Fuelwood dependence and forests in Armenia

Source: www.enpi-fleg.org/news/progress-towards-new-sanctuary-in-tavush-region-of-northern-armenia/

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PROFOR

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Acronyms and abbreviations

AMD	Armenian Dram
CIFOR	Center for International Forestry Research
EU	European Union
ENPI FLEG II	European Neighbourhood and Partnership East Countries Instrument Forest Law Enforcement and Governance program II
FAO	United Nations Food and Agriculture Organization
AFEPS	Forest, Energy and Poverty Survey
FMP	Forest Management Plan
GHSL	Global Human Settlement Layer
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (German Development Cooperation)
IFRI	International Forest Research Institute
ILCS	Integrated Living Conditions Survey
IUCN	International Union for the Conservation of Nature
NDC	Nationally Determined Contribution
NTFP	Non-timber forest products
PPS	Probability Proportionate to Size
PROFOR	Program on Forests
PSU	primary sampling unit
SWIFT	Survey of Well-being via Instant and Frequent Tracking
tcm	thousand cubic meters
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WWF	World Wildlife Fund

Abstract

Forests are estimated to make up 11.2 percent of Armenia's land area and are in decline (GIZ 2014). Meanwhile, there is a large gap between reported fuelwood consumption and official fuelwood supply. Fuelwood supply[1] was estimated at 848,000 m^3 in 2016, most of which goes to fulfil households' consumption (840,000 m^3). [2] With additional degradation of the forest resource, the current figure is likely lower. This report aims to provide more evidence on the linkages between forest uses and poverty in Armenia with a focus on fuelwood. The report aims to answer the following three questions: What are the patterns of energy use across poverty incidence and forest-proximity?; Which household characteristics are associated with a higher likelihood of fuelwood consumption?; and Have these patterns changed in the last five years, as a result of increased gas connectivity?

Findings from an original household survey, the Armenia Forest, Energy and Poverty Survey (AFEPS), conducted in 2018 across Armenia, indicate that households rely both on gas and fuelwood to fulfill their energy needs. Further, households in rural areas and located near forests are more likely to depend on fuelwood. To some extent there is no statistically significant differences in usage of fuelwood across welfare (consumption) quintiles although households with more liquidity (pensioners, wage workers) are less likely to use alternative options to fuelwood. Little significant switching between different energy types: fuelwood and gas was reported from 2013 to 2018. The study provides some reflections for three key sectors (health, forest, energy) to promote the use of alternatives to fuelwood for heating and cooking.

[1] Officially recorded supply equals AAC + fallen wood, illegal production and imports.

[2] http://www.factfish.com/statistic-country/armenia/fuelwood%2C%20production

1 Introduction

1. **Extensive harvesting and limited replanting have left Armenia with a declining and threatened forest stock.** Restoring degraded forests, ensuring adequate long-term supplies of timber for construction and energy, preventing forest damage from illegal logging, fires and uncontrolled grazing, are the primary challenges to Armenia's forest sector.[3] Demand for timber far exceeds officially recorded supply, while the forest cover area is lower than official forest committee estimations,[4] despite forming the basis of forest management planning.

2. **As a signatory to the Paris Agreement, in its first UNFCCC Nationally Determined Contribution (NDC), Armenia has made a commitment to increase forest cover to 20.1 percent by 2050.** Rehabilitation of degraded forest resources, expansion of forest cover, maintenance and development of forest environmental, social and economic functions, and the continuous and efficient use of forest resources in the Republic of Armenia are considered national priorities. Nevertheless, development in the sector continues to face key challenges including: illegal logging, inadequate forest management and harvesting practices, lack of resources, uncontrolled grazing, fires, and the spread of insects and diseases (ICARE 2011).

3. **A lack of data on change in forest cover and on demand for fuelwood does not facilitate a full understanding of the extent of the problem.** The demand for wood for energy, or fuelwood, is a large contributor to the high rates of forest extraction and is assumed to be concentrated in areas of high poverty incidence, as well as forest-dependence. Without a more informed understanding of the linkages across these three factors, namely forests, energy, and poverty, it is difficult to design appropriate pro-poor forestry and energy sector interventions.

4. With this backdrop, this report aims to provide more evidence on the linkages between forest uses and poverty in Armenia with a focus on fuelwood. To give such evidence, the report answers three questions:

   a) What are the patterns of energy use across poverty incidence and forest-proximity?
   b) Which household characteristics are associated with a higher likelihood of fuelwood consumption?
   c) Have these patterns changed in the last five years, as a result of increased gas connectivity?

[3] www.worldbank.org/en/country/georgia/brief/eu-funded-fleg-ii-program-supports-bilateral-cooperation-and-best-practice-sharing
[4] Ibid

5. **The report uses primary household survey data from the 2018 Forest, Energy and Poverty Survey (AFEPS).** Designed for this survey, the AFEPS instruments are quite innovative as they bring together data on forest, energy and poverty which are often not available from a single source. The data were gathered on households between the month of October and December 2018 and are representative at the national, urban/rural levels, and for forest areas. Poverty in the data is estimated using a methodology called Survey of Wellbeing via Instant and Frequent Tracking (SWIFT) which does not rely on item-level consumption data but on the imputation of a consumption aggregate.

6. This report is organized as such: the following section (2) explains the forest and energy context in which the study takes place. Section 3 describes the research methodology before providing a description of Armenian households in 2018. The findings in section 4 are grouped around the three guiding questions. The report concludes with key findings from the AFEPS and policy reflections.

2 Context: forests, fuelwood and energy use in Armenia

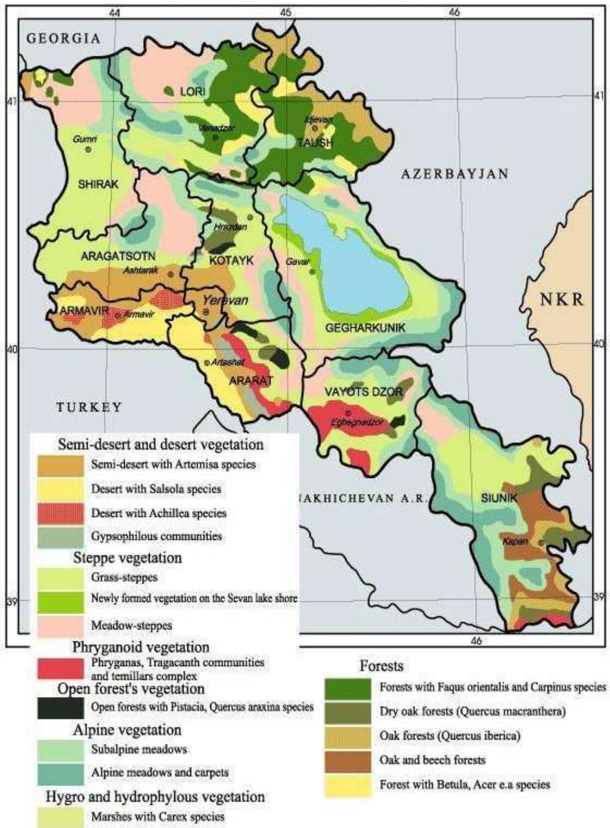
2.1 State of forests and the forest sector

7. **Armenia has lost much of its remaining forest area due to the energy and economic crises of the 1990s, followed by inadequate management of the forest resource over the last 30 years.** According to the most recent National Forest Inventory (1993), forests and forest lands in the Republic of Armenia covered 460 thousand ha, of which 334.1 thousand ha or 73 percent were forested areas (these data do not include further changes in forest areas). Re/afforestation of forest areas has been minimal despite the high levels of logging and widespread understanding of the issues of forest loss and degradation.

8. **Forests make up less than 11.2 percent of Armenia's total land area**, or about 3,271 km^2 according to the remote sensing data gathered by the 2011 GIZ-supported project, "Integrated Biodiversity Management in Armenia" (GIZ 2014). Today the forest area is distributed in Armenia mostly among 3 out of 11 marzes[5]: 62 percent is concentrated in Tavush and Lori, 36 percent - in Syunik, and only 2 percent in the central part of the country (Sayadyan 2010) (Figure 1). While the total *de jure* population in Armenia in 2018 was 2,972,700 people (National Statistical Committee of Armenia 2018), 16.2 percent live in forest areas (in Tavush, Syunik and Lori).

[5] These are administrative divisions corresponding to provinces.

Figure 1 Vegetation and Habitat Types of Armenia



Source: http://maps.unomaha.edu/peterson/funda/MapLinks/Armenia/Armenia.htm

9. **Forests are owned by the State, under the responsibility of the State Forest Committee and actively managed by Hayantar State Non-commercial Organization.** Forests and forest lands in Armenia can be owned by the State, community, or be private. The forests under state ownership are not subject to transfer to local communities, legal entities or individual citizens. None of the forest lands are productive forest plantations, although in some regions, non-governmental organizations have developed forest areas on community lands. Primary oversight of Armenia's forests is under the Ministry of Environment, with the State Forest Committee responsible for oversight of forest management performed by Hayantar.

