	0.7034	0.5053	0.7304
Calorie intake (CAL)	0.8668	0.2487	0.7735
Household Food Insecurity Access Scale (HFIAS)	-0.8673	0.2477	-0.8561
Coping Strategy Index (CSI)	-0.8515	0.2750	-0.8454

208 Source: factor analysis result (2017)

209 These indicators play important role in estimating the IFA dimension although they differ in their
210 correlation coefficients. As expected, the factor loadings and correlation coefficients of income
211 (INC), expenditure (EXP) and calorie intake (CAL) are positive while of household food

insecurity access scale (HFIAS) and coping strategy index (CSI) are negative. All the five variables have high correlation and play almost the same role in estimating the IFA, because the magnitude of their factor loadings and correlation coefficients are similar. As expected, HFIAS and CSI have a negative correlations since their respective score increases when food security declines (Table 2). The relative size of factor loading of each variable has therefore important policy implication

4.2 Asset Possession

This dimension is a crucial aspect of household resilience because the more a household possess asset such as land and livestock, the more that household copes with a shock and becomes more resilient. For this study, three observed variables were used to estimate the AP component as they were very essential for a farm household. These are farm land, livestock ownership and farm implements. This component measures the impact on resilience of assets important for agricultural production. It has been computed by adding all the farm plots the PSNP graduated household possesses at different sites in hectare, animals owned by the PSNP graduated household in tropical livestock unit (TLU) and farm implements computed as the sum of the monetary values for the farm implements the PSNP graduated household owns.

Table 3. Eigen values of each factor

Factor	Eigen value	Difference	Proportion	Cumulative
Factor 1	1.33731	0.34114	0.4458	0.4458
Factor 2	0.99617	0.32966	0.3321	0.7778
Factor 3	0.66651		0.2222	1.0000

LR test: independent vs. saturated: chi2(3) = 35.20 Prob>chi2 = 0.0000, source: factor analysis result (2017)

According to the Kaiser criterion, for this dimension the factor retained has eigen value of 1.337 that accounted for about 44.6% of the variation. The factor produced is quite meaningful and can be considered as the underlying latent variable for asset possession. The KMO) measure of sampling adequacy is 0.4979. indicating that the sample size was nearly adequate for running factor analysis and indicating a reliable first principal component representing AP. (Table 3).

Bartlett's test was significant (p = 0.000) and Chi-square = 35.085 suggesting that the factor analysis was appropriate with the data available for this study.

Table 4. Factor loadings, uniqueness and correlation with Asset Possession(AP)

Variables	Factor 1	Uniqueness	AP
Farm land (FLAND)	0.2172	0.9528	0.2172
Farm implements (FIM)	0.8152	0.3355	0.8152
Tropical Livestock Unit (TLU)	0.7909	0.3744	0.7909

Source: factor analysis result (2017)

These indicators play important role in estimating the AP dimension although they differ in their correlation coefficients. As expected, the factor loadings and correlation coefficients of indicators are positive. Except farm land other two indicators have high correlation and play almost similar important role in estimating the AP, because the magnitude of their correlation coefficients are similar (Table 4). The relative size of factor loading of each variable has therefore important policy implication. As it can be seen from the Table 4, the factor loading of farm land is very small (0.217). However, this does not mean that the land has less importance for the rural livelihood resilience rather indicates less farm land ownership of PSNP graduated households confirming that there was fair selection of the beneficiaries as landownership used to be one of the selection criteria for the program

4.3 Adaptive Capacity

This is another important dimension of resilience, which measures the household's ability to adapt and react to shocks. Adaptive capacity refers to the level of access to and exploits benefit therein from resources in order to deal with shocks (Frankenberger *et al*., 2012). Education average as one of the observable indicator is used in the estimation of adaptive capacity, which is the average of years of education completed by PSNP graduated household members. The other variable included to estimate this latent variable is diversified sources of income. It was based on the premises that a diversified sources of income leads to a greater adaptive capacity. Furthermore, based on the flexibility principle of resilience, periodic maintenance of conservation structure is also addressed as one of the observable variables in this study, since the study area Konso is known for its conservation practices

