Assessment Of The Economic And Social Impact Of Unsustainable Forest Practices And Illegal Logging On Rural Population Of Armenia

ICARE Foundation

Yerevan, 2011

EXECUTIVE SUMMARY

The economic prosperity and double-digit growth that Armenia experienced during the first decade of the 21st century up until the occurrence of global economic crisis greatly reduced the poverty level in Armenia. Consequently, more households were able to afford first necessity products than they were at the beginning of 2000's. Efforts on infrastructure development and improvement of livelihoods of rural communities have been cited to be one of the national priorities.

Intensive rate of gasification efforts since the establishment of the ArmRusGasProm ("Gazprom" OJSC owns 80% and Armenian government owns 20% of the shares) has provided many dwellings with alternative fuel option, i.e. mains gas. Gasification coupled with economic prosperity translates into increased gas consumption today relative to 2003. In addition, it also implies potential decline in the use of other types of fuel. Rigorous efforts of "Hayantar" SNCO, "State Forest Monitoring Center" SNCO, various Ministries of Armenia and NGOs on forest protection and maintenance of sustainable forests are supplementary causes that could lead to one thing only – elimination/reduction of illegal logging and sustainable use of forests.

This study assesses the economic and social impact of unsustainable forest practices and illegal logging. Predominantly, it analyzes the results of survey conducted in 2003 and 2010. The comparative figures are then presented to monitor and comment on the observed trends. Households and sawmills are the primary targets of the study.

Household survey results clearly indicate the reduced consumption of fuelwood and increased consumption of mains gas compared to 2003. Over the 7 year period, the average fuelwood amount over all surveyed households has declined, but average price per cubic meter has increased. More households switched to mains gas, relying on fuelwood primarily for heating purpose. Back in 2003, forest access was much easier for households. The illegal payment system was also much more "advanced" than it is in 2010. Transportation costs from forests to dwellings have increased as well due to disappearance of forests on the roadside. These factors affected the preference of households to bring firewood from forests; instead, many now buy from middlemen.

Sawmills, on the other hand, buy most of the round logs from "Hayantar" SNCO (i.e. forest) than from middlemen or clients. The trend is exactly the opposite of that of households. The common factor between both sectors is the reduced amount of fuelwood/wood. Although the statistics indicate reduction in timber or fuelwood use, it could very well be reversed depending on the relative prices of alternative fuel.

The announcement of "Gazprom" OJSC in 2010 about charging European prices for gas in Armenia will soon become the devastating reality for many rural households. The latter are the main fuelwood consumers given the lack of gas in settlements. Based on survey results, the absolute minimum demand for stacked fuelwood in 2003 was 892,500 m^3 and declined to 652,000 m^3 in 2010, or in terms of solid wood, 562,000 m^3 (in 2003) to 457,000 m^3 (in 2010). Hence, if the alternative fuel price (i.e. gas) increases, other households who currently use mains gas will switch to fuelwood as well. This will potentially wipe out the results of rigorous efforts to cut down firewood consumption. Illegal logging is likely to increase due to this expected hardship. Suggestions to improve the livelihoods of rural households include promotion and subsidies for use of alternative fuel (i.e. solar energy, etc.), collection center for NFTPs, development of beekeeping in some forest-rich marzes, and overall improvement of ticket-tracing.

ACKNOWLEDGEMENTS

This report is the result of an activity funded by the European Commission and implemented by IUCN as part of the ENPI-FLEG program (WB, WWF), which aims to promote the development of improved forest law enforcement and governance arrangements in six countries.

The report was prepared by International Center for Agricultural Research and Education Foundation (ICARE) in Armenia and field work was implemented by Research and Outreach Development Center (RODC) of ICARE.

The authors of the report are:

Dr. Vardan Urutyan (Director of ICARE)

Dr. Tatevik Zohrabyan (Director of ICARE RODC)

Yerevan, 2011

LIST OF ABBREVIATIONS

AAC	Annual Allowable Cut
AMD	Armenian Dram
ASME	Agribusiness Small and Medium Enterprise
CIS	Commonwealth Independent States
CRRC	Caucasus Research and Resource Center
ENPI-FLEG	European Neighborhood Policy Integration – Forest Law Enforcement and Governance
FAO	Food and Agriculture Organization
FMP	Forest Management Plan
GDP	Gross Domestic Product
HS	Household Survey
ICARE	International Center for Agribusiness Research and Education
ILO	International Labor Organization
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature
NGO	Non-Governmental Organization
NSS	National Statistical Services of Republic of Armenia
NTFP	Non-Timber Forest products
SIDA	Swedish International Development Cooperation Agency
SME	Small and Medium Enterprise
SNCO	State Non-Commercial Organization
USAID	United States Agency for International Development
WWF	World Wide Fund for Nature

TABLE OF CONTENTS

INTRODUCTION

The rate of deforestation is at alarming stage in the world. The reasons for deforestation are not only logging in an unsustainable manner, but also transforming the forests into agricultural land. According to Bruinsma (2003), forests are gradually being converted into cropland, pastures, and farmlands, and over the next three decades, 3.8 billion hectares of new croplands a year would be emerged in the developing world. Disappearance of forests entails numerous environmental damages such as climate change, changes in ecosystem, changes in water flows, microclimates, and so on (Pearce et al., 2003; Chomitz et al., 2007). Funds from international donor organizations flood the forestry sector with the objective of mitigating the deforestation and promoting the sustainable forest practices to lessen the potential environmental impact. Despite these centered efforts, the illegal logging and unsustainable forest practices continue threatening the environment.

REVIEW OF LITERATURE ON INTERNATIONAL FOREST MATTERS

The disappearance of forests brought forth a line of empirical studies that attempt to determine the underlying causes and provide feasible solutions. It has been suggested that economic development and per capita GDP increase shifts the demand for products, including wooden (timber) products. That is, welfare and economic progress are contributing factors for increased forest use (legal or illegal). This could be the main factor of logging in developed countries, but given the significant number of developing nations and level of poverty in the world, this appears to be not the major driver of forest disappearance.

The global benefit of improved forest protection is acknowledged, but at a local scale it affects people especially from developing countries who benefit from forests in many ways (Norton-Griggiths and Southey, 1995; Adam and McShance, 1996; Völker and Waibel, 2010). Poverty has long been considered to be a major factor of illegal logging because forest-dependent communities, who generally are quite poor, rely on forests for satisfying their fuel needs both for cooking and heating and non-timber forest products (NTFPs) for own consumption and for sale (Reddy and Chakravarty, 1999; Cavendish, 2000; Schwarze et al., 2007; Mamo et al., 2007; Babulo et al., 2009).

Therefore, many reports focus on the forest-dependent communities and suggest policies centered on improving the livelihoods of the poor rural communities, opportunities for off-farm employment, agricultural diversification as a method of insurance, and other strategies to alleviate the illegal felling of forests (Völker and Waibel, 2010). However, as MacKinnon (2005) claims, caution is necessary to suggest an effective and truly workable policy. There are outside opportunists (rent-seekers) who take advantage of loopholes in the forest governance laws and heavily corrupt system to exploit forests for profit opportunities. This seems to be the case for many developing countries with weak and highly corrupt system of governance. In such locations, illegal logging by rural (forest-dependent) communities makes up a miniscule fraction, while outsider opportunists are responsible for the large share of total illegal felling of forests (Hansen and Treue, 2008). This assertion clearly needs proper justification for each country.

