

Investigating Household Food Expenditures and the Engel's curve in Ghana: The Empirics

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Abstract:

This paper examines Ghana's annual household food expenditures and their Engel food curve using data from the 2013-2014 sixth round of the Ghana Living Standards Survey which covered 16, 772 household and lasted for one-year. A sample size of 16,035 was however valid for the model estimation in this paper. Household demographics and specific variables, including income, education status, religion, number of rooms, access to clean water, ownership of household, electricity supply to household, and refrigerators availability at the household that influence the annual household food budget decisions in Ghana are examined. It establishes an inverse relationship between the share of the household food budget and the increase in household income. The paper established high annual household food expenditure elasticity with 0.52 pesewas out of every one cedi serving as an annual household marginal food budget share in Ghana, on average and *ceteris paribus* and provides additional statistical evidence that characterises food as a necessity in Ghana. Policy-wise, the central government is advised to take more pro-poor agricultural interventions to improve food production and reduce its cost in the country. With a rapidly growing population, these measures will bring Ghana's economy into a state of food security and allow the country to also achieve the SDG 2 goals it has set for itself.

Keywords: Household, expenditure, food budget share, Engel food curve, food security

1. Introduction

Household budget allocation to food is well established in the developed economies' literature, since (Engel, 1857) seminal paper and recent literature *inter alia* includes (Abdulai, 2003; Almas, 2012; Aromolaran, 2004; Aykac, 2018; Blundell *et al.* 2007; Deaton, 1992; Engel & Kneip, 1996; Jaiyeola, *et al.* 2020; Lewbel, 2008; Ravallion & Chen, 2015). Ghana is a developing country with about thirty-one million population and located in the West Africa of the Sub-Saharan Africa (SSA) region with four

identified agricultural ecological areas (Nin-Pratt & McBride, 2014). The Agricultural sector in Ghana offers the largest employment to its working populace, contributing in 2013: 21.7%; 2014: 22.1%; 2015: 22.1%; 2016: 22.1%; 2017: 21.2; 2018: 19.7; 2019:18.5% as shares to Ghana's GDP in these fiscal years, Ghana Statistical Service (2020).

The Government of Ghana (GOG) since the country's independence in 1957 has in its developmental drive continued to promote and ensure adequate food production in the country. In pursuing this goal in recent times, various agricultural policies and interventions aimed at increasing the production of food for household consumption have been implemented. There are also some policy interventions commenced by international donor partners. These policies and interventions of the GOG include *inter alia*, the Agriculture Sector Investment Programme which aims at increasing investment in the food value chains. This GOG and the IFAD intervention, which started in 2018 for a six-year maximum duration is at a cost of US\$ 113.2 million (Ministry of Food and Agriculture, 2018). The Youth in Agriculture Policy as a food production intervention is to make farming attractive to the youth. The perception of the youth in Ghana is that farming is a profession for the low class in the society and is an occupation reserved for the aged (<http://mofa.gov.gh/site/programmes/youth-in-agriculture>). Linked to the Youth in Agriculture Policy, is the Planting Food for Jobs policy intervention, which commenced in 2017. This policy intervention hinges on households planting crops in commercial quantities for export and domestic market, promoting rural development and greenhouse technology villages for industrial agricultural production, and the rearing of animals for food and job creation, and modernising agricultural activities through the promotion of an increased mechanisation service, (<http://mofa.gov.gh/site/programmes/pfj>). There is also the collaborative policy aimed at increasing the agricultural investments, and the enhancement of agro-based value chains between the EU and the GOG for the 2017- 2024 period. There is a support policy intervention also aiming at increasing food production in the country. The CARES food intervention identifies food production as one of the critical sectors to revitalize and transform the economy during this COVID-19 and allied infection era. The Ministry of Food and Agriculture (MOFA) administers the policy interventions to ensure the rapid competitive import substitution of food and industries to support commercial farming and support the educated youth to engage in modern farming to ensure increased food security, and the supply of raw materials for agro-processing industries and for value-additions, (<http://mofa.gov.gh/site/agricultural-component>). There is also the Savannah Investment Program which as an intervention is set to increase domestic meat and poultry production from 2020-2025, [MOFA, 2022].