Table 5. Eigen values of each factor

Factor	Eigen value	Difference	Proportion	Cumulative
Factor 1	1.82428	0.76355	0.4561	0.4561
Factor 2	1.06074	0.39760	0.2652	0.7213
Factor 3	0.66314	0.21130	0.1658	0.8870
Factor 4	0.45184		0.1130	1.0000

LR test: independent vs. saturated: chi2(6) = 161.24 Prob>chi2 = 0.0000, source: factor analysis result (2017)

Two factors, factor 1 and factor 2 were retained with eigen values of 1.824 and 1.060 respectively that accounted for about 72.3% of the variation. The factor produced is quite meaningful and can be considered as the underlying latent variable for adaptive capacity (Table 5). The KMO measure of sampling adequacy is 0.587 indicating that the sample size was adequate for running factor analysis and indicating a reliable first principal component representing adaptive capacity. Moreover, Bartlett's test was significant (p = 0.000) and Chi-square = 160.697 suggesting that the factor analysis was appropriate with the data available for this study.

Table 6. Factor loadings, uniqueness and correlation with Adaptive capacity(AC)

Variables	Factor 1	Factor 2	Uniqueness	AC
Income diversity (ID)	0.7424	-0.4446	0.2511	0.8057
Employment ratio (ERP	0.7129	0.1964	0.4532	0.6707
Education average (EDU)	0.8350	-0.0546	0.2997	0.8326
Periodic maintenance of conservation measure	0.2600	0.9064	0.1109	0.1067

Source: factor analysis result (2017)

The three observed variables on the first factor have high factor loadings while periodic maintenance of conservation structure has high factor loading on the second factor. The income diversity and education average on the second factor loading have negative values while the factor loading for the education average is very low (-0.055). As expected, all variables are positively correlated to the AC. Periodic maintenance of conservation structure has low (0.107) correlation with adaptive capacity, confirming the finding of Tesfaye (2003) which says

conservation based farming system in Konso community is degrading due to some internal and external factors.

4.4 Access to Basic Services

Though it is beyond the control of sample households, access to basic services is a key factor for enhancing households' resilience by improving their access to assets (Alinovi *et al*, 2009). It is true that better access to basic services (ABS) affects the capacity of households to manage risks and respond to crisis. The observable variables addressed in this latent component were telecommunication, distance to water, distance to work, school dropout, credit access, market distance and health station distance. The average distance to reach the nearest available services is taken as a proxy for representing ABS .

Table 7. Eigen values of each factor

Factor	Eigen value	Difference	Proportion	Cumulative
Factor 1	1.45841	0.10023	0.2083	0.2083
Factor 2	1.35818	0.34735	0.1940	0.4024
Factor 3	1.01083	0.01633	0.1444	0.2468
Factor 4	0.99450	0.13054	0.1421	0.6888
Factor 5	0.86396	0.14759	0.1234	0.8123
Factor 6	0.71638	0.11864	0.1023	0.9146
Factor 7	0.59774		0.0854	1.0000

LR test: independent vs. saturated: chi2(21) = 90.11 Prob>chi2 = 0.0000, source: factor analysis result (2017)

In this component three factors, factor 1, factor 2 and factor 3 were retained with eigen values of 1. 458, 1.358 and 1.011 respectively that accounted for about 54.67% of the total variation. The factors produced are quite meaningful and can be considered as the underlying latent variable for access to basic services (Table 7). The KMO measure of sampling adequacy is 0.514 indicating that the sample size was adequate for running factor analysis and indicating a reliable first principal component representing ABS. Furthermore, Bartlett's test was significant (p = 0.000)

and Chi-square = 93.299 suggesting that the factor analysis was appropriate with the data available for this study.