Most of the existing studies use qualitative methods to suggest policies. Quantifying the illegal logging and measuring its potential impact on the society as a whole is not as common. However, it certainly improves the efficiency of proposed policies and their further implementation. In the last several years, a line of studies proposed several quantitative methods of measuring the illegal logging (Pattanayak and Sills, 2001; Cordero, 2003; Takasaki et al,, 2004; McSweeney, 2004; Guiterrez-Valez and MacDicken, 2008; Völker and Waibel, 2010). Statistical inferences of a sample to the entire population are made to find the magnitude of logging at a country-level. These methods encompass sound statistical justification to explore the extent of the "unobserved" variable - illegal logging. Similar approach was used not only in South America, Asia, and so on, but also in Armenia.

LITERATURE ON CALCULATION OF ILLEGAL LOGGING

Forest extraction as a result of financial and economic crisis in 2009 is studied by Völker and Waibel (2010). Three geographically diverse Vietnamese provinces in mountainous uplands were included in the two-year study. Total of 889 households from 45 communes in three districts were interviewed based on a 3-stage cluster sampling procedure. The main objective of the paper was to clarify what types of shocks affect

households in the selected provinces in Vietnam to engage in forest extraction. Standard probit model is used to model the probability that households will engage in the extraction of the forests[1].

$$Prob(extract_i = 1) = F\left(\delta S_i + \varphi R_i + \theta X_i + \omega Y_v + \gamma P_p\right),$$

where i represents households, $extract_i$ is a binary variable indicating households' engagement in forest extraction during the last 12-month, S_i is a vector of shock measures, R_i is a measure of perceived future shocks, X_i – vector of socio-demographic characteristics of households that may affect the decision of households to engage in forest extraction activities or not, Y_v is the travel time from village to nearest market, and P_p represents the vector of dummy variables capturing the effect of the province. They estimated four different models by varying different features. Their results indicate that incidence of shocks is a determinant of forest extraction.

Moreover, the large share of surveyed households were engaged in collecting and logging of fuelwood for heating and cooking purposes, whereas the non-fuelwood timber and NTFPs play quite minor role. Hence, their suggestion was that all these factors should be considered and if forest protection policies are too strict, they could negatively impact the households in such area.

Quantification of illegal logging is important and is becoming more critical given the alarming rates of deforestation. Hansen and Treue (2008) estimate the amount of illegal logging in Ghana through timber export statistics, estimates of domestic timber consumption and official harvesting records. Their finding shows that 70% of total harvest in Ghana is illegally logged. In terms of quantity, it is estimated to be 2.3-2.7 million m^3. Moreover, over two-thirds of illegal harvesting is done my chainsaw operators who are the key distributors of timber within Ghana, while one-third of illegally logged timber is being exported.

Estimating the costs of illegal logging is another important aspect which is captured by some studies. Gutierrez-Velez and MacDicken (2008) evaluate some of the most relevant impacts of illegal logging to government and society in Bolivian, Brazilian and Peruvian Amazon. Specifically, they evaluate the loss of government royalties, missed appropriation of revenues, inefficiency in logging operations, loss of productivity and unemployment. The estimated total cost of illegal

[1] They also proposed two other versions of model employing instrumental variable methods to overcome possible missing variable biases.

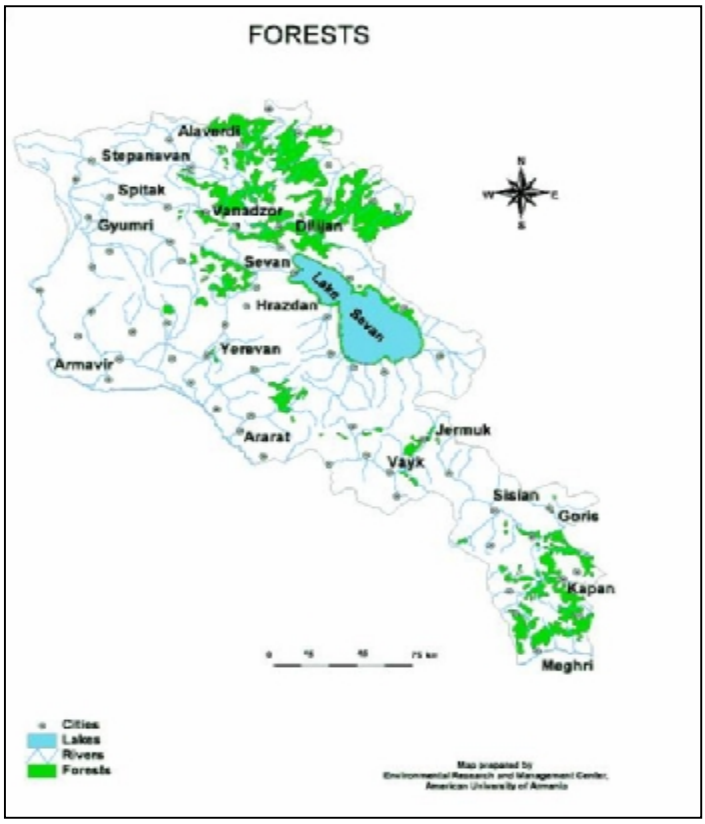
logging is between the range of $588- $639 million. The cost is similar to the one reported by Baird (2001). The latter calculates the cost of illegal logging in Indonesia ranging from $10 million to $600 million. Marfo (2010) estimates that the loss from not collecting stumpage fees from chainsaw operators and instead collecting informal payments costs them $17 million per year. Specifically, the government officials in Ghana collected estimated informal payments of $ 1.2 million in 2007, but they could have received officially if the informal market was eliminated and the sum could have been up to $ 18 million per year. This number is different across countries. For example, $13.1 million in Cameroon, $2.4 million in Gabon, and $18-$42 million in Liberia are the estimated lost stumpage revenues that government could have had in case of formal industry (Lescuyer et al., 2010; Langbour et al., 2010; Kamara et al., 2010)[2].

LITERATURE ON ARMENIAN FORESTRY SECTOR

Armenian forestry sector, unlike that of Asian, African, South American countries, is not well explored. The earliest study that included quantification of illegal logging was conducted by Mitchell in 2004. Survey of 812 households in 62 settlements was conducted in 2003 to analyze the pattern of illegal logging by households. In addition, sawmills and cargo/transportation surveys were conducted to study the business sector as well. To quantify the illegal logging in the sample marzes in Armenia, mean fuelwood consumption was calculated over the entire sample, which then was referred to the population living within 10km distance from forests. Household demand for fuelwood alone was measured to be minimum of 567,563 m^3. Obviously, the quantity of illegal logging can be measured if "legal" published supply amount is subtracted from the absolute minimum level of demand. Marzes that were far from forests were not included in the study, such as Armavir, Shirak and Yerevan. However, it is known that rural population in the first two marzes also rely on fuelwood. Hence, if the total demand for fuelwood is calculated throughout the entire country, 567,563 m^3 will be far surpassed.

[2] Cases of numerous other countries are included in the "European Tropical Forest Research Network" Issue 52, December 2010.

Similar estimate for fuelwood was calculated by Vardanyan and Sharoyan in 2005. They calculated that total volume of annual logging is 1 million m^3 50% of which is the fuelwood share. In newspapers, Mrs. Vardanyan noted that in 2003 the volume of illegally logging was between 800,000 m^3 and 1,000,000 m^3 (Harutyunyan, 2007). Consistent with Mitchell's study in 2004, World Bank study in 2005 included an estimated total volume of annual logging of 1 million m^3 with 56.8% fuelwood demand. The decreasing trend in demand for fuelwood is documented in the study by Hergnyan et al. in 2007. They calculated the demand for fuelwood to be 350,000 m^3.[3] This reduction was referred to be mainly due to the availability of alternative fuel. Available literature outside of Armenia does not seem to consider the case of alternative fuel (i.e. mains gas, electricity, diesel, solar energy, etc.) to be important to the forest extraction by households. Unlike the studies on other countries, Mitchell (2004) and Hergnyan (2007) accounted for availability of alternative fuel in Armenia as a separate variable that is detrimental of forest extraction.