10. **Armenia is slowly transitioning to a 10-year forest management cycle to.** Forest use, recreation, forest rehabilitation and other forest-related activities are supposed to be carried out in accordance with 10-year forest management plans (FMPs). The FMPs are prepared for fifteen forest business branches of the Ministry of Environment in the Lori, Tavush and Syunik marzes. However, the uptake of FMPs has been slow, due in part to a lack of local implementing and technical capacity.

11. **Forests provide the population with timber, non-timber forest products, fuelwood for rural communities and industrial purposes.** Communities benefit from the environmental services the forest provides: forests protect the land from floods and erosion, improve soil fertility vital for agriculture, while forest water basin areas provide both fresh drinking and irrigation water for agricultural lands. The forest-adjacent population also use the forests as shelter and fodder for grazing cattle, as access to grazing lands, and supplement their food, medicine and cash income through the selling of non-timber forest products (NTFPs, including wild fruits, nuts, mushrooms, honey).[6] Forests have the potential to put the forest-dependent poor on a sustainable path towards prosperity (Shyamsundar et al., 2019).

12. **Communities can extract timber for their own consumption and currently there are no productive forest plantations.** Forests are classified as special purpose forests (e.g. protected areas, urban and recreational forests), or protective (e.g. water source protection, soil stabilization, climate regulation), where only sanitary felling is allowed. There is no formal production harvesting, only cutting conducted for sanitary purposes ~~and intermediate thinning~~ with the intent of preventing damage due to pests and diseases or that is justified for other forest protection reasons is permitted (Mkrtchyan and Grigoryan 2014). In Armenia, sanitary felling also includes regular thinning. In addition, for example, in 2017, 66,614 m^3 of debris fuelwood was provided for free to people living in close proximity to the forest.[7]

Box 1 Changes in forest sector after the AFEPS 2018

There have been several institutional and policy changes in the forest sector in Armenia following the AFEPS 2018. On the one hand, illegal cutting of wood in Armenia was criminalized, which may have had impacts on the current picture of fuelwood and other forms of energy use in the country. In addition, institutionally, the oversight of Hayantar has been transferred from the Ministry of Agriculture to the Ministry of Environment. Meanwhile, various forest monitoring and management functions have been divided amongst subsidiary agencies under the Ministry of Environment Undoubtably, in its new role of monitoring changes in forest cover, coupled with the Armenian police force having the mandate and authorizing environment to arrest suspected illegal loggers, the situation of illegal harvesting should change for the better.

13. **Illegal logging is rampant and not well monitored.** Illegal logging is estimated to be 20–30 times more than the official records. Forest loss through illegal logging in the country is driven by both commercial interests and poverty-related factors. Efforts supported by the EU-World

[6] Fripp, E. (28 June 2010). Socio-economic impact of illegal logging Consultancy Report for the World Bank. Trip 1: Initial findings and briefing note for project update meeting. EFECA: Economics, Climate, Environment.
[7] Sixth National Report to the Convention on Biological Diversity

Bank-IUCN-WWF-supported European Neighbourhood and Partnership East Countries Instrument Forest Law Enforcement and Governance programs (ENPI FLEG I and II, 2008–2017)[8] have worked to address illegal logging, support the enforcement of the forest law and improve governance in the sector, as well as other actions to combat forest loss.

2.2 Fuelwood as part of household energy mix

14. **Rural and urban households in Armenia—especially the poor and most vulnerable ones—rely on fuelwood to meet their heating and energy needs.** Fuelwood remains the cheapest and most easily accessible energy source. Based on earlier household survey data (2003 and 2010), rural households are the largest consumers of domestic forest products due to their reliance on fuelwood for heating. The main factors influencing fuelwood demand are: i) household welfare, ii) availability of alternatives; iii) availability of fuelwood; and iv) access (Junge and Fripp 2011). Households using fuelwood are at greatest risk of exposure to indoor air pollution with women and children disproportionately affected if these fuels are used for cooking.

15. **Each household in forest-dependent communities may collect and obtain up to 8m^3 of fuelwood (debris wood) per year for free from the regional forestry organization, according to Decree # 1535-N, 2011 ratified by the Government of Armenia.** Other households require tickets to cut wood or have the option of purchasing wood at the market. The total cutting area of the country amounted to 1,558 ha in 2014, 1,501 ha in 2015, 1,940 ha in 2016 and 2,010 ha in 2017. Thus, it became obvious that cutting areas expand in Armenia. Within the period between 2014 and October 1st, 2018, 10,606 m^3 of timber and 116,980 m^3 of fuelwood was sold out of the total harvested volume.[9] Based on the information provided by Hayantar, prices for firewood and construction materials were approved in 2016: the harvesting fee for stumpage was USD 22/m3, the harvested fee for road side was USD 30/m3, and the price after transportation for storage was USD 45/m3 (World Bank, 2020).

16. **Only a minority of rural households collect their own fuelwood (including fallen wood) due to difficulties either accessing forests or obtaining fuelwood permits.** Additionally, many members of rural communities are elderly (pensioners) and unable to collect wood (Mkrtchyan and Grigoryan 2014).

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[8] www.enpi-fleg.org
[9] Sixth National Report to the Convention on Biological Diversity

17. **Fuelwood supply goes towards fulfilling households' consumption.** In 2016, fuelwood production[10] was estimated at 848,000 m^3 (about 0.29 m^3 per person) with 99 percent of it going towards households' consumption.[11] In comparison, in Georgia, fuelwood production was greater at 2,052,000 m^3 (about 0.52 m^3 per person). Rural households consume as much as 15 m^3 of fuelwood annually in mountainous areas, while the national average consumption is estimated at 6.8 m^3.[12] While the estimates on actual harvesting volumes have wide variation depending on the data sources and methodology used, they all show harvesting volumes that are by order of magnitude higher that the officially sanctioned harvesting and this demonstrates severe challenges in the sustainability of forest use and governance of the sector.

18. **The full demand for wood is met through the informal sector**. Since the annual allowable cut determined by the FMPs is usually limited to thinning and "sanitary" cutting at various stages, this amount is too low to meet demand. The gap between demand and supply is fulfilled by the informal sectors which prevents the Ministry of Environment and rural communities from capturing the revenue generated from informal fuelwood collection.[13] This illegal logging results in negative economic, environmental and social impacts , employment, tourism value, erosion, over-harvesting, protection function of forests, biodiversity loss and poverty.

2.3 Changes in the energy sector to curb forest degradation

19. **Nearly eight out of ten households prefer gas as a fuel source, its relative cost and, in rarer cases, availability discourage forest households from adopting this source of fuel (Fripp, 2010).** Both forest and non-forest households in Armenia continue to depend on fuelwood to supplant their heating and cooking needs. Gas is often a more expensive energy source than fuelwood and thus does not necessarily reduce local populations' dependence on fuelwood. Rural residents connected to gas pipelines often cannot afford gas.

20. **Energy substitution from fuelwood to gas happened in part in Armenia but is not linear.** Since 2004, Armenia has increased its gas main coverage in rural areas with the assumption that rural households would correspondingly reduce their consumption of fuelwood. However,

[10] Officially recorded supply equals AAC + fallen wood, illegal production and imports.
[11] http://www.factfish.com/statistic-country/armenia/fuelwood%2C%20production
[12] Fripp, E. (28 June 2010). Socio-economic impact of illegal logging Consultancy Report for the World Bank. Trip 1: Initial findings and briefing note for project update meeting. EFECA: Economics, Climate, Environment.
[13] There are 22 Forest Enterprises, each responsible for a forest area; however, they can only conduct sanitary cuts and thinnings. There remains a ban on harvesting 'mature' trees.

while Armenian households' connection to gas mains increased from 31 percent to 94.8 percent between 2003 and 2018;[14] between 2003 and 2010 fuelwood use fell from 73 percent to 61 percent – only 12 percentage points (Junge and Fripp 2011).[15] This small decrease in fuelwood was likely due to the increase in gas tariffs relative to the average cost of fuelwood from 2003 to 2010. Although following, in accordance with the regulator's decision on gas prices in 2017, gas tariffs decreased to 100,000 AMD/'000 m^3 (approx. USD 210.00/'000 m^3 and 139,000 AMD/'000 m^3 (approx. USD 290.00/'000 m^3) beyond consumption of 600 cm/year for socially vulnerable families (CBD, 2019).

21. **There is some stickiness in changing fuel sources.** Despite increasing gas network coverage across the country (17,017 km in pipelines and 634 communities gasified) as of 2018,[16] it has been noted in prior studies that in the past in some cases when gas prices increase, the Armenian population increasingly switched to fuelwood (Mkrtchyan and Grigoryan 2014). As of the Armenian regulator's decision on gas prices in 2016[17], gas prices have been fixed . Rather, prices increase for households beyond a threshold of 600 cm of annual consumption to 139,000 AMD/'000 m^3 (approx. USD 290.00/'000 m^3). Further, households which have already invested in gas-reliant household appliances for their heating and cooking needs are in some ways "locked in" and have less flexibility to switch back to fuelwood use.

22. Against this backdrop, with the survey developed as part of this analytical work, we attempted to paint an updated picture of the current situation of the fuelwood-poverty-forest-dependence nexus in Armenia.