These and other policies notwithstanding, the economy of Ghana with the advent of the COVID-19 global pandemic have experienced several setbacks, which have put the country off track in ensuring that household demand for food is affordable. Ghana occasionally experiences domestic tribal and ethnic conflicts and all the negativities identified by the FAO (2021) that affect countries' food security and nutrition, Boero, *et al.*, (2021). These have also plagued the economy of Ghana in

achieving the SDG targets 2.1. and 2.2 which focused on eliminating hunger and all manner of malnutrition in the country. Hunger affects a little over one-fifth (21.0%) of the population in Africa, and 799 million, in Africa lived with moderate to severe food insecurity, FAO (2021). African Union Agenda 2063 (2013) target is to vigorously ensure the elimination of hunger and food insecurity on the African continent by the year 2025. The AU intends to realise this target in Africa through the promotion of its Accelerated Agricultural Growth and Transformation Strategy, (2014, 2015). This idea is to be pursued by researchers and assisted through the production of periodic empirical research aimed at monitoring household food budget share and expenditures in member states to inform and guide policy.

This paper serves as a contribution to the embryonic stage of investigating household annual food budget shares in Ghana in its quest to achieving the SDG targets 2.1. and 2.2. It analyses the household Engel food coefficient and curve, household marginal food budget share and their expenditure elasticity. It also adds to the few existing literatures (Abdulai & Aubert, 2004; Abdulai & Kuhlitz, 2011; Abdulai, 2003; Akparibo *et al.* 2021; Essilfie *et al.*, 2020; Annim & Frempong, 2018; Antwi & Lyford, 2022; Aykac 2018; Devereux & Maxwell, 2001; Ecker & Fang, 2015; Ecker, 2018; Omari *et al.*, 2018; Fashogbon & Oni, 2013; Frempong & Annim, 2017; Hasan, 2016; Hasegawa *et al.*, 2008; Jaiyeola *et al.*, 2020; Ansah *et al.*, 2020; KC *et al.*, 2017; Maxwell, 1999 Maxwell, 2001; Maxwell, 2001; Melo *et al.*, 2015; Moss *et al.*, 2016; Nsabimana *et al.* 2020; Osei-Kwasi *et al.*, 2021; Otsuka, 2015; Scrimshaw, 2008; Setsoafia *et al.*, 2022), studies on developing countries' household food budget and expenditure analysis. This paper is carved in this form. Section 2 deals with the method, description, and definitions of the variables. Section 3 pertains to the results and discussion section. The conclusion of this paper is in Section 4 at the end.

2. Method

2.1 Participants

The Ghana Statistical Service Living Standards Survey Six (GLSS6) is analysed in this paper with permission. The GLSS 6 is a nation-wide household survey, covering a data collection from all the 10 regions of Ghana. The survey activity received funding from the central government of Ghana and other international donor agencies, and technical assistance from the World Bank. Survey enumeration covered 16, 772 household and lasted for one-year. A sample size of 16,035 was however valid for the model estimation in this paper.

2.2 Design

2.2.1 Description and definitions of variables

The descriptions and definitions of the household variables are presented in Table 1.

Table 1- Definitions and descriptions of household variables used

Variable	Description
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ATE_i	Household total annual nominal expenditure in cedis
E_i	Household total annual food expenditure
LOGync	Natural logarithm of ATE_i in Cedis
FBS_i	Annual average household i food budget share in cedis
$\bar{O}$	sample mean of FBS_i
hhsex	Household head sex
hysize	Household size
hHAGEY	Age of household head
hHMARST	Marital status of household head
hHEDLEV	Household head education level
religion	Household head religion
water	Main source of water in the household
rooms	Number of habitable rooms in the household
ownhouse	Ownership of dwelling units
electcon	Household connection to electricity
fridge	Household with refrigerators

Some theoretical considerations that influence the annual household food budget decisions in Ghana are examined to guide the empirical model estimated in this paper. These are some socioeconomic variables, which are characteristics of household (Ansah *et al.* 2020). Given the foregoing, household demographic and specific variables, which potentially influence annual household food budget and expenditure based on data availability, given the application in a Ghanaian context, are examined. Household income is a major determinant established in the literature as influencing household food budget and expenditure (Deaton, 2019; Engel & Kneip, 1996; Hasan & Mozumder, 2017; Nsabimana *et al.*, 2020). The expectations are that as household income increases, annual household budget allocation to food and expenditure will decrease, and $\delta FBS_i / \delta LOGync_i < 0$ *ceteris paribus*. The age of household head in Ghana, has most influence on household annual food budget (Ansah *et al.*, 2020; Nsabimana *et al.*, 2020). The expectations are that $\delta FBS_i / \delta hHAGEY_i > 0$ *ceteris paribus*, (Nsabimana *et al.*, 2020).