Danielian and Dallakyan (2007) studied the causes and main drivers of deforestation. Their sample included all the ten marzes and the capital. Although they did not estimate total demand by households, they reported average household consumption of fuelwood to be about 6.7 m^3. Hence, if we infer this number for the entire sample and country, then the estimated demand for fuelwood would surpass that of the previous studies. The most recent qualitative study conducted by Hazarashen NGO (Kharatyan) (2010) explores the attitudes, preferences, and various other factor of households, specialists, forest-guards, etc in three forest-rich marzes. She reported that many of the respondents use fuelwood, even in case of available gas. This is because of the high gas prices.

Considering the above mentioned studies and reports on Armenian forestry sector, it is clear that reported numbers by "Hayantar" SNCO (hence, NSS) are only fractions of the entire volume. Hence, the illegal logging in all the prior years is couple of time higher than the reported ones. Does this imply that the officially reported forest cover is also false given the fact that there is large volume of illegal logging? According to "Hayantar" SNCO, forest cover in 2010 is 345,820 ha, which is about 11.2% of total area, which is the same as it was in 1993 (Hergnyan et al., 2007). The unofficial data, published by various authors indicate apparent declining trend in forest cover area in Armenia. In recent years, satellite imaging (Landsat images from Hergnyan et al., 2007) is used to track the true forest cover. The forest cover decreased from 334,100 ha in 1993 to 232,000 ha in 2006, or in terms of % of total area, it declined

[3] In addition, demand by restaurants and businesses are calculated to be about 120,000 m^3 and 130,000 m^3, respectively.

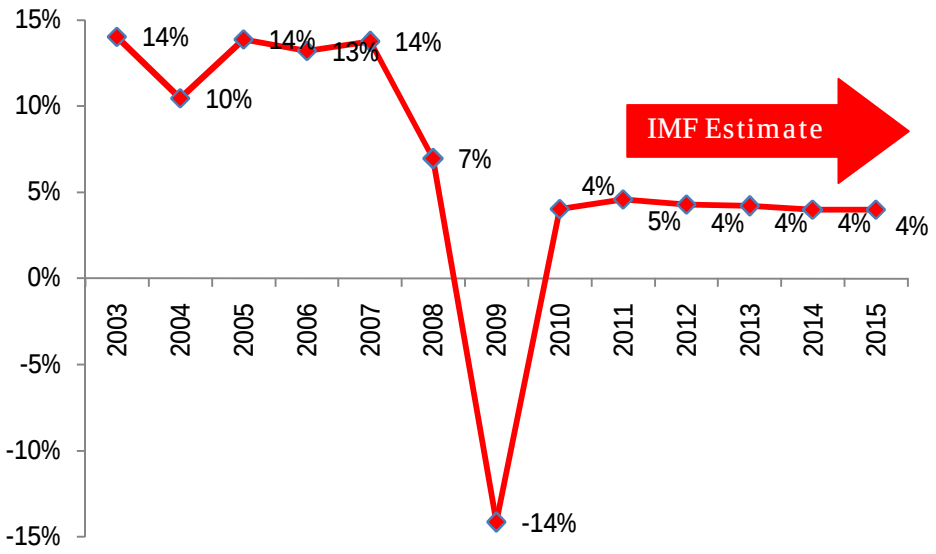
from 11.2% in 1993 to 7.7% in 2006 (Hergnyan, 2007). Given the estimate of 390,000 m^3 annual incremental growth, it is clear that with consumption of wood beyond this level will reduce the forest cover.

Reports in 2007 were the last ones to quantify the consumption of fuelwood. The objective of this study is to explore the Armenian forestry sector by conducting surveys among forest-dependent households and sawmills in 2010. The aim is to use the survey data as well as available external information to suggest pilot programs that would improve the livelihoods of rural population and provide policy recommendations to rejuvenate the forestry sector. In 2003, similar survey among households and sawmills in the same locations was been conducted. Comparison of the trends and general notions between 2003 and 2010 is another objective which provides the luxury of analyzing the effectiveness of policies of this sector over time.

The survey of representative sample of forest-dependent communities revealed some interesting facts. Significantly more people started using mains gas as a result of increased gasification efforts. However, the decline in fuelwood consumption is not overwhelming. Furthermore, demand analysis of fuelwood indicated that sellers are quite flexible in increasing the price without suffering much from the quantity decrease. The consumption of fuelwood decreases with the increasing distance from the forest, however, it doesn't seem to be statistically significant. Hence, conclusion is that forest-dependent community consumes more fuelwood, but the other rural communities (farther from the forest) consume as well just with limited quantities. The findings also indicate that households are not the major illegal loggers, but rather the outside opportunists for profit opportunities. Therefore, suggested policies that aim at improving the livelihoods of the forest-dependent community will only partially alleviate the issue illegal logging, while the parts of it which is done by outsiders, will remain intact.

The Armenian independence in 1991 entailed large costs in terms of burden on population and its destructive impact on the country as a whole. The economic recession accompanied by the scarce resources universally touched citizens' lives in a dreadful manner. Poverty, abandoned factories, appalling infrastructure, and many other issues caused the livelihoods of people both in rural and urban areas to deteriorate. The start of 21st century was quite promising with noticeable changes in many industry sectors. In fact, the GDP of Armenia was growing at double digits which led the country to be considered the fastest progressing country among in the CIS (Figure 1). As a result of financial and economic crisis, negative growth was reported in 2009. Although there is some improvement in 2010, the change is quite small with very conservative estimates for the next 5 years. Therefore, it can be assumed that the full economic recovery of the country to the pre-crisis level is quite unlikely in the near future (IMF, 2010).

Figure 1: Percentage Change in GDP of Armenia, 2003-2015



Source: IMF Database

Increasing trend is observed for exports and imports. They both peaked in 2008 and were affected by the crisis in 2008-2009, but are recovering in 2010 (Figure 2). This is another indicator of improving economy.

The rate of inflation has increased as well during the crisis time (2008), recovered, then reversed the trend reaching to 8% in 2010 (Figure 3). This indicates that the same bundle of goods that consumers could buy in 2009 will cost more in 2010. In addition, the inflation rate in 2010 higher than that of 2003. IMF's forecast of inflation rate for the next 5 years is about 4%. It is estimated to be relatively fixed due to the policy of Central Bank of Armenia (inflation targeting policy). On the other hand, unemployment rate in Armenia appears to be declining starting from 2003. Only during the economic crisis it increased slightly, but is estimated to be returning to the pre-crisis low level (6%). The more exact estimate of unemployment rate is provided by International Labor Organization (ILO). According to ILO's estimation, the rate ranges from 31.7% in 2003 to 18.7% in

2009. Similarly, Caucasus Research and Resource Center (CRRC) in Armenia reported unemployment rate being 28% in 2007 rather than 5% (CRRC, 2007). These rates are more exact and indicate much higher rates than those reported by IMF. However, ILO, CRRC and IMF estimates indicate declining trend in unemployment rate which is a positive indicator for the country.