3 Data and research methods

3.1 Data and SWIFT methodology

23. **The 2018 Armenia Forest Energy Poverty Survey (AFEPS) is a nationally representative multi-topic household survey.**[18] The instruments for this survey were designed around three primary points of interest (i) forest-use and means of value extraction, (ii) energy consumption by source and season, and (iii) poverty incidence. The sample was designed to be

[14] Meetings with Forest State Committee in Armenia confirmed that about 90 percent of the country was covered with gas-line.
[15] Gas prices in Armenia have since 2016 been reduced, with a lifeline gas tariff having been put in place in 2016.
[16] Armenia's Energy Strategy to 2036.
[17] http://psrc.am/public/pages/28.
[18] See appendix A for more information on the survey.

representative at various levels, including Armenia,, Yerevan, other urban, and rural areas. Urban and rural areas were further stratified into poor forested areas, and sampled to be representative.. The sample frame was built using spatial imagery to create 250 meters square and 1.5 km square grids for urban and rural areas, respectively. A grid is considered "forest poor" under two conditions: (1) if there is non-zero forest area in the grid; and (2) if the grid is in a community with a community poverty rate higher than 30 percent (see Appendix A for more information).

Table 1. Proposed Stratifications and surveyed households by Strata

Strata	Domains of Inference	Total surveyed households
Yerevan	**Yes**	**108**
Other Urban	**Yes**	**374**
Forest poor t	Yes	*290*
Non-Poor and/or Non-Forest	No	*84*
Rural	**Yes**	**266**
Forest poor	Yes	*128*
Non-Poor and/or Non-Forest	No	*138*

Note: Global Human Settlement Layer (GHSL) grids with non-zero forest cover are classified as forest-proximate grids. Grids with over 30 percent poverty incidence as per commune-level data from Integrated Living Conditions Survey (ILCS) 2015 are classified as Poor grids. A grid is classified as a Forest grid if the centroid of the grid is less than 2 km away from the closest forest areas.

~~25.~~24. **The AFEPS is innovative in terms of its multifaceted nature, combining both forest and energy use questions, in addition to piloting Forest-SWIFT**.[19] The forest module is adapted from the latest forestry sourcebook published by the FAO, CIFOR, IFRI and World Bank (2016). The energy component of the survey consisted of multiple modules to assess households' heating system, their sources of energy, and if these two have changed in the last five years. The Forest-SWIFT component was restricted to collecting factors to estimate consumption. Forest-SWIFT uses existing data to identify what determinants are highly correlated with consumption or forest income. Unfortunately, because there were no existing household survey data on forest income in Armenia, the Forest-SWIFT methodology was only performed to estimate consumption.

~~26.~~25. **SWIFT methodology consists of modeling consumption with existing data to identify the main determinants that can be later used to predict data on poverty in a timely and accurate fashion** (Ahmed et al., 2014; Yoshida et al., 2015). Using the 2015 Integrated Living Conditions Survey (ILCS), the SWIFT model assumes a linear relationship between household per capita consumption and its correlates with a projection error, the model also

[19] While a description of the Forest-SWIFT follows, additional details can be found in the Appendix.

controls for issues linked to over-fitting – when a model performs well within the sample but poorly outside the dataset – by cross-validating the model (Kuhn and Johnson, 2013). Once the correlates are identified and a new dataset is collected, the last phase of SWIFT is to predict consumption based on the coefficients from the models using multiple imputation estimations to apply the coefficients from the respective models to the variables in the new dataset. Random error is simultaneously introduced by adding 1000 imputations with error per household estimate (See Appendix B for more information).

~~27.~~26. **The data were collected by a consortium of Turkish and Armenian firms between October and December 2018.** The final sample is composed of 748 households throughout the country and forest areas (Figure A.1. in Appendix A). Although four households were planned to be interviewed per grid, this number was not achieved in some grids where there were no residential structures. Household weights were calculated to ensure that the estimates are representative of the populations of interest.

3.2 Describing households in Armenia

~~28.~~27. **Households in rural areas, especially those in the poor forested areas, present more features linked to poverty than households in urban areas and in Yerevan.** Heads of households in rural areas are more likely to be female with about half of households in rural areas being headed by a woman compared to 30 percent in Yerevan. Household heads in rural areas are less likely to be pensioners although they have the same age as household heads in urban areas and in Yerevan (Table 1). Household heads in rural areas are less likely to be employed and to have completed high school. Low levels of education and of employment are assumed to bring low levels of productivity and of revenue which is associated with higher levels of poverty.

~~29.~~28. **At the household level, households in rural areas are larger, with higher dependency ratios, although more people are employed in rural areas than in urban or poor forested areas.** Despite high unemployment, more households in rural poor forested areas send remittances than in the other areas, even though they are equally likely to receive remittances as Yerevan. In a similar vein, although fewer households in rural areas have registered in a poverty scheme than households in urban areas, the rates of registration among households living in rural poor forested and urban areas are similar.

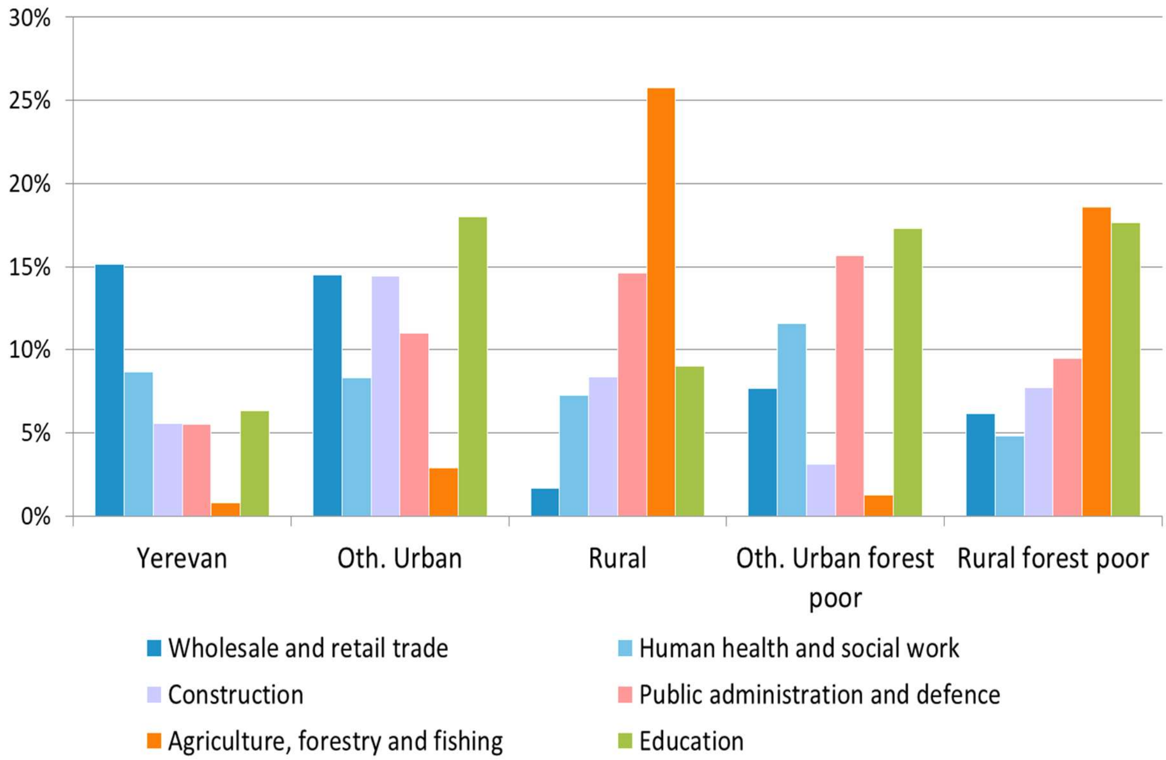
Table 1 Characteristics: households, heads, and dwellings, 2018

	Yerevan	Urban	Rural	Urban forest poor	Rural forest poor
Head of Household					
Male (percent)	69.10	66.03	48.82	73.72	65.35
Age (years old)	58.77	58.15	58.23	59.56	58.61
High school graduate (percent)	96.01	96.34	84.70	94.84	87.64
Pensioner (percent)	40.95	42.96	44.39	43.69	36.76
Employed (percent)	46.07	29.48	27.80	25.61	24.65
Household Characteristics					
Household size	3.2	3.82	4.54	3.76	4.09
Dependency Ratio (percent)	50.09	58.44	67.52	58.62	53.30
Employment rate	79.73	45.44	60.55	39.66	40.10
Sent remittances (percent)	6.98	5.51	6.14	8.98	11.92
Received remittances (percent)	21.96	18.11	17.18	13.29	20.95
Registered for poverty benefit system (percent)	7.97	17.54	11.36	20.01	16.29
Dwelling types					
Private House (percent)	63.09	82.26	99.70	80.82	95.73
Apartment (percent)	36.91	12.33	0.20	16.36	2.85

Note: average values are weighted.
Source: authors' estimates using AFEPS 2018

~~30.~~29. **Sectors of employment differ greatly among areas.** More households in rural areas participate in agriculture, forestry and fishing activities than in other strata. On the other hand, the main sector of employment in Yerevan is in wholesale and trade (Figure 2). Households in rural areas rely greatly on activities that are more likely to be their own business or to be employed by the government or the education sector. The latter two are assumed to have more security in terms of employment and salaries while agriculture-related activities have a high degree of risks. These rates of participation signal household choices but also availability of opportunities. For example, rural areas are unlikely to have a bustling retail trade even if it is a sector with high returns, and are more likely to have a opportunities in agriculture.