Table 8. Factor loadings, uniqueness and correlation with Access to basic Services (ABS)

Variables	Factor 1	Factor 2	Factor 3	Uniqueness	ABS
Telecommunication (TEL)	-0.0018	0.7795	-0.1230	0.3772	-0.0061
Distance to water (WAT)	0.8069	-0.0702	0.1449	0.3229	0.8151
Distance to work (DTW)	0.7580	0.1579	-0.1153	0.3872	0.7482
School dropout (SDO)	-0.1139	0.2601	0.2603	0.8516	-0.0925
Credit access (CRE)	0.0582	0.7872	0.0525	0.3742	0.0669
Market distance (MKTD)	-0.0605	-0.0255	0.8004	0.3551	-0.0771
Health station distance (HSTD)	0.3544	-0.0735	0.6039	0.5043	0.3981

Source: factor analysis result (2017)

Except access to health station, each of observed variables loaded to different components/factors but only one factor with high loadings while the rest are with low loadings below the suggestion of Peterson (2000). Access to health station loaded to both factor one (0.35) and factor three (0.63). Distance to water and work have loaded to factor one where as access to phone network and access to credit have loaded to factor two and access to market loaded to factor three (Table 8). As it was expected access to credit was positively correlated with the estimated ABS while the correlation was so weak indicating that sample households had less access to credit. This is also confirmed by the qualitative aspect of this study.

Access to phone network by PSNP graduated household head or any members in the household enable farmers to obtain updated information on their crop and livestock prices, agricultural input prices such as price of fertilizer and improved seeds, insecticides and pesticides. This helps farmers to make aware of where to sell their products and livestock. Contrary to the expectation access to telecommunication correlated negatively with access to basic services. This can be explained by less access to phone network due to the capacity limitation of the PSNP graduated households that they could not afford to buy mobile phones like other better-off farmers.

4.5 Agricultural Practices and Technologies

This resilience component is directly related to the household's degree of production capacity. The observable variables that are expected to generate this latent variable are organic fertilizer, inorganic fertilizer, veterinary services and artificial insemination. In fact, there are also other factors such as pesticides and extension contact that could generate this variable but for this

study based on the context of the study area the researcher focused on the first four observable variables. Farmers of the study area often use organic fertilizers such as cattle manure to boost up their crop production and hence included to check for the regular use of it to maintain their soil fertility

Table 9. Eigen values of each factor

Factor	Eigen value	Difference	Proportion	Cumulative
Factor 1	1.57360	0.56757	0.3934	0.3934
Factor 2	1.00603	0.20998	0.2515	0.6449
Factor 3	0.79605	0.17173	0.1990	0.8439
Factor 4	0.62433		0.1561	1.0000

LR test: independent vs. saturated: chi2(6) = 70.94 Prob>chi2 = 0.0000, source: factor analysis result (2017)

For this component two factors, factor 1 and factor 2 were retained with eigen values of 1. 574, and 1.006 respectively that accounted for about 64.49% of the total variation. The factor produced is quite meaningful and can be considered as the underlying latent variable for agricultural practices and technologies (Table 9). The KMO measure of sampling adequacy is 0.587 indicating that the sample size was adequate for running factor analysis and indicating a reliable first principal component representing APT. This well fits the suggestion of Field (2005) that says KMO statistics should be greater than 0.5, if sample size and the proportion of variance in variables that might be caused by underlying factors are adequate for running factor analysis. Furthermore, Bartlett's test was significant (p = 0.000) and Chi-square = 70.702 suggesting that the factor analysis was appropriate with the data available for this study.

Table 10. Factor loadings and correlation with Agricultural Practices and Technologies (APT)

Variables	Factor 1	Factor 2	Uniqueness	APT
Organic fertilizer (ORG)	0.7215	0.2571	0.4133	0.7568
Inorganic fertilizer (INO)	0.5536	0.5404	0.4016	0.6447
Veterinary services (VET)	0.7606	-0.2527	0.3576	0.7001
Artificial insemination services (INS)	-0.0392	0.8663	0.2479	0.1231

Source: factor analysis result (2017)

Use of both organic and inorganic fertilizers and having more access to veterinary services play significant role in estimation of APT. As it was expected all the observable variables have positive correlation with APT and correlations between each variable and APT is higher whereas artificial insemination is less important (Table 10). These variables are the most import inputs for boosting agricultural production whereby food is available at household level. Often use of these agricultural inputs enables PSNP graduated households to produce more and as the result households would have more options and enhance their capability to escape from food insecurity and relatively become more resilient to food insecurity.