Figure 2: Trend in Total Exports and Imports of Armenia, 2003-2010

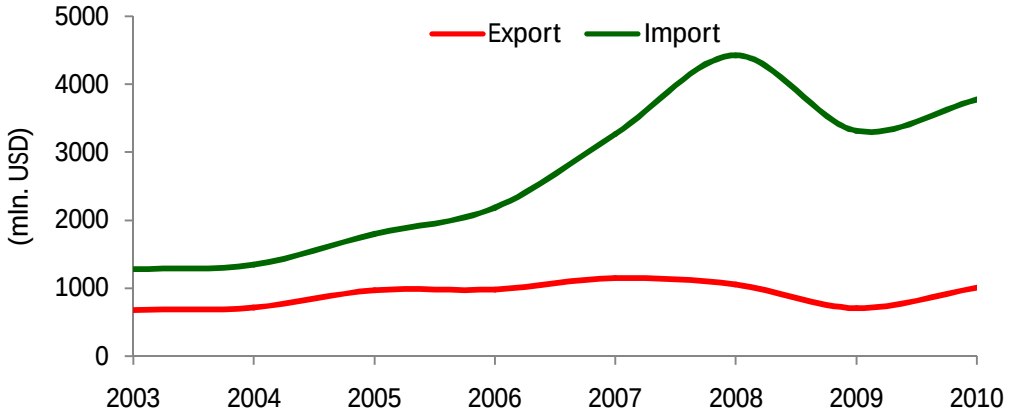
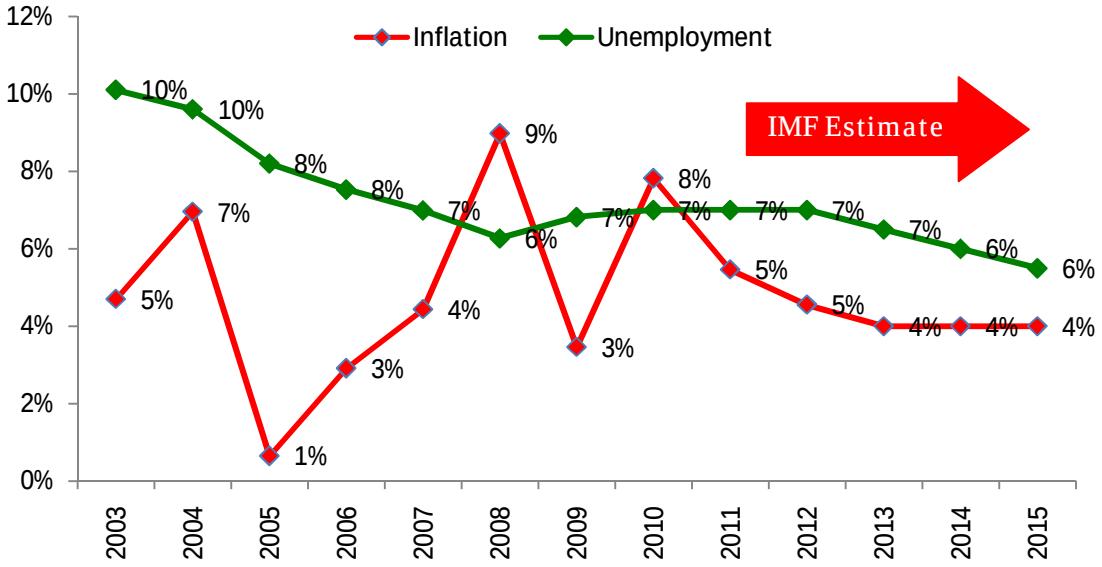


Figure 3: Trend in Rates of Inflation and Unemployment in Armenia, 2003-2015



Source: IMF Database

The unemployment rate alone is not sufficient to make implications on welfare level of population. Although one could be employed, the increasing inflation coupled with low level of income would imply insufficient financial conditions. According to NSS, the absolute average monthly wage increased from 34,783 AMD to 108, 852 AMD in 2003-2010 period. The price level for the same period increased about 40%, whereas wages increased about 220% (NSS). This implies decrease in

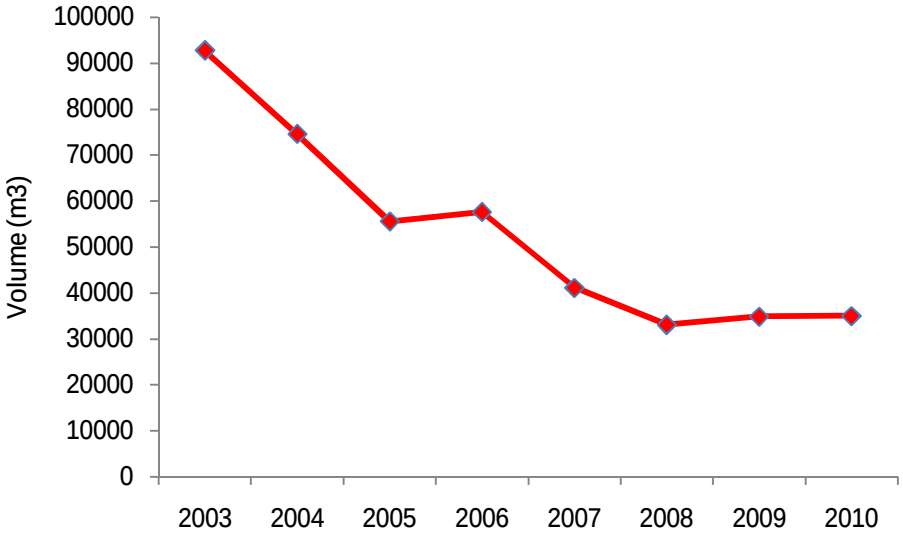
potential poverty rate. In fact, the poverty rate dropped from 35% in 2004 to 24% in 2008 (NSS).[4] It is uncertain if there is any improvement in 2010, although it can be implied from the wage level and other macroeconomic indicators that it declined further. However, there is no distinction of poverty rate by rural and urban types.

FORESTRY SECTOR

Above presented general economic trend, inflation, and unemployment rates indicated some improvement relative to 2003. Consequently, forestry sector should be improved as well relative to the 2003 level, being part of the overall upward moving economy. Mitchell (2004) report indicated that due to high level of poverty, demand for fuelwood was very high especially in the rural areas. As stated above, both poverty level and unemployment rates have gone down since 2003. Thus, the demand for fuelwood should show decreasing trend as well. These questions are analyzed in the data analysis section of the report.

Given the fact that Armenia is one of the 70 low forest-covered countries with 0.12 ha of forest area per capita, forest protection was and still is considered to be detrimental (Papinyan, 2003; Sayadyan, 2005; Moreno-Sanchez and Sayadyan, 2005; Sayadyan and Moreno-Sanchez, 2006; Hergnyan et al., 2007). The forests are in such an alarming state that only sanitary cuttings are allowed. According to the Forest Management Plan (FMP) of Armenia, the allowable cuts by "Hayantar" SNCO declined over time, indicating the urgency of forest protection. In 2010, the stated allowable cuts (AAC) were 35,000 m^3.