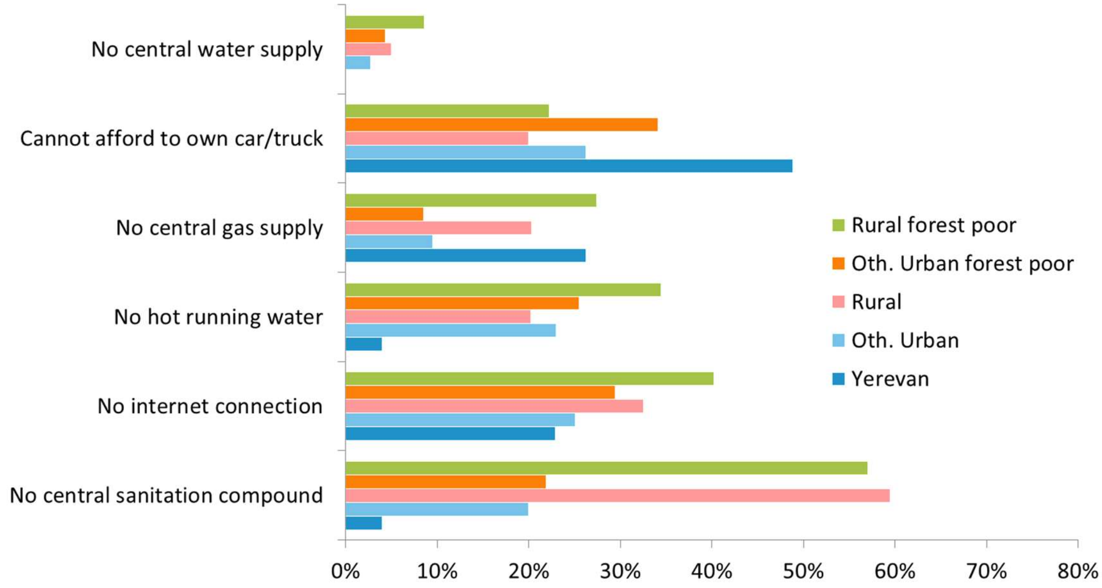
Figure 2 Sector of employment, 2018 (percent of working-age population)



Note: average values are weighted.
Source: authors' estimates using AFEPS 2018

~~31.~~30. **Fewer households living in rural areas have high-quality dwelling amenities although more households in rural areas own transport means than households in urban areas and in Yerevan.** Private houses are more common in rural and urban areas, where they are more likely to be owned, whereas on average more households in Yerevan own apartments compared to other households (Table 1). Households living in poor forested areas tend to have the least access to utilities such as hot running water, or central sanitation compounds. In terms of assets, as one would expect, computer ownership and access to the internet are low in rural areas, especially in poor forested areas. On the other hand, private transport is less common in Yerevan since it can be costly to secure parking when living in an apartment and households in Yerevan can use public transportation (Figure 3).

Figure 3 Access to services and assets, 2018 (percent of households)



Note: average values are weighted.
Source: authors' estimates using AFEPS 2018

Poverty has not changed between 2015 and 2018 although it increased slightly in urban areas outside Yerevan. Nearly one out of three people in Armenia is poor (Table 2). SWIFT consumption estimates in 2018 are smaller than consumption values in 2015 as consumption decreased in urban areas including Yerevan. On the other hand, in rural areas, households' consumption only increased slightly. This geographical disparity in poverty is in line with evidence from the latest Poverty and Equity Brief for Armenia.[20] However, the SWIFT poverty estimate for 2018 is higher than the observed poverty rate in the brief for 2017. This difference may be resulting from the surge in poverty in 2015 in Armenia, as supported by the brief. The SWIFT consumption model is built on data from 2015, and as such the model might be underestimating consumption in 2018, and projecting a poverty pattern that does not match the brief.

Table 2 Poverty and consumption estimates, 2015-2018

	ILCS 2015	AAFEPS 2018
Poverty rate (percent of population)		
Armenia	29.6	29.5
Yerevan	24.9	20.6
Other Urban	33.6	38.3
Rural	30.7	29.9
Consumption per capita (AMD)		
Armenia	69,207.3	66,579.9
Yerevan	80,593.7	75,270.9

[20] https://databank.worldbank.org/data/download/poverty/33EF03BB-9722-4AE2-ABC7AA2972D68AFE/Global_POVEQ_ARM.pdf

Other Urban	60,802.7	59,090.5
Rural	65,456.2	65,294.8

Note: average values are weighted. ILCS 2015 results come from the survey and correspond to the national estimates. The consumption aggregate and poverty rate in AFEPS 2018 were estimated using SWIFT (see appendix B). USD1 = 478.3 AMD
Source: authors' estimates using AFEPS 2018

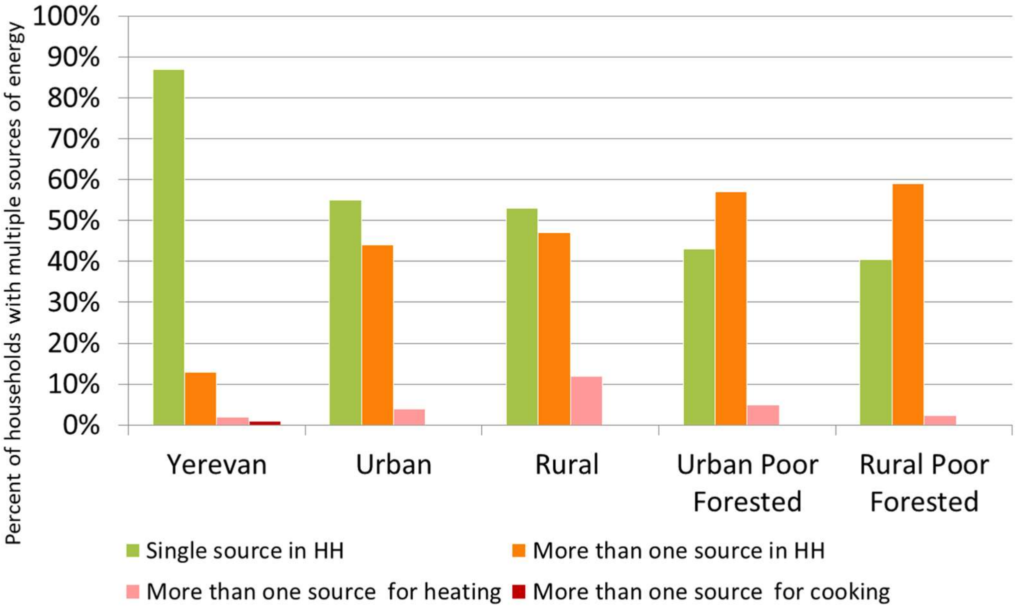
4 Importance of forest resources for energy heating

4.1 Patterns of energy use

~~32.~~31. **Gas is the main source of energy for heating and cooking in all areas but rural poor forested areas.** Households report three main types of energy sources: gas, fuelwood, and electricity. On average, over 90 percent of households in Yerevan and in other urban areas use gas as their main energy source either as a single source or as part of an energy mix. However, when looking at households in rural areas, the latter use more fuelwood and fuelwood is the main source of energy for households in rural poor forested areas (Figure 4).

~~33.~~32. **Households appear to use more than one source of energy although they favor a single source for specific activities such as heating and cooking.** Figure 5 below accounts for usage of electricity, natural gas, and fuelwood. The overlap between use of both natural gas as well as fuelwood across the household is evident, however the overlap drastically reduces when looking specifically at each activity. Households clearly prefer natural gas for cooking across all strata. For heating however, fuelwood appears to be the preferred choice but by a smaller margin. A significantly large share of households also use gas. Since dual energy usage or energy stacking is prominent across households, where the tendency is to predominantly use gas for cooking, but not always for heating, access in this case appears to not be the main challenge to increase gas usage.