4.6 Estimation Result of Resilience

The variables estimated in the previous sub-sections become co-variates in the estimation of the resilience index by assuming that all the estimated components are normally distributed with zero mean and variance equal to 1, where by a factor analysis was run using principal component factor method. In this factor analysis the first two factors, factor 1 and factor 2, were retained with an eigen values of 2.219 and 1.071 explaining about 71.24% of the total variation (Table 11). The KMO measure of sampling adequacy for resilience is 0.707 indicating that the sample size was adequate for running factor analysis and indicating a reliable first principal component representing resilience index.

Table 11. Eigen values of each factor for resilience index

Factor	Eigen value	Difference	Proportion	Cumulative
Factor 1	2.21959	1.14810	0.3699	0.3699
Factor 2	1.07149	0.08785	0.1786	0.5485
Factor 3	0.98364	0.22147	0.1639	0.7125
Factor 4	0.76217	0.17134	0.1270	0.8395
Factor 5	0.59083	0.21855	0.0985	0.9380

LR test: independent vs. saturated: chi2(15) = 276.29 Prob>chi2 = 0.0000, source: factor analysis result (2017)

As expected all the latent dimensions have positive correlation with resilience index and except access to basic services all the remaining four latent dimensions have high correlation with the

resilience index (Table 12). Accordingly income and food access, asset possession, agricultural practices and technologies and adaptive capacity are very important components in enhancing resilience. In particular, asset holding is the most important component in resilience of smallholder farmers, which represent household's level of wellbeing. Among the dimensions of resilience, APT is negatively related to the second factor implying that farmers with poor agricultural practices and technologies are less resilient to food insecurity.

Table 12. Factor loadings and their respective correlation with resilience index (RI)

Resilience dimensions	**Factor 1**	**Factor 2**	**Uniqueness**	**RI**
Income and Food Access (IFA)	0.8538	0.0298	0.2701	0.8529
Asset Possession (AP)	0.7435	0.0039	0.4472	0.7432
Agricultural Practices and Technologies (APT)	0.5160	-0.2324	0.6797	0.5212
Adaptive Capacity (AC)	0.8017	0.1082	0.3456	0.7990
Access to Basic Services (ABS)	0.0989	0.8307	0.6662	0.0800

Source: factor analysis result (2017)

4.7 Status of Resilience Across Livelihood Strategies

The analysis of resilience and its components by livelihood strategy has generated insightful results. When we compute the difference between each livelihood strategy index and the overall resilience index for the PSNP graduated households (Table 13), those households pursued both combination, farm plus off-farm plus non-farm were relatively tending to be resilient (2.436), followed by farm plus non-farm combination (0.081) while for the farm plus off-farm (-0.524) and farm alone (-0.590) was the worst. Similarly, the indexes of resilience dimensions for the first two livelihood options (farm alone and farm plus off farm) are negative for the second livelihood strategy. For the livelihood option (farm plus non-farm) income and food access, adaptive capacity and access to basic services have positive indexes whereas asset possession, and agricultural practices and technologies have negative indexes while all the five latent components have positive indexes for fourth livelihood option, combining both farm, off farm and non-farm livelihood activities.

Table 13. Resilience latent dimensions and resilience indexes for different livelihood strategies

Resilience dimensions & resilience indexes	**Y = 0**	**Y = 1**	**Y = 2**	**Y = 3**
Income and Food Access (IFA)	-0.686	-0.537	0.368	2.228
Asset Possession (AP)	-0.064	-0.308	-0.164	1.058
Agricultural Practices and Technologies (APT)	0.117	-0.341	-0.165	0.656
Adaptive Capacity (AC)	-0.888	-0.308	0.243	2.502
Access to Basic Services (ABS)	-0.124	-0.118	0.270	0.102
Resilience Index	-0.590	-0.524	0.081	2.436

Source: factor analysis result (2017)

As shown in Table 13 resilience index across livelihood strategies is different. This finding is supported by growing number of empirical evidence in the field of household resilience to food insecurity. Though, studies applying the concept of resilience to the assessment of rural livelihoods strategies in Ethiopia are limited, Frankenberger *et al*. (2007), using qualitative information obtained through rapid rural appraisal, showed that households who were able to cope with shocks that regularly plague their communities are characterized by several factors, including diversification of income sources. A similar resilience study in Tigray region (Vaitla *et al*., 2012) also found a strong and positive association between diversified income sources and household resilience. Hence, households with diversified income sources are relatively more resilient than those with less diversification of income sources.