Figure 4: Volume of Cut by "Hayantar" SNCO, 2003-2010

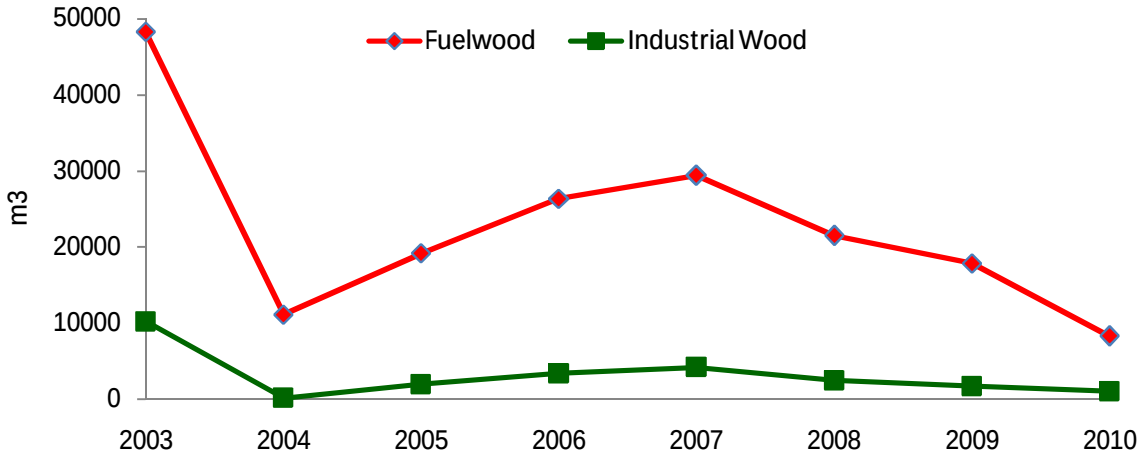


Source: Hayantar Statistics

[4] The study was conducted in 2009. New studies in assessing the poverty level in Armenia are not available. However, we intend to fill this gap with the survey conducted among 819 households in 8 marzes of Armenia.

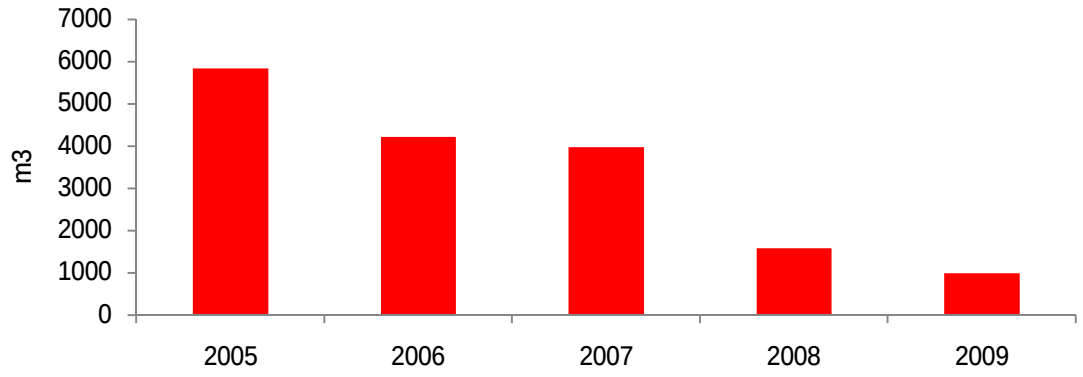
The sanitary cuttings include wood for fuel and construction. Figure 5 shows that the portion of fuelwood has always outweighed that of construction wood. The trend in both fuelwood and construction wood is similar to that of AAC. In addition to the internal market, AAC includes wood for exports as well. However, as shown in Figure 6, exports are drastically declining leaving most of the AAC for internal market. Unlike exports, imports of wooden products are increasing. However, the increase in imports and volume of allowable cuts does not seem to be sufficient enough to satisfy local demand for wood as reported in previous studies (demand of minimum of 500,000 m^3 only by households). Logically, the difference between supply and demand of wood and wooden products represents the informal/illegal portion of overall logging.

Figure 5: Fuelwood and Industrial Wood from Sanitary Cuttings, 2003-2010



Source: Hayantar Statistics

Figure 6: Overall Volume of Sawn Wood Exported, 2005-2009

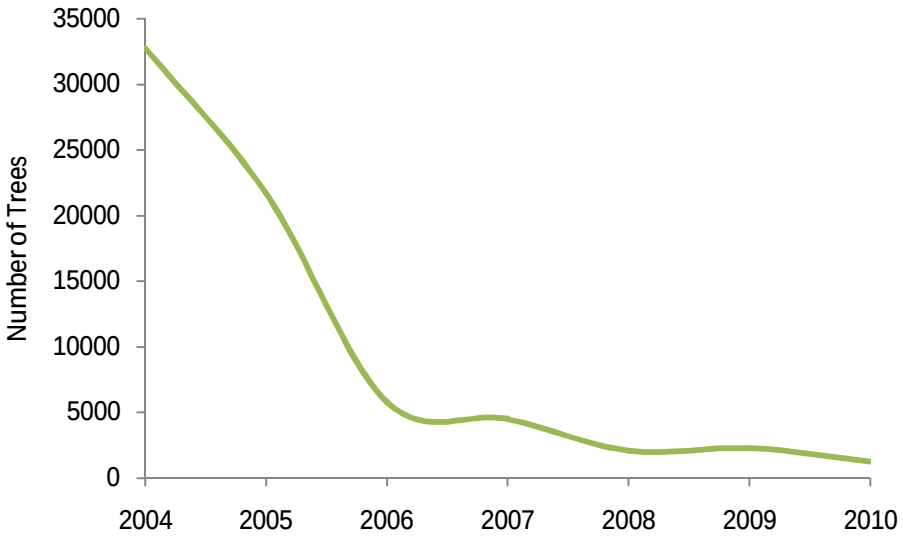


Source: Hayantar Statistics

It has been acknowledged by government that massive loggings of forests took place during the energy crisis right after the independence of Armenia. It continued due to high level of poverty in the entire nation. In 2003, the level of illegal logging declined but still it was considerable amount given the decreasing area covered by forests. "State Forest Monitoring Center" SNCO was formed to keep track of illegal loggings and "Hayantar" SNCO addressed the issue by enforcing more

regulations and improving the protection of forests. As a result, official number of illegal logging declined dramatically to negligibly low levels. Illegally logged trees have declined from about 32,000 to 1,270 (Figure 7).

Figure 7: Illegal Logging in Armenia, 2004-2010



Source: Hayantar Statistics

Considering all the above presented statistics provided by "Hayantar" SNCO and National Statistical Services of Armenia, it can be concluded that forestry sector in Armenia is largely improved and on the sustainable path. However, if this was the case, NGOs involved in protecting the environment of Armenia would probably not be in the center of spotlight complaining about the illegality and imperfect forest protection and management.[5] The following section of the report describes the methodology of the survey conducted in 2010 by ICARE Foundation to make sense of the changes, trends and statistics in the forestry sector.

[5] Hundreds of articles were reviewed related to Armenian forests and loggings, which are available at www.ecolur.org, www.antarner.net, www.news.am, www.hetq.am.

METHODOLOGY

The methodology of the study is constructed for two separate target groups: households and sawmills. The target population of the Household Survey section encompasses households in 8 Armenian marzes who live within 10km vicinity from the forests or forest-like areas. The household survey followed a stratified five stage design, whereas sawmill survey followed a stratified two stage design. For the latter, the target population includes all the sawmills in three forest-rich marzes in Armenia.

HOUSEHOLD SURVEY

The Household Survey (HS) includes households from eight marzes in Armenia some of which are very rich in forests, while the rest are scarcely covered with forests or forest-like lands. The sampling methodology is kept consistent to that of 2003 study for maximum comparability. Following the methodology of 2003 was one of the rules this study had to comply. According to 2003 study, the selection criteria are households who are the potential fuelwood consumers and who are likely to obtain fuel wood from the forest. Hence, 10 km vicinity from the forest is the main criterion for selecting the settlements, because it is unlikely that households will use forests to satisfy their wood needs if they are located farther than 10 km, instead they will buy from middlemen to satisfy.