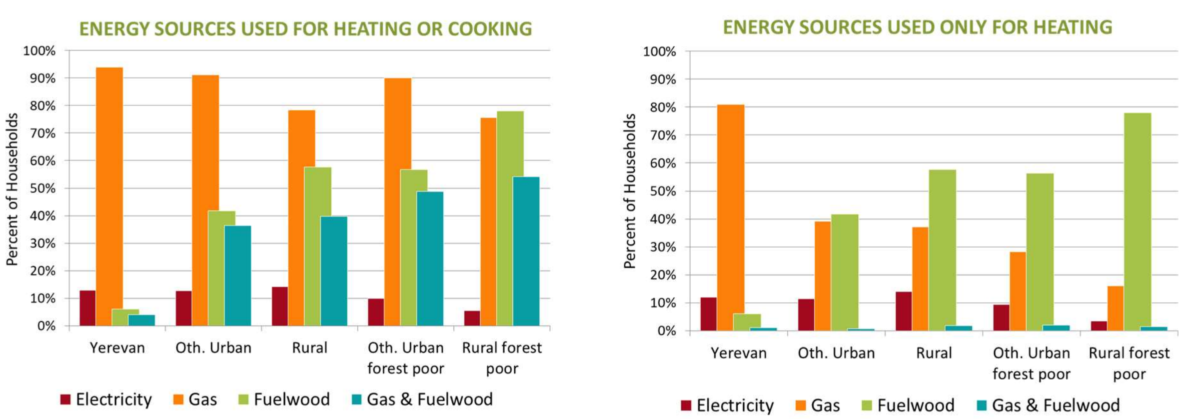
Figure 4 Number of sources of energy for heating and cooking, 2018



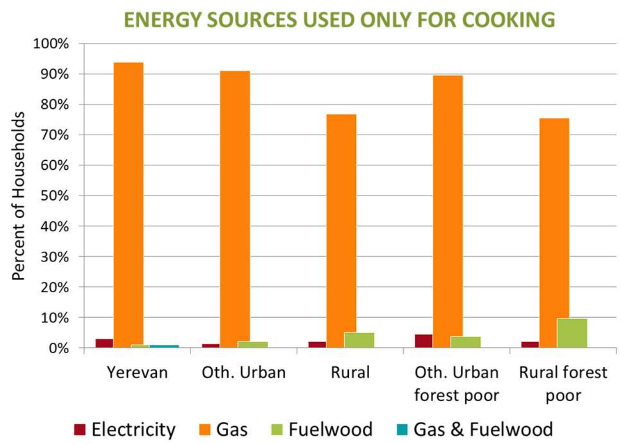
Note: average values are weighted.
Source: authors' estimates using AFEPS 2018

~~34.~~33. **The bulk of fuelwood consumed by rural households is for heating energy.** Considering only households using fuelwood, 80 percent of them purchase at least some quantity of fuelwood across seasons: 70 percent purchase fuelwood in winter and 30 percent in summer. Households in rural areas[21] consume twice as much fuelwood in the winter than in the summer, increasing from 1.5m^3 in the summer to 3m^{3}in the winter. It is interesting to note that compared to households in rural areas, households in urban areas or in poor forested areas report smaller changes in usage between seasons suggesting that this wood could be used for other purposes.

Figure 5 Sources of energy for heating and/or cooking, 2018



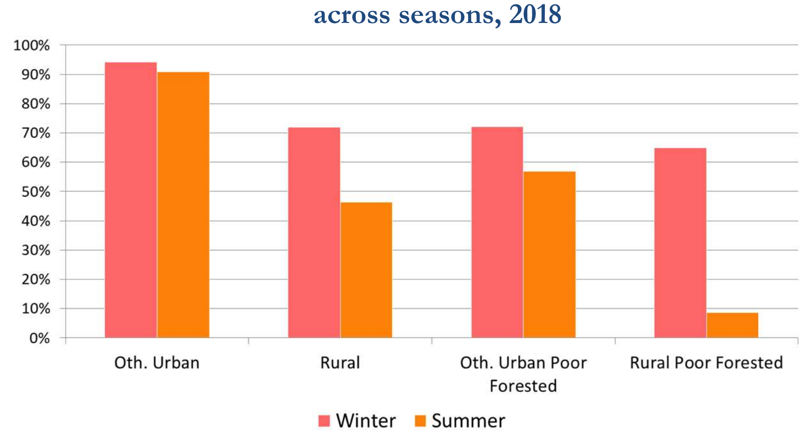
[21] For the remainder of this sub-section, we do not include Yerevan households as they do not consume fuelwood.



Note: average values are weighted. The first figure
Source: authors' estimates using AFEPS 2018

~~35.~~34. **Fuelwood is predominantly purchased in the winter months.** Figure 6 presents the preferences of households who either purchased or harvested fuelwood across both seasons. Rural households, especially those in poor forested areas, purchase less and harvest more, with almost 90 percent harvesting rate in the summer.

Figure 6 Purchased fuelwood as a share of total fuelwood across seasons, 2018



Notes: Average values are weighted. Total collection is the total quantity either purchased or harvested by the household.
Source: authors' estimates using AFEPS 2018

~~36.~~35. **There are major differences in the price of fuelwood between seasons and across strata.** As explained in section 2, the Forest Committee is responsible for setting fuelwood prices. The prices per cubic meter of fuelwood reported by the respondents is the same as the official price per cubic meter. Due to concerns around the confidentiality of responses, it is possible that respondents quoted the official price, and not necessarily the variation in prices they paid on the legal and grey markets for fuelwood. By extension, it is also possible that fuelwood consumption was underreported, not only due to recall issues, but also due to concerns around responses being shared with the authorities.

~~37.~~36. **Households in rural areas spend the most on fuelwood across both seasons.** Households in rural areas report spending 1.6times more than households in urban areas, despite similar consumption per capita (these HHs are also often larger than urban HHs). Households in rural poor forested areas and the ones in urban areas have on average similar levels of spending across the whole year (Table 3).

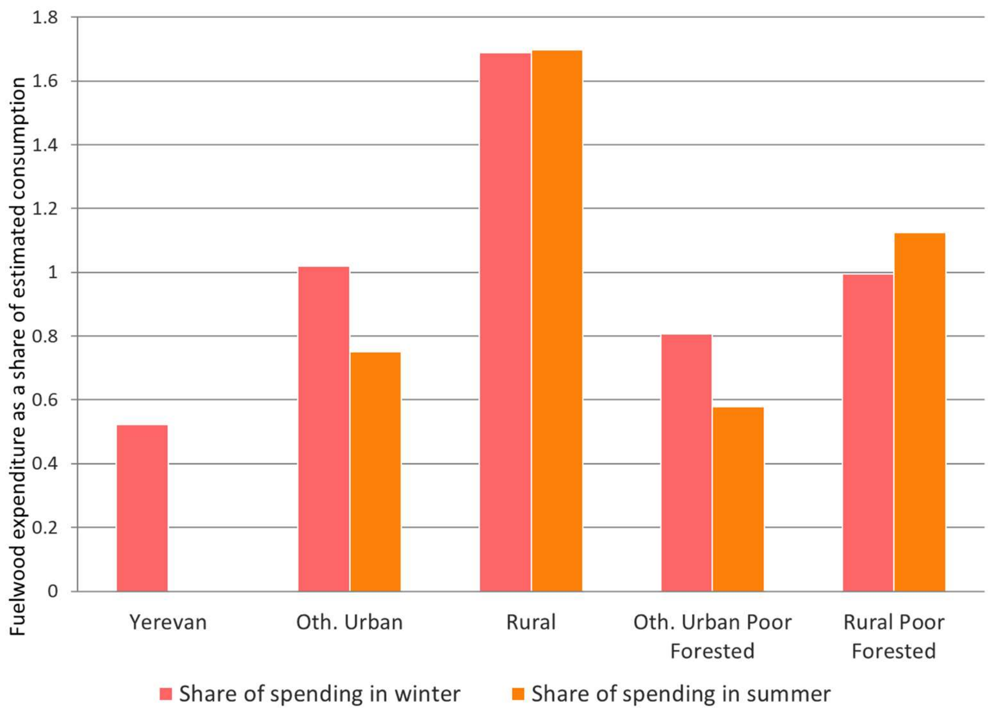
Table 3 Spending on fuelwood across strata, 2018 (AMD)

	Urban	Rural	Urban forest poor	Rural forest poor
Fuelwood expenditures in avg. winter month	48217.38	78440.11	34116.1	43593.7
Fuelwood expenditures in avg. summer month	16135.18	42058.98	9251.551	20489.73

Note: USD 1 = 478.3 AMD
Source: Authors' estimates using AFEPS 2018.

~~38.~~37. **Rural areas spend significantly more on fuelwood in both seasons.** When looking at fuelwood expenditure as a share of estimated consumption, ratios are greater for households living in rural areas and rural poor forested areas than in any other areas. These differences shed light on the importance of the proximity to the resources or to the lack of alternatives when households make their decisions to use fuelwood.