Monogamous household in Ghana do care a lot about their family food budget allocation and expenditure and is plausible to have an increasing family food budget share and expenditure all year round. Hence, the expectations are that, $\delta FBS_i / \delta hHMARST_i > 0$ *ceteris paribus*. Household heads possessing university qualifications can happen to have smaller family size and therefore have less food budget allocation and expenditure annually. The expectations are that,

$\delta FBS_i / \delta hHEDLEV_i < 0$ *ceteris paribus*. Pentecostal/Charismatic Christian household heads are not in polygamous marriages and are concerned about their family budget allocation to food and expenditure. It is plausible for such household willingness to have positive annual family food budget share and expenditure. The expectations are that, $\delta FBS_i / \delta religion_i > 0$ *ceteris paribus*. Household with only a room do not have a large family size and plausible do not have to increase household food budget and expenditure annually. The expectations are that, $\delta FBS_i / \delta rooms_i < 0$ *ceteris paribus*. Household with water from protected well sources in Ghana need not worry spending on food as there is water available for both cooking and drinking throughout the year. The expectations are that $\delta FBS_i / \delta water_i > 0$ *ceteris paribus*.

Household owned by the household heads are more concerned about the immediate welfare of the household occupants and are in a better position to ensure their food security by having an increased food budget and expenditure annually. The expectations are that, $\delta FBS_i / \delta ownhouse_i > 0$ *ceteris paribus*. Household connected to electricity supply from the national grid are able to preserve all kinds of food using modern gadgets and food preservation equipment. Such household do not need to increase their food budget share and expenditure annually. The expectations are that, $\delta FBS_i / \delta electon_i < 0$ *ceteris paribus*. Likewise, household with refrigerators is plausibly able to stock and preserve all kinds of food all year round. Such household do not need to increase their food budget share and expenditure annually. The expectations are that, $\delta FBS_i / \delta fridge_i < 0$ *ceteris paribus*.

2.3 Procedure

The paper defines the value of total annual food consumption expenditure for a particular household as E_i , and its annual total nominal expenditure as ATE_i .

Then it identifies the household food budget share (FBS_i) which is used as the dependent variable as:

$$FBS_i = \frac{E_i}{ATE_i}.$$

The (Working-Leser 1943, 1968) model is used to define a linear OLS framework to estimate a sampled household annual food budget share and expenditure as:

$$FBS_i = \alpha + \beta_1 LOGync_i + \beta_2 hHAGEY_i + \beta_3 hHMARST_i + \beta_4 hHEDLEV_i + \beta_5 religion_i + \beta_6 room_i + \beta_7 water_i + \beta_8 ownhouse_i + \beta_9 electcon_i + \beta_{10} fridge_i + \mu_i.$$

where $i = 1, \dots, 16,035$.

[1]

The model has an error term with a zero mean, represented by the symbol μ_i .

In estimating household food budget share and expenditure, in a developing agrarian economy of Ghana, this paper adopts the (Working-Leser 1943, 1968) linear model unlike the quadratic term approach by (Banks *et al.*, 1997) for a developed economy.

The household food budget share estimate at the marginal sampled mean value is estimated as:

$$\frac{dE_i}{dATE_i} = \hat{\beta}_1 + \bar{O}, \text{ and } ceteris\ paribus \quad [2]$$

And the paper estimates household food expenditure elasticity at the sampled mean as:

$$\varepsilon_i = \frac{\hat{\beta}_1}{\bar{O}} + 1, \text{ and } ceteris\ paribus \quad [3]$$

The $\hat{\beta}_1$ is an estimated parameter. The sampling variance for the household food expenditure elasticity as estimated in eqn. [3] is derived as:

$$\text{Var}(\hat{\varepsilon}_i) = \left(\frac{1}{\bar{O}}\right)^2 \text{var}(\hat{\beta}_1) \quad [4]$$