Given the possible non-responses, initially, large sample size was selected. However, at household level, the non-response rate was about 1.2%. Hence, from the initial sample size of 829 only 819 were surveyed and the 10 (1.2%) refused to participate in the interview process. Therefore, total of 819 (instead of 812 in 2003) households were surveyed[6] in 2010.

STRATIFICATION

Representativeness of the sample is the key for reliable data and accurate inferences. Accounting for representativeness and compatibility criteria, 8 strata was used for 2010 HS. The 8 strata are the 8 marzes of Armenia which cover all but 2 western marzes (with no forest cover) and the capital. In each stratum, the number of households was selected proportional to the availability of forests, distance from forests, type, availability of gas, level of poverty, and hypothesized consumption of fuelwood.

PRIMARY STAGE

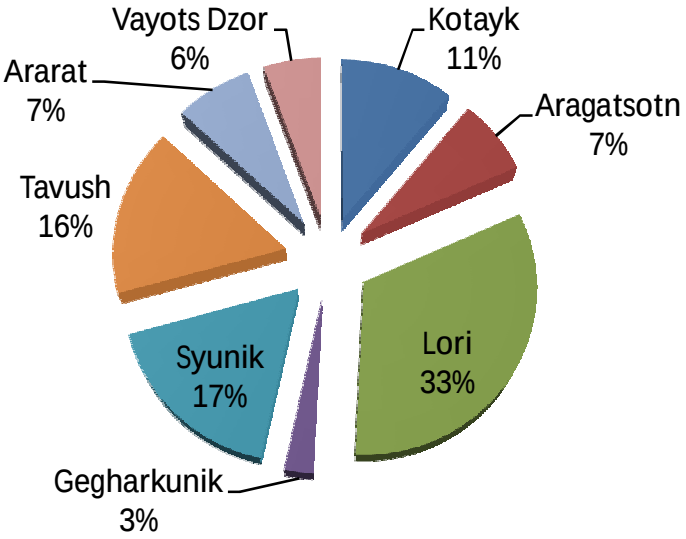
The primary stage of the household methodology is to select Marzes of Armenia. The three marzes together (Tavush, Lori and Syunik) encompass over two-thirds of national forests (Lori Mayor's Office/Economic Development Program, 2009). Yerevan, Armavir and Shirak are not included

[6]Initially, non-response rates were considered to be about 2%. Hence, to achieve 812 completed surveys, 2% of it was added to the total number of households (812+0.02*812 = 819) to yield total households of 829 in 2010. Due to great efforts of the survey team, only 1.2% of households refused to participate to the interviews.

because the forest covered areas are either quite small or non-existent. Hence, at primary stage the following marzes are selected:

1. Aragatsotn
2. Ararat
3. Gegharkunik
4. Kotayk
5. Lori
6. Syunik
7. Tavush
8. Vayots Dzor

Figure 8: Percentage of Respondents (Households) by Strata, 2010



SECONDARY STAGE

The secondary stage of HS is the selection of cities/town/villages. To keep the consistency with 2003 survey methodology, the same settlements (i.e. cities/towns/villages) are selected. Haghpat is the only addition in 2010 due to some rumors that illegal logging activities were observed. Total of 64 settlements are selected including 24 cities/towns and 40 villages. Settlements selected for the sample include many different features, which are used to support or refute various hypotheses in the data analysis section. The characteristics of the selected settlements are presented in Table 1.

TERTIARY STAGE

The tertiary stage of HS is the selection of routes in each of the 64 settlements. To keep the consistency with 2003 survey methodology, the same number of routes was selected for each of the settlements (i.e. cities/towns/villages). The selection of the routes is based on the principle of random sampling. Main streets, outskirt streets, undefined streets (in some villages) are included in the selection.

For the purpose of robustness, separate mini-survey was conducted on the opposite routes of each of the selected settlements. The results of the controlled survey were not statistically different from that of the treatment or main survey. Hence, 2003 study's approach of selecting certain number of routes in each settlement is statistically robust with small margin of error.

The main street was starting point of route selection. To choose other routes, interviewers were instructed to keep the proportion of main and outskirt street in equal proportions. However, in some villages, most of the streets were outskirt type and equal proportion was not possible to maintain. Total of 184 routes were selected. The details of the number of selected routes are presented in Table 1.

QUATERNARY STAGE

The dwelling selection is done at the quaternary stage of HS. The methodology varies slightly depending on the type of dwelling (i.e. apartment complex, house, etc.). Total of 819 households have been surveyed. About 5 % of households lived in the apartment buildings, while the rest (about 95%) lived in the houses. The main reason for such partition was that proportionally fewer settlements included apartment buildings, whereas many of them were villages including only houses.

SELECTION OF HOUSES

The selection of routes is followed by selection of houses. As soon as the route was selected, the interviewers were instructed to walk towards the direction of increasing building numbers while keeping on the right side of the street. The selection of houses started from the third house on the right side of the randomly selected route. The next house on the same route was the sixth one on the right side of the route. The interviewers were instructed to always move towards the direction of increasing house numbers and always be on the right side. In case the route spliced into two streets, right route was the one to be followed. Non-response or empty houses should be accounted for as well. In case of a non-response of the selected household, the next house was selected (i.e. forth one). The houses that were selected but nobody was home to open the doors were additionally visited two more times. If the last attempt was unsuccessful, the next house as selected (i.e. forth one or N+1 house).

SELECTION OF APARTMENTS

Similar to houses, selection of apartment starts from the third one in the building. Only one apartment in each randomly selected building was selected. After the first apartment selection and interview, the second apartment was selected by leaving the current building and walking towards the direction of increasing building numbers on the right side. The second apartment was the third one from another building and the process continued that way. Similarly, if the selected apartment was not-inhibited, then the next one (i.e. forth or N+1) was selected.

QUINARY STAGE

The final stage of multi-stage sampling design is the selection of respondent. Prior to interview process, few facts were checked to ensure there were adult household members (18 years old and older) who lived in the house. If there were no adults in the house, the selected dwelling was visited two more times and in case of failure to meet adult household members, the next dwelling on the right side of the selected rouse was selected. If there was at least one adult in the household, then the interview process took place. In case of more than one adult household members, the most informed member[7] was selected as the respondent of the interview.

Table 1: Five Stage Sampling Design

Primary Stage (Marz)	Secondary Stage (Settlements)	Type of Settlements	Distance of Settlements from the Forests (M)	Tertiary Stage (Routes)	Quaternary Stage (Dwellings on Each Route)	Total Number of Households
Aragatsotn	Aragats	Village	8,531	2	5+4	9
Aragatsotn	Byurakan	Village	1,944	2	5+5	10
Aragatsotn	Aparan	City/Town	1,966	3	4+3+3	10
Aragatsotn	Ashtarak	City	9,210	5	5+5+5+5+4	24
Aragatsotn	Yeghipatrush	Village	1,389	2	4+3	7
Subtotal	*5*			*14*		*60*
Ararat	Ararat	City/Town	18,130	4	5+5+4+4	18
Ararat	Vedi	City/Town	10,681	3	5+4+4	13
Ararat	Shaghap	Village	11,137	2	4+3	7
Ararat	Surenavan	Village	20,814	2	4+4	8
Ararat	Vardashat	Village	15,453	2	4+3	7
Ararat	Vosketap	Village	18,550	2	4+4	8
Subtotal	*6*			*15*		*61*
Gegharkunik	Chambarak	City/Town	5,321	2	5+5	10
Gegharkunik	Daranak	Village	45	2	3+2	5
Gegharkunik	Martuni	Village	0	2	3+3	6
Subtotal	*3*			*6*		*21*

[7] The interviewer asked the members of household who was the most informed person about the following question: basic economics, indicators, fuel sources and usage, timber production, grazing livestock, etc. Then the one who was more informed was selected for the interview.