Figure 7 Share of fuelwood expenditures out of total household expenditures

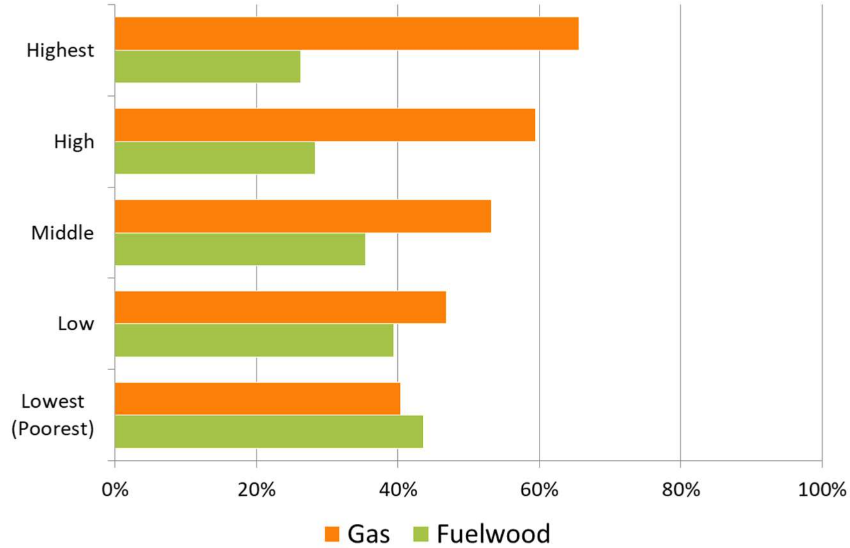


Note: Total households' expenditures are estimated using SWIFT methodology.
Source: Authors' estimates using AFEPS 2018

~~39.~~38. **The use of fuelwood, as well as the relative expenditure on fuelwood, increases with poverty.** The use of gas decreases with consumption quintiles while the use of fuelwood increases; on average a larger share of households in the bottom consumption quintile uses fuelwood than in the top consumption quintile (Figure 8). Overall, poorer households are more likely to use fuelwood, especially for heating in the winter.[22]

[22] We attempted to calculate shares of fuelwood expenditure out of total consumption, but the price reported by households in the data were not trustworthy and too high in comparison to households' total consumption expenditures.

Figure 8 Two main heating sources by consumption quintiles (percent of households)

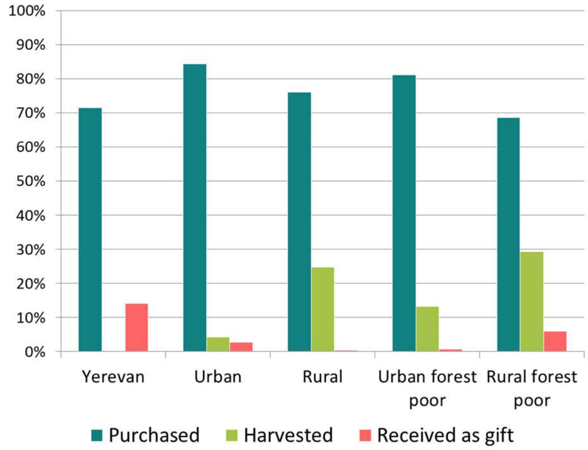


Note: Household consumption quintiles are estimated using SWIFT methodology. Other sources of heating energy used by households include electricity and cow dung (together with gas and fuelwood accounting for 100% of hearing energy sources).
Source: authors' estimates using AFEPS 2018

4.2 Characteristics of fuelwood users

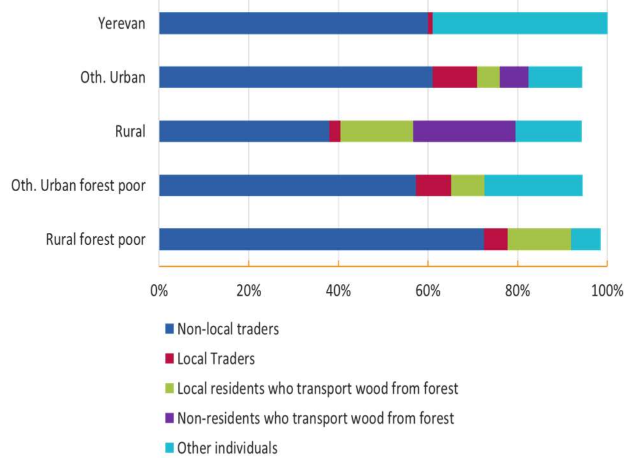
~~40.~~39. **Fuelwood is primarily sourced through sellers (i.e. purchased), while household harvesting is less common and limited to rural and poor forested areas.** Throughout Armenia, households report purchasing fuelwood although households in areas in close proximity to the forest, a larger share of households reported harvesting fuelwood (Figure 9). Non-local traders are the predominant sellers; rural and forested households also buy from residents who presumably collect directly, while urban households buy from non-local fuelwood transporters (Figure 10).

Figure 9 Sources of fuelwood (share of households using fuelwood)



Note: measured for households reporting using fuelwood.
Source: Authors' estimates using AFEPS 2018

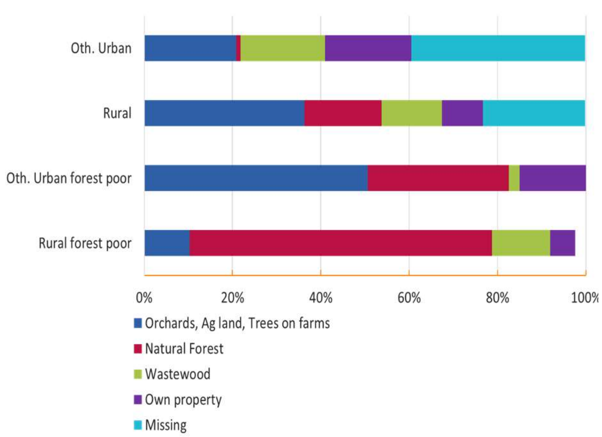
Figure 10 Sources of fuelwood purchase (share of households purchasing fuelwood)



Note: measured for households reporting purchasing fuelwood.
Source: Authors' estimates using AFEPS 2018

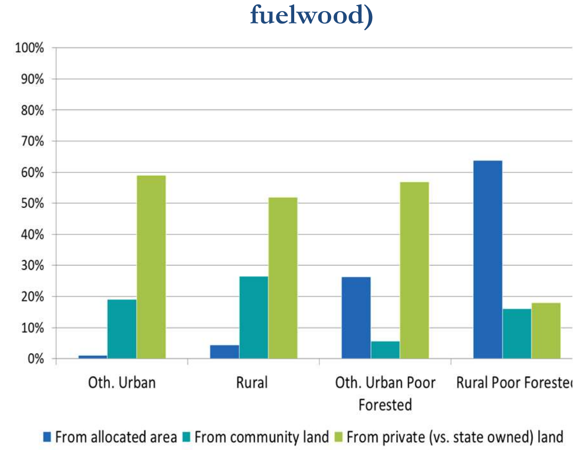
~~41.~~40. **While rural forest households harvest from natural forests, urban forest households favor orchard and agricultural lands**. The most important locations to harvest fuelwood in Armenia are agricultural lands, orchards, and natural woodlands (Figure 11). In addition, rural households living in areas closer to forests are most likely to collect from forestlands where they are permitted to collect fuelwood, while the other areas were most likely to favor private land (Figure 12). However, one can see that many households in urban areas chose not to respond, presumably because these households are worried their extraction could be reported to the authorities.

Figure 11 Places to harvest fuelwood (share of households harvesting fuelwood)



Note: measured for households reporting harvesting fuelwood. Two percent of households in rural forest

Figure 12 Types of land for fuelwood harvest (share of households harvesting fuelwood)



Note: measured for households reporting harvesting fuelwood.

poor also reported harvesting in forest allocated by the State but for clarity we did not add this category here.
Source: Authors' estimates using AFEPS 2018

Source: Authors' estimates using AFEPS 2018

~~42.~~41. **Households who rely on their business to generate their income are more likely to use fuelwood.** [23] Controlling for other characteristics, households whose head works in non-farm self-employment are more likely to use fuelwood while households with sources of income provided by an employer, the state, or a relative are less likely to use fuelwood. There seems to be a liquidity constraint that pushes households to use fuelwood. Households who know that they will receive regular transfers do not face such liquidity constraints, which encourage them to use alternative sources of fuel.

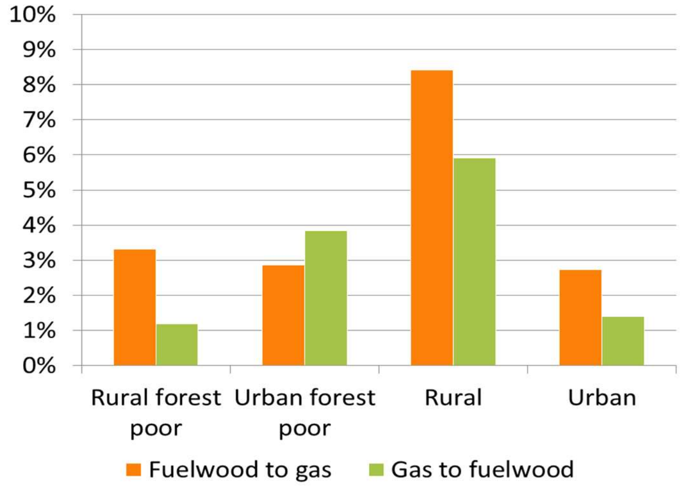
~~43.~~42. **Households without improved housing amenities are more likely to use fuelwood.** Lack of hot running water doubles the likelihood of fuelwood usage in comparison to households who have hot running water; households without hot running water might use fuelwood for heating water. Similarly, households who do not have an indoor kitchen are more likely to use fuelwood since outdoor kitchens are unlikely to be connected to gas or electricity. On the other hand, factors associated with residing in urban areas, such as apartments or private sanitation compounds, decrease the likelihood of fuelwood use.