And the paper test what type of good food is in Ghana as:

$$H_0: \varepsilon_i = 1$$

$$H_a: \varepsilon_i < 1$$

In line with the established trend in the household food budget share and expenditures literature, (Deaton, 2019; Hasan & Mozumder, 2017; Engel & Kneip, 1996; Nsabimana *et al.*, 2020;) for low-income agrarian economies, total annual nominal household expenditure is captured as a proxy for total annual household nominal income. Cross section, living standards survey data in developing countries generated are characterised by a potential heteroscedasticity mainly due to difficulties in recollecting retrospectively, and the fading of some respondents' memories, and the misunderstanding of a survey item among others (Grosh & Glewwe, 1998). In adjusting for a potential heteroscedasticity in the (Working-Leser 1943, 1968) linear regression model, (White, 1980) Heteroscedasticity consistent standard errors robust estimates using STATA is implemented to deal with it. In dealing with endogeneity bias affecting the estimation of the Engel food coefficient when a function regressing household food budget share on total household expenditure is specified as in (Banks *et al.*, 1997; Blundell *et al.*, 2007; Blundell *et al.*, 1998; Hausman *et al.*, 1995; Hasan & Mozumder 2017) studies, this paper uses the natural log of annual household income and household size as instrumental variables for the natural log of annual total household expenditure.

3. Results and discussion

The means and standard deviations of the various demographic and household-specific variables in the paper are reported in Table 2. The mean age of household respondents was 46 years. About 9% of respondents attained tertiary education, and 8% household head is in a monogamous marriage. About 6% of the household heads are Pentecostal/Charismatic Christians, and 7% of the household have water from protected well source. Close to 6% of the household have one habitable room to spare and about 75% of the household heads owned their various dwelling units. About 76% of the household are connected to electricity, while about 72% of household do have refrigerators. The average household size of 4 people confirms

(Ansah *et al.*, 2020) studies. There is an average natural log household annual income value of about 8 cedis.

Table 2- Mean and standard deviations of specific demographics and household variables

Variable	Mean	Standard deviation
Average age of household head (hHAGEY)	46	(15.89)
Household head have a university degree (hHEDLEV) = 6, 0 otherwise)	0.8604	(0.3467)
Household head is in a monogamous marriage (hHMARST=2, 0 otherwise)	0.8814	(0.3233)
Religion	0.6527	(0.4761)
Household head is a Pentecostal/Charismatic Christian (religion=4, 0 otherwise)		
Household have water from protected well source (water = 4, 0, otherwise)	0.7564	(0.4293)
Household with one habitable room (room = 1, 0 otherwise)	0.6538	(0.4757)
Household head owns the dwelling unit ownhouse=1, 0 otherwise)	0.7501	(0.4329)
Household is connected to electricity (electcon=1, 0 otherwise)	0.7592	(0.4276)
Household have a fridge (fridge=1, 0 otherwise)	0.7158	(0.4510)
HHlnInc Natural log of household annual income (IV)	8.034	(1.4314)
hhsiz (IV)	4	2.8

Source: Author's calculations based on GLSS 6 database

A summary of the annual household budget indicating food budget share, total expenditure means, medians, and percentiles estimates respectively are shown in Table 3.

Table 3 - Distribution of annual household budget, total expenditure means, medians, and percentiles estimates

Variable	Mean	25 th Percentile	50 th Percentile (Median)	75 th Percentile
FBS_i	0.55	0.43	0.56	0.68
ATE_i	8105.183	3665.598	6161.721	10020.81
E_i	4062.273	2005.067	3248.378	5066.078

US Dollar equivalence in cedis during survey period = Cedis 2.32 to US\$ 1.

An investigation of the estimates presented in Table 3 shows that annual household expenditures based on the 25th percentile is 3,665.598 cedis, while the 50th percentile (median) indicates household expenditures of 6,161.721 cedis. Household annual total food expenditure at the 25th percentile is 2,005 cedis, representing 54.7% of the annual 25th percentile household total expenditures. The household annual median total expenditure on food value is 3,248 Cedis, which is 53% of the total annual total household median expenditure. The annual household total food expenditure mean value of 4,062 is 50.12 % of the mean total annual household expenditure. To derive the household Engel food curve, the relationship between annual household food share and natural logarithm of annual total household income are plotted as graphs. The curve has a negative slope and corresponds to (Nsabimana *et al.*, 2020) findings for Rwanda and (Ansah *et al.*, 2020) findings on Ghana. The household Engel Food Curve is shown in Figure 1.