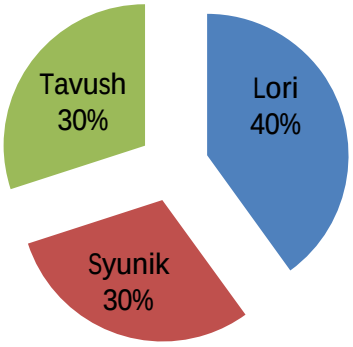
Kotayk	Hrazdan	City	986	8	5+5+5+5+5+5+5+5	40
Kotayk	Tsakhkadzor	City/Town	0	2	5+5	10
Kotayk	Garni	Village	5,134	3	5+4+4	13
Kotayk	Geghadir	Village	8,035	3	4+4+3	11
Kotayk	Meghradzor	Village	125	2	3+3	6
Kotayk	Solak	Village	1,301	2	5+5	10
Subtotal	*6*			*20*		*90*
Lori	Antaramut	Village	242	2	4+4	8
Lori	Akhtala	City/Town	0	3	4+4+3	11
Lori	Alaverdi	City	0	2	5+5	10
Lori	Shamlugh	City/Town	0	2	5+5	10
Lori	Stepanavan	City/Town	0	4	5+5+5+5	20
Lori	Tashir	City/Town	8,483	3	5+5+5	15
Lori	Tumanyan	City	0	2	5+5	10
Lori	Vanadzor	City	0	25	5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+5+3	123
Lori	Yeghegnut	Village	8	2	4+4	8
Lori	Margahovit	Village	828	2	5+5	10
Lori	Pambak	Village	500	2	4+4	8
Lori	Sverdlov	Village	8,797	2	4+4	8
Lori	Haghpat	Village	189	2	3+3	6
Lori	Tsaghkashat	Village	0	2	4+4	8
Lori	Odzun	Village	659	3	4+4+3	11
Subtotal	*15*			*58*		*266*
Syunik	Goris	City/Town	0	5	5+5+5+5+5	25
Syunik	Kapan	City	0	9	6+5+5+5+5+5+5+5+5	46
Syunik	Meghri	City/Town	469	2	5+4	9
Syunik	Qajaran	City/Town	271	2	6+5	11
Syunik	Kaghnut	Village	418	2	5+5	10
Syunik	Khdzoresk	Village	0	2	5+5	10
Syunik	Shikahogh	Village	0	2	5+5	10
Syunik	Tandzaver	Village	0	2	5+5	10
Syunik	Vorotan (Sisian district)	Village	1,232	2	6+5	11
Subtotal	*9*			*28*		*142*
Tavush	Artsvaberd	Village	0	2	4+4	8
Tavush	Aygehovit	Village	43	2	4+4	8
Tavush	Bagratashen	Vilage	2,431	2	5+5	10
Tavush	Berd	City/Town	0	2	5+4	9
Tavush	Dilijan	City/Town	0	4	5+5+5+5	20
Tavush	Ijevan	City	0	4	5+5+4+4	18
Tavush	Noyemberyan	City/Town	23	2	5+5	10
Tavush	Chinari	Village	1,070	2	4+4	8
Tavush	Gandzaqar	Village	0	2	5+5	10

Tavush	Haghartsin	Village	0	2	4+4	8
Tavush	Koghb	Village	38	2	4+4	8
Tavush	Sevqar	Village	3,389	2	5+4	9
Tavush	Voskepar	Village	152	2	4+4	8
Subtotal	*13*			*30*		*134*
Vayots Dzor	Areni	Village	16,223	1	5	5
Vayots Dzor	Jermuk	City/Town	0	2	4+3	7
Vayots Dzor	Vayq	City	10,951	2	4+4	8
Vayots Dzor	Chiva	Village	14,271	2	3+3	6
Vayots Dzor	Eghegis	Village	6,161	2	3+3	6
Vayots Dzor	Gndevaz	Village	1,458	2	3+3	6
Vayots Dzor	Malishka	Village	13,573	2	4+3	7
Subtotal	*7*			*13*		*45*
Total	64			184		819

SAWMILLS SURVEY

Stratification of the sawmills was done at marz level. Only three forest-rich marzes were considered for sawmills survey: Lori, Syunik and Tavush. Overall, there were limited number of sawmills in Armenia implying small sawmills population. Therefore, initially, all the existing sawmills were attempted to include in the survey, but several problems were faced. First, the accurate and exact number of existing sawmills was either unavailable or non-existent. Various sources, such as National Statistical Services of RA, Hayantar, FAO, Ministry of Agriculture, Ministry of Natural Protection, were use to fathom total number of sawmills, but no single source contained full and complete information. The number of establishments operating in forest, wood and pulp, and paper products industry was available in 2003 at National Statistical Services of RA. It was 121[8]. Similar statistics was not available for 2010. In 2003, the survey team of the company conducting the initial series of this study, approached all the available 121 sawmills. The non-response rate was as high as 74%, i.e. only 32 sawmills agreed to participate in the interview process.

Figure 9: Percentage of Businesses/Sawmills by Strata, 2010



[8] Source: http://www.armstat.am/file/article/prom_e_1.pdf

Considering the potential large non-response rate, this study also tried to cover all the available sawmills. As an estimate of sawmills, total number of sawmills identified by AM Partners Consulting Company (contracted by WWF) was used, which included 100 identified establishments (companies) in forest, wood and pulp, and paper products industry. Furthermore, considering similar non-response rate as in 2003, it was estimated that completed surveys would be 26. To have this number, all 100 of these businesses had to be approached.

Each one of the companies/proprietors was first accessed by phone to discover the nature of business, status of functionality and operations, and address. As a result of phone calls, about 25 were nonfunctional, 15 were in engaged in trade or other kind of business where the main source, wood, was imported, about 20 were engaged in chair, window, furniture carving business. Only 40 were sawmills or like-companies/proprietors. Unlike AM Partners Consulting Company (2010), which surveyed total of 55 companies/proprietors, only 20 sawmills were successfully reached and surveyed. The others either refused to participate or kept deterring the interview time (to the point of survey completion). Therefore, sawmills survey did not incorporate complicated sampling design, rather one simple stratification (marzes) and the rest was based on "all or nothing".

The non-response rate in 2010 was 80%, 6% higher than that of 2003. The surveyed sample is small, though it is representative. However, given the limited number of businesses, inferences to overall population is possible but might not provide the exact details. The general picture of the industry will be assessed based on the survey results which is adequate given total population of sawmills is 100 and surveyed ones comprise 20%.