4.3 Changes in energy choices between 2013 and 2018

~~44.~~43. **Between 2013 and 2018, few households reported having changed their energy sources.** As illustrated in Figure 13, less than 10 percent of households across strata had changed their energy sources. These changes transpired in both directions: from fuelwood to gas and from gas to fuelwood. More households in rural areas have replaced fuelwood with gas than households in any other stratum. However, because these changes are minimal, it is difficult to ascertain what specifically triggered the switch from one source of fuel to another.

[23] These two paragraphs rely on the results in Table 1 in Appendix C. This table reports the average marginal effects of a range of characteristics of the household head, members, and assets on the probability of fuelwood use. The model was selected using a forward backward stepwise selection method, that limited the variable set to significant ordinary least squares regression coefficients This stepwise selection was inserted in a probit model. Although various models were tested, the set of household characteristics with statistically significant effects remained constant.

Figure 13 Changes in energy source between 2013 and 2018



Source: Authors' estimates using AFEPS 2018

5 Conclusion and policy reflections

~~45.~~44. **This study provides food for thought on potential policy incentives and changes in the forestry and energy sectors by highlighting the linkages between forest uses and poverty in Armenia with a focus on fuelwood.** Using data from a household survey designed for this study, 'the Armenia Forest, Energy and Poverty Survey', with a sample designed to be representative at the national level (along with Yerevan/urban/rural levels, and urban poor forested and rural poor forested areas), the study provides a detailed description of the energy choices made by a wide range of households throughout Armenia.

~~46.~~45. The data gleaned from the analysis provides the following key insights:

a. **Households in Armenia use both natural gas and fuelwood to fulfill their energy needs:** in rural areas, households reported using natural gas for cooking and fuelwood for heating, except for households lacking an indoor kitchen which were more likely to use fuelwood. On the contrary, households in urban areas and Yerevan only use natural gas as they are more likely to live in apartments with an indoor kitchen which prevents the use of fuelwood.

b. **There is a clear linkage between forest proximity and use of fuelwood:** rural households living near forests spend on average 1.5 times more than urban households on fuelwood. At the same time, rural households change only slightly their purchases of fuelwood when comparing summer and winter seasons showing that households are equally reliant on fuelwood across seasons or equally constrained, and/or households maintain the same purchase volume in order to store and dry fuelwood for future and other uses.

c. **Lack of secure and regular earnings pushes households to rely on fuelwood:** On average, fuelwood usage decreases by consumption quintiles. In addition, households working as non-farm self-employed are more likely to use fuelwood while households with more secure revenues (pensioners, wage workers, with a migrant) are less likely. A liquidity constraint seems at play when deciding which fuel to use.

~~47.~~46. **Survey results present some limitations due to response rates and instrument design.** Due to a low response rate to forest-related questions, aside from fuelwood use, the degree of potential correlation between dependence on fuelwood and dependence on other forest products remains unknown. The survey suffered a bit from the fact that respondents were worried their names could be shared with authorities; this resulted in lower response rate on location for harvest and expenditures. In addition, since the data were collected in a single visit, it is difficult to describe seasonal or year-to-year trends as well as variation in energy usage. The survey included questions on recent changes, but as is common in household surveys, respondents fall prey to recall bias, having difficulty remembering activities conducted in past seasons and years. Finally, no verification of purchased or collected fuelwood volume was conducted in order to validate the survey responses. Further, the response rate on questions related to the extraction of forest products (timber and non-timber forest products) sold on the market or consumed by the household, along with forest-related wage and non-wage activities had very low response rates.

~~48.~~47. Nonetheless, while the responses on changes are quite limited, there seems to be some stickiness in switching back from gas to fuelwood, as having gas-dependent appliances tends to reduce household demand for fuelwood. Future energy sector policies would do well to understand how appliances 'lock in' energy consumers – specifically, how gas-line appliances prevent switching back to fuelwood, and further how this impacts the share of income spent by poor households on energy.

~~49.~~48. Aligned with the findings from this study, the following reflections should be considered when thinking through the development of related forest and energy sector as well as social protection policies:

a. **Addressing fuelwood supply:** Forests remaining the main sources of fuelwood for rural households which puts pressures on the resources, the Forest Committee could examine how to adapt the regulatory framework to promote forest plantation for commercial timber or to community/private-based forest management. In a recent World Bank study in Armenia, the authors noted that the greatest potential for commercial timber can be found in woodlots and plantations intended for harvesting both fuelwood and industrial roundwood (World Bank, 2020). The regulatory framework would have to shift to permit commercial timber production, however. If policymakers would like to permit the continued use of fuelwood by the Armenian population (notably those proximate to forest areas), there is a case to be made for transitioning forests to private land ownership, promoting trees on farms and landscape restoration.

b. **The energy sector could explore two options to work towards the conservation of forest resources.** A first option could be to link the extension of the gas-line with the provision of gas-dependent appliances (boiler gas) could be a more successful strategy to ensure the abandon of fuelwood for heating. A second option could be the promotion of improved and more efficient wood boilers, with or without accumulator tank, and requiring wood pellet or wood oil, or other types of biomass.

c. **Indoor air pollution and health:** although the study did not produce any data on health outcomes, the correlation between lack of improved living conditions and use of fuelwood makes questions about indoor pollution even more crucial. The usage of fuelwood can have great impact on populations' health as the burning of fuelwood increases indoor air pollution. The promotion of switching from fuelwood to cleaner fuels could come with a behaviorally-informed message and information on the impacts of fuelwood burning on health, notably in the minority of households in Armenia that use fuelwood for cooking. In this case of cooking, women and children tend to be disproportionately affected.

~~50.~~49. Further research is needed though to ensure the feasibility of these policy reflections, their efficiency, and their direct economic impacts on tax-payers and beneficiaries.

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Appendix

A. Forest Energy and Poverty Survey: instruments and implementation

Sampling design

Given the objectives of AFEPS the stratifications of interest were (1) geographical density (Yerevan, Urban, and Rural), (2) forest proximity, and (3) poverty incidence. However, the capability of inferences was only prioritized for a subset of these strata, and only *Poor Forested i.e. forest adjacent* areas were sampled to be representative within *Urban* and *Rural* areas. This is further explained in Table 1 below.

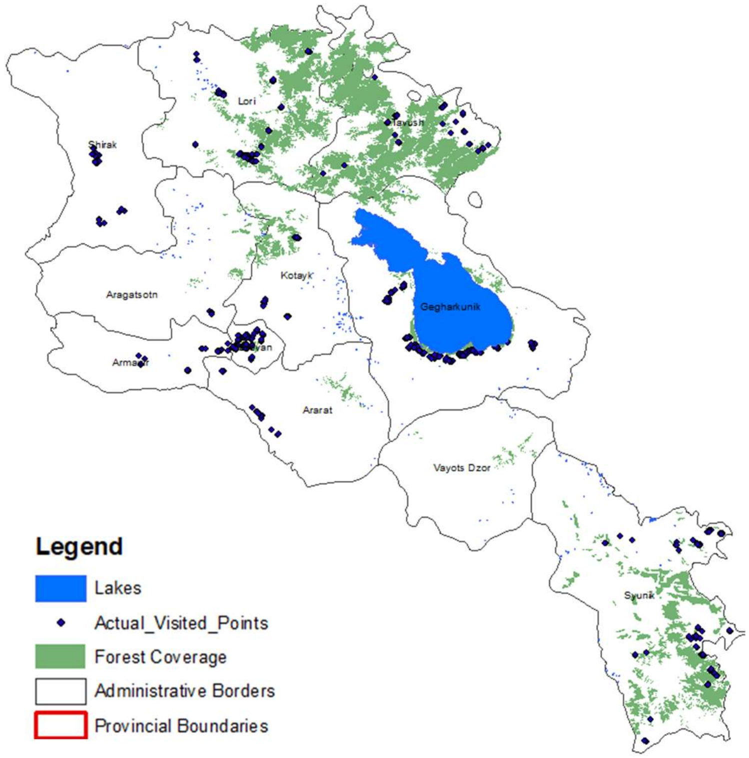
Table A.1. Proposed Stratifications and surveyed households by Strata

Strata	Domains of Inference	Total surveyed households
Yerevan	**Yes**	**108**
Other Urban	**Yes**	**374**
Forest poor t	Yes	*290*
Non-Poor and/or Non-Forest	No	*84*
Rural	**Yes**	**266**
Forest poor	Yes	*128*
Non-Poor and/or Non-Forest	No	*138*

Note: Global Human Settlement Layer (GHSL) grids with non-zero forest cover are classified as forest-proximate grids. Grids with over 30 percent poverty incidence as per commune-level data from Integrated Living Conditions Survey (ILCS) 2015 are classified as Poor grids. A grid is classified as a Forest grid if the centroid of the grid is less than 2 km away from the closest forest areas.