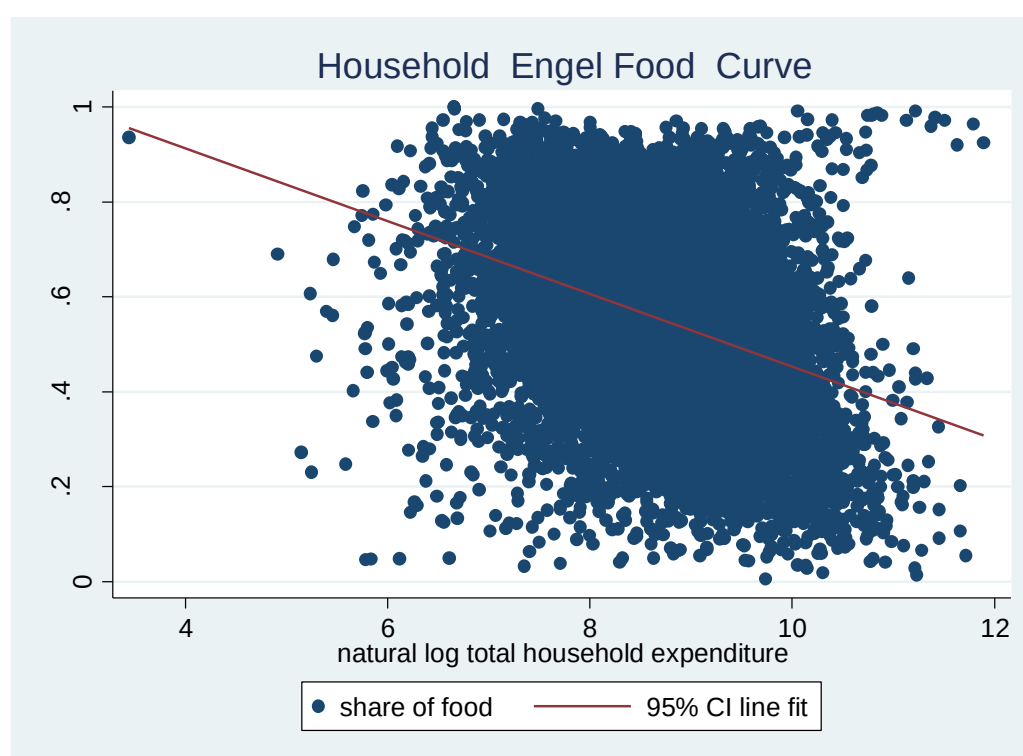


Figure 1. Household Engel Food Curve

The estimates of the (Working-Leser 1943, 1968) linear IV model annual household food budget share and expenditure is reported in Table 4.

Table 4 - Estimates of (Working-Leser 1943, 1968) linear IV model

Variable	Estimated coefficients
LOGync	- 0.0264* (0.0039)
hHAGEY	0.0005* (0.0001)
hHMARST	0.0031* (0.0008)
hHEDLEV	- 0 .0134* (0.0007)
religion	0.0038* (0.0007)
rooms	- 0.0090* (0.0012)
water	0 .0127* (0.0009)
ownhouse	0 .0219* (0.0027)
electcon	- 0 .0459* (0.0028)
fridge	- 0.0509* (0 .0032)
constant	0 .7729 (0.0332)
**Sargan (score), chi. ²	(p = 0.6850)
***Basman (score), chi. ²	(p = 0.6851)
Number of observations	16,035

Source: Author's estimation based on GLSS 6 database. * Denotes significance level at 5 percent. Robust standard errors in parentheses. P-values of both the **Sargan score and ***Basman test respectively for tests of over identifying restrictions, suggest that the instrument set is 68 percent valid and the model is correctly specified.