When analyzing resilience by sex of the household head, the study found that male-headed households are relatively tended to be more resilient than female-headed ones. The chi-square test shows that there is a statistically significant difference at less than 1% probability level between male and female headed households in their tendency to be resilient to food insecurity. Significant proportion of male headed households were tended to be resilient to food insecurity than their counterparts (Table is not shown)

5. CONCLUSSION AND POLICY PRIORITIES

Food insecurity is a main problem in study area, one of the less favored areas of protracted crisis in Ethiopia. Climate related shocks and stresses are the major causes of rural households' food insecurity. The way a household withstands and copes with these climate related shocks and stresses depends on the preconditions and options available to them in terms of capabilities, assets and activities. The best option to address the effects of these prevailing climate related shocks and stresses is through resilience approach. Using resilience analysis framework, resilience index of this study was the function of five latent dimensions, namely, income and food access, asset possession access to basic services, agricultural practices and technologies and adaptive capacity.

For the analysis of the resilience and its dimensions, factor analysis was run using principal component factor method and factors with eigen values higher than 1 were retained. For income and food access (IFA) one factor was retained that explains more than 67% of the variation Among its observable variables income, expenditure and calorie intake were positively correlated with IFA while household food insecurity access scale and coping strategy index were negatively correlated with IFA. For asset possession (AP) one factor was retained which explains more than 44% of variation and all its observable variables were positively correlated with AP. For adaptive capacity (AC two factors were retained which explains more than 72% of variation and all its observable variables were positively correlated with AC. For access to basic services (ABS) three factors were retained which explains more than 54% of variation and all its observable variables were positively correlated with ABS. For agricultural practices and technologies (APT) two factors were retained which explains more than 64% of variation and all its observable variables were positively correlated with APT.

The results obtained in resilience analysis are meaningful and the resilience index estimates across livelihood groups show significant differences. The resilience structure of each group is distinct, and depends on how the different components contribute to household resilience according to the options available for household livelihoods. PSNP graduated households who pursued combination of farm plus off-farm plus non-farm livelihood strategy tended to be more resilient followed by farm plus non-farm livelihood group.. Whereas the worst off are farm plus off-farm and farm alone. For graduated households who pursued the combination of farm plus

off-farm plus non-farm livelihood strategy, all the latent dimensions of resilience showed positive indices, implying that diversifying income sources via the engagement in different livelihood strategies would greatly contribute and enhance household resilience to food insecurity. The study also found there is the differences in level of resilience by sex of household heads.

Based on the above conclusions the following policy priorities are recommended.

- Income and food access is one of the dimensions of resilience. The study has indicated all the observed variables of this dimension almost have equal importance for estimating IFA and hence needs equal attention in planning for resilience building intervention in the study area. Particularly as HABP is meant to address household asset building through creating opportunities to boost the income of the household, enabling policy environment should be created for the promotion of income generating activities that PSNP beneficiary households could have access to off farm/non-farm activities to earn more income so that they would get easy access to food and ensure food security at household level
- Income diversity as one of the observed variable of adaptive capacity (AC) has shown high correlation with AC. Moreover PSNP graduated households who diversified their livelihood strategies had better resilience index showing that they are relatively more resilient than their counter parts, therefore, the government should give due attention for developing other rural development packages as like to agricultural technology packages in its rural development strategies. Henceforth, growth and transformation plans (GTP) of the government should seriously try to address the gap felt in rural non-farm economy to attain intended sustainable graduation.
- Credit access is one of the vital services for which HABP was designed and intended to complement PSNP for facilitating its effective sustainable graduation while its correlation with access to basic service is low indicating less service provided by HABP. Therefore, local government should take the initiative of establishing rural credit and saving cooperatives in their own community and try to re-visit the services planned to be rendered by HABP.

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