The first stage of the sampling design involved the selection of primary sampling units (PSUs). Although PSU selection is typically based on the national census sample frame, without access to this frame we instead relied on the Global Human Settlement Layer (GHSL) developed by the Joint Research Centre of European Commission as our sample frame. In this method, a Geographic Information System (GIS) was used to construct square grids within available administrative borders in GIS, which were overlaid with GHSL population density. Grids in rural and urban areas were of different sizes to account for differing population densities; rural grids were constructed at 1.5 km_2, and urban at 250 m^2. Grids were tagged as forest grids, if there was non-zero forest area present in the grid. Grids were tagged as poor grids if the poverty data from 2015 for the overlapping community was greater than 30 percent. In the first stage of sampling, 162 stratified grids, or PSUs, were selected using Probability Proportionate to Size (PPS) method, by which PSUs with larger populations were more likely to be selected.

Figure A.1. Map of sampled points



Source: UDA Consulting/CRRC Armenia

The second stage of sampling involved the random sampling of buildings within the selected 162 PSUs, as well as a partial listing of 15 PSUs in order to update the household density estimates for weighting calculations. The third and final stage was the random selection of apartments within a building if the building was not a single residence. The optimal household-cluster size to be surveyed per PSU was determined to be at least 4, upon consideration of the design effect, intraclass correlation coefficient, and relative standard errors in the Integrated Living Conditions Survey (ILCS) 2015. The final sample size of AFEPS was 748 households, distributed across strata as shown in Table 1.

Questionnaire development

The questionnaire consisted of three main components: (a) a basic household questionnaire including a household roster with activities and educational levels; (b) energy modules; and (c) forest-related questions. The basic household questionnaire contained a household roster with household member characteristics, migration, labor participation. This component of the questionnaire helped the enumerator to collect information on housing characteristics and households' assets.

The energy modules consisted of two sections: one section on fuelwood and another on all energy sources. With respect to the questions on fuelwood, the respondents were asked if they harvested, purchased or processed fuelwood, and from whom they purchased the fuelwood. There were also questions on changes in their uses of fuelwood. The section on energy use asked about appliances and energy sources used for cooking and heating in households. The module also inquired about changes in energy use in the last 5 years, in terms of price and quantity, as type of fuel.

The forest-related sections in the questionnaire were adapted from the Forestry modules[24] from the National socioeconomic surveys in forestry written by the FAO, CIFOR, IFRI and the World Bank (FAO et al., 2016). The forest sections encompass detailed questions on forest uses (harvest, consumption, and sales), processing of harvested forest products, place of forest extraction, gender of the household members working in forest-related activities, questions on other forest income sources (wage and non-wage), and questions on forest dependency and forest degradation.

The information on extraction of forest products (timber and non-timber forest products) that are sold on the market or consumed by the household, but also on forest-related wage and non-wage activities allows one to build a comprehensive forest income. Collected data provides information on cash and non-cash sources of income and uses price information to value the extraction of forest products. To robustly estimate forest income, information is also collected on inputs and costs.

Survey implementation

Survey implementation along with listing was conducted from October to December 2018, simultaneously to the partial listing. To conduct the survey and the listing, enumerators used tablets and corresponding programmed forms to fill in the results as they progressed. Every enumerator was provided guidance and instructions and was assigned one or several regions. Data collection in all the regions was performed under the supervision and regulation of a fieldwork coordinator. A pilot survey was completed prior to the main survey, after which several changes were made to the questionnaire. Notably, there were difficulties associated with answering the energy-related questions. It was especially challenging for respondents to identify the amount of energy they used in winter/summer and the amount they used for heating, cooking and boiling water. To acquire more precise data, the wording of the question was changed.

Amongst all the households visited by enumerators, 748 agreed to participate in the survey. At the start, 4 households were planned to be interviewed per grid, but in some cases, this was not possible as specific grids lacked residential structures, and in other households were reluctant to participate in

[24] www.fao.org/forestry/forestry-modules/en/

the survey. Many structures were abandoned, commercial, government, or other types of structures which enumerators could not access. To survey the minimum number of households, enumerators substituted households as required.

B. Forest-SWIFT – methodology and application

Forest-SWIFT is a data collection method developed to provide timely, quick, and accurate data on poverty and forest dependence through a small set of country-specific questions. As an extension of the Survey of Wellbeing via Instant and Frequent Tracking (SWIFT), a methodology developed by the World Bank to estimate poverty incidence between consecutive comprehensive household surveys (Ahmed et al., 2014; Yoshida et al., 2015), Forest-SWIFT additionally tracks forest dependence, defined as the forest income share of permanent household income. These two survey tools complement traditional household surveys which are collected on average every five years by providing more frequent poverty measurements to monitor poverty changes. Although the model can use either consumption or income as the welfare measure, the country preference takes precedence to maintain comparability. Forest-SWIFT develops country-specific models for each indicator, which often requires different variables per model.

Each model assumes a linear relationship between household total consumption/income, or forest income (y_h) and their correlates (x_h) with a projection error (u_h). The inclusion of this error term differentiates this model from other predictive tools

$$ln y_h = x_h'\beta + u_h \quad (1)$$

Forest-SWIFT estimates the log transformation of the dependent variable to smooth asymmetries and normalize the distribution of the variable, making it easier to estimate. Forest-SWIFT controls for issues linked to over-fitting – when a model performs well within the sample but poorly outside the dataset – by cross-validating the model (Kuhn and Johnson, 2013). The purpose of cross-validation in Forest-SWIFT is to identify the optimal level of significance- or p-value- in the model, which would balance the number of determinants and the goodness of fit across the sample. Cross-validation consists of two steps: (a) splitting the sample in n-folds and running the model in n-1 folds and testing it on the nth fold i and (b) running multiple models per fold, testing various thresholds of significance for model variables. This process of 'stepwise' selection entails adding variables to the Ordinary Least Square (OLS) model sequentially if they bring enough information, and simultaneously removing them if they do not. Each fold has a chance to be the testing data and this process is repeated n times by changing the nth fold each time. The optimal p-value performs best in terms of mean-squared errorsii between actual and projected welfare, and the absolute value of the difference between the actual and projected poverty (or forest-dependence) rates. This concludes the cross-validation process and the stepwise OLS regression is run a final time on the full sample of data using the selected p-value. The resulting regression is the SWIFT poverty model.

To ensure the quality and robustness of the models, Forest-SWIFT carries out two tests (if data are available): backward imputation and validity test. The former applies the final model to a previous round of data to check the stability of the model over time. The latter tests whether the error term follows a normal distribution using a simulation method developed by Elbers, Lanjouw and Lanjouw (2002, 2003).

The result is a small set of questions that considerably simplifies data collection and encourages teams to collect data quicker and more frequently than traditional lengthy household surveys. Forest-SWIFT data are collected through CAPI (Computer Assisted Personal Interviews) to ensure quick analysis and results. Having similar questionnaire designs for baseline and Forest-SWIFT surveys is essential. Differences in questionnaire design, recall periods, and labeling of questions, can bias estimates and require re-estimations of models with fewer variables that can be selected since there are fewer variable options once the survey is rolled out.

After creation of the questionnaire, the last phase of Forest-SWIFT is to predict consumption and forest income based on the coefficients from the models. In this final prediction phase, Forest-SWIFT utilizes multiple imputation estimations to apply the coefficients from the respective models to the variables in the new dataset. Random error is simultaneously introduced by adding 1000 imputations with error per household estimate.

A household is identified as poor if its consumption is below a poverty line. As we have estimated 1000 imputations per household, we had 1000 estimates of consumption, and therefore poverty status per household. To compare poor and non-poor households, we used a multiple imputation (mi) command that split the sample in two and provide sample means for the two different samples.

C. Determinants of using fuelwood

Table 1. Estimating likelihood of using fuelwood

Variables	Fuelwood (probit)
Head is male	0.458** (0.22)
Head Migrated (attempted/successfully)	-0.440* (0.26)
Head is a non-farm self-employed worker	1.275* (0.70)
Share of females in household	0.525 (0.43)
Share of employed members in household	-0.803* (0.43)
Share of pensioners in household	-0.821*** (0.28)
Highest educational attainment in household is a High School degree	0.426* (0.23)
Highest educational attainment in household is a Vocational degree	0.619*** (0.22)
HH Remittance sent	0.533 (0.35)
HH Type: Apartment	-1.663*** (0.41)
No Central water supply in HH	-1.187** (0.51)
No hot running water in HH	1.020*** (0.27)
No local sanitation compound/hole in HH	-0.473** (0.20)
No kitchen in HH	0.892** (0.44)
No computer in HH	-0.455* (0.24)
Strata = Non-Poor or Non-Forest Rural	0.519** (0.21)
Strata = Poor-Forest Rural	0.766*** (0.18)
Strata = Yerevan	-1.172*** (0.28)
Strata = Poor-Forest Urban	0.471** (0.21)
Constant	-0.0859 (0.42)
Observations	747

Note: Model was selected using forward backward stepwise modeling to avoid collinearity. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses

4.

[i] We pick ten folds but it could be any number of folds.

[ii] The average of the sum of squared differences between y_h and $\hat{y}_h = x_h' * \hat{\beta}$