The demographic characteristics impel significant influence on household food budget share and expenditure decisions. The estimated coefficients of household head's age, monogamous household heads, household heads with university degree are all significant at 5 percent level and have the expected signs and are similar to the findings of (Nsabimana *et al.*, 2020). Household head age variable estimate is similar to the findings of (Ansah *et al.*, 2020). The Estimated coefficient of religion is significantly established and has the expected sign. The other household specific variables rooms, water, ownhouse, electon, fridge are all significantly determined at 5 percent significance level with the expected signs, respectively. The estimated LOGync coefficient ($\hat{\beta}_1$) is the response of annual household food budget share with respect to the log of annual total household expenditures. It shows that a 10% rise in annual household expenditure decreases the share of the annual household food budget by 02.6 percent on average, and *ceteris paribus*. This paper tests the estimated effect of the LOGync coefficient ($\hat{\beta}_1$) with reference to the validity of the Engels food

law in Ghana. The Engels food law states that as household income rises, household budget devoted to food declines.

The Engels food law test in Ghana is as follows:

$$H_0: \beta_1 = 0$$

$$t_{16, 024} = \frac{-0.0264 - 0}{0.0039} = -6.7692$$

Because the critical value of -1.645 rejects the null hypothesis, it statistically confirms the existence of the Engel's food Law in Ghana. The annual household food budget marginal share estimated at the sample mean value is derived as:

$$\frac{\partial E_i}{\partial ATE_i} = \hat{\beta}_1 + \bar{O} = -0.0264 + 0.55 = 0.5236. \quad [2']$$

This shows that a one cedi increase in annual household expenditure results in a marginal 0.5236 pesewas increase in annual food expenditure on average, and *ceteris paribus*.

The annual household food expenditure elasticity is estimated as

$$\varepsilon_i = \frac{\hat{\beta}_1}{\bar{O}} + 1 = \frac{-0.0264}{0.55} + 1 = 0.952 \quad [3']$$

The estimate shows that any 10% increase in annual household expenditure results in an increase of annual household food demand of 9.5% on average, and *ceteris paribus* in Ghana. Various studies on other developing countries (Ansah *et al.*, 2020; Melo *et al.*, 2015; Moss *et al.*, 2016; Nsabimana *et al.*, 2020; von Braun *et al.*, 1991) on household budget food budget share and expenditure confirms high food expenditure elasticities. The household food expenditure elasticity estimate being numerically greater than zero but less than one, statistically confirms food as a necessary good in Ghana.

The paper derives the sampling variance for the annual household food expenditure elasticity estimated in [3'] to test if food being a necessary good in Ghana is plausible.

The statistical test conducted is:

$$H_0: \varepsilon_i = 1$$

$$H_a: \varepsilon_i < 1$$

$$\text{Var}(\hat{\varepsilon}_i) = \left(\frac{1}{\bar{O}}\right)^2 \text{var}(\hat{\beta}_1) = \left(\frac{1}{0.55}\right)^2 \times 0.06244 = 0.2064 \quad [4']$$

The null hypothesis is rejected in this case suggesting that food is a necessary good in Ghana. This confirmed the findings of (Ansah *et al.*, 2020) that classified about

97% of the food groups in Ghana as necessary goods. (Abdulai, 2004) also opines that in developing economies, food is usually necessary goods.

4. Conclusions

Using the GLSS 6 national representative data, this paper estimates the Engel food curve relationship, which has received particular attention in investigating household budget allocation to food preferences for the economy of Ghana. The findings of this paper resonates with (Ansah *et al.* 2020; Nsabimana *et al.* 2020), studies that established an inverse relationship between household food budget share and increasing household income. The paper also has established high annual household food expenditure elasticity as has also been established in other developing economies by (Ansah *et al.*, 2020; Melo *et al.*, 2015; Moss *et al.*, 2016; Nsabimana *et al.*, 2020; von Braun *et al.*, 1991). This paper provides additional statistical evidence that characterises food as a necessity in Ghana. With 0.52 pesewas out of every one cedi serving as an annual household marginal food budget share in Ghana, on average and *ceteris paribus*, Ghana is in the (Smith & Subandoro 2007) medium food insecurity category. They opined that household in an economy spending between 50 - 65% of total annual household expenditure on food places that economy in a medium food insecurity zone. Policy wise, more pro-poor agro-based interventions aimed at improving food production in the country by the central government is recommended. These measures would thereby turn the economy of Ghana into a food security state as its population grows rapidly and enables the country to also achieve the SDG 2 targets it has set for itself.

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