SURVEY PROCEDURE

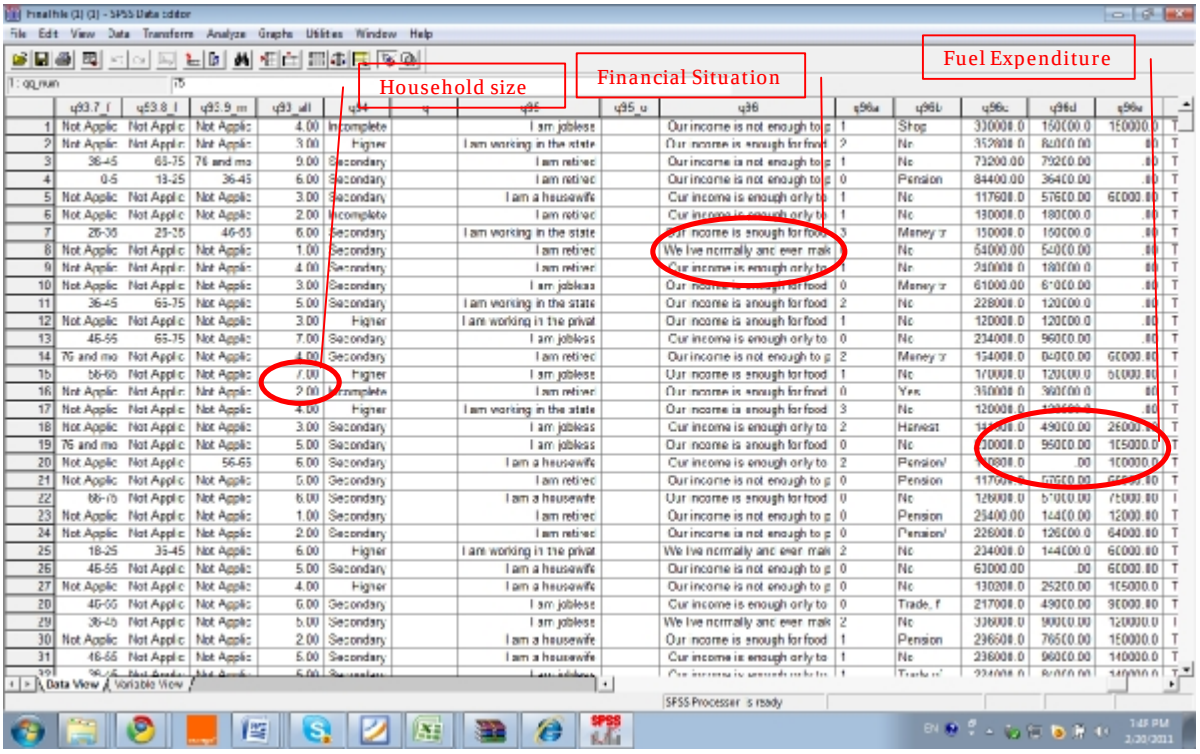
To maintain the consistency with the study completed in 2003, survey tools were nearly unchanged. The 2003 questionnaires (household and sawmill) were re-examined in 2010. Questions were not changed, but new set of questions were added. The new set of questions included gas connection in the village and dwelling, expenditure on fuel partitioned by gas and fuelwood, hypothetical gas price increase to make them switch to fuelwood and vice versa,

and community engagement in forest management. The pretest of questionnaires took place in July, 2010. Questionnaires were then finalized for the fieldwork. The recruitment and training of enumerators was completed by late August. The fieldwork took place in September-November. Simultaneously, data entry into SPSS was implemented.

The entire sample was also partitioned into control and treatment groups to further test if distance to forest is a significant parameter for fuelwood consumption and illegal logging. For this purpose, small sample of households were interviewed in Shirak marz, Maralik town. This additional survey results are not presented, but the potential difference from the treatment sample is analyzed. In addition, several truck drivers were also approached and informally interviewed to gain more extensive information about the issue. About 8 truck drivers willingly provided information on various questions related to fuelwood sale, legality of it, etc. The analyses of the survey results are presented in data analysis section.

DATABASE

Database of both household and sawmills surveys is available in SPSS. The random checking and cleaning of the entries was completed. Qualitative information about most of the households is also included in the database under "Comments" section. It will enable the analyst to make inferences with increased confidence by using both quantitative and qualitative datasets. Qualitative survey results are also presented in the data analysis section.



DATA ANLYSES

Survey results are consistent with the previously conducted research studies. Both quantitative and qualitative findings imply the illegal logging is predominantly implemented by profit-seeking outsiders rather than households or sawmills. The results are quite homogenous across the 8 marzes (used for this study). Gasification clearly affected the demand for fuelwood, but the recent increase and expected increase in gas price would likely cancel out the positive impact gasification.

QUANTITATIVE SURVEY ANALYSIS

Results of the representative sample of households and 20 sawmills have been analyzed with all the possible methods including both quantitative and qualitative. The results do not contradict each other; instead, they complement and support one another.

> "We like to use gas because it is clean and safe. You see many people use Baxi system. You think we don't want to use it? But the reality is that gas is more expensive than fuelwood. That's why we use fuelwood."
>
> - Respondent in Dilijan, Tavush

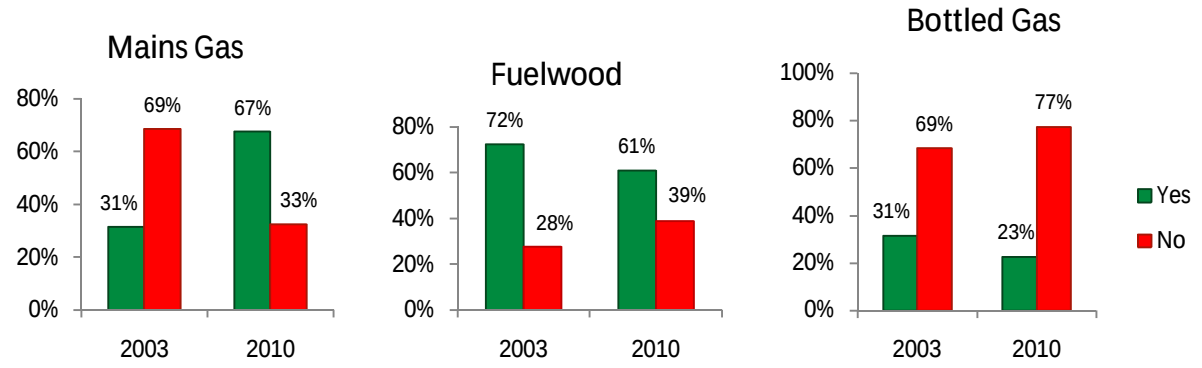
HOUSEHOLDS

The most critical questions to estimate the demand for fuelwood are the consumption and price of fuelwood, the availability and consumption of substitute products, income, distance from forest, preferred source of fuel, and enforced legal restrictions. Given the 2003 survey results, it is possible to evaluate trends of the key factors over the time span.

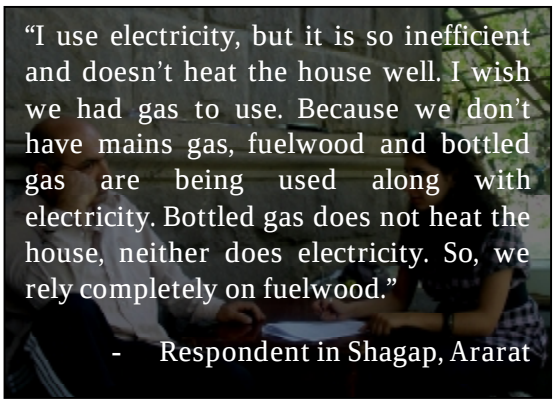
SOURCES OF FUEL

The most common sources of fuel according to all the surveyed households are natural gas, fuelwood and bottled gas (Figure 10). About two-thirds of the respondents (68%) said they used mains gas. This number is up by 36% compared to 2003, when only 31% of the households reported of using mains gas. Increased efforts of gasification across the country not only solved the availability issue of close substitute product for fuelwood, but also intensified the consumption of mains gas. However, many dwellings both in rural and urban areas are still non-gasified and depend on fuelwood, electricity, and other sources of fuel.

Figure 10: Household Fuelwood Consumption by Sources of Fuel, 2003-2010



The second most common source of fuel used by the households is fuelwood: 61% of respondents reported of using fuelwood in 2010, which is down from 72% in 2003. The 11% drop in fuelwood consumption over time could be due to increased availability of gas or other alternative fuel sources, higher prices of fuelwood, and enhanced regulations on the forest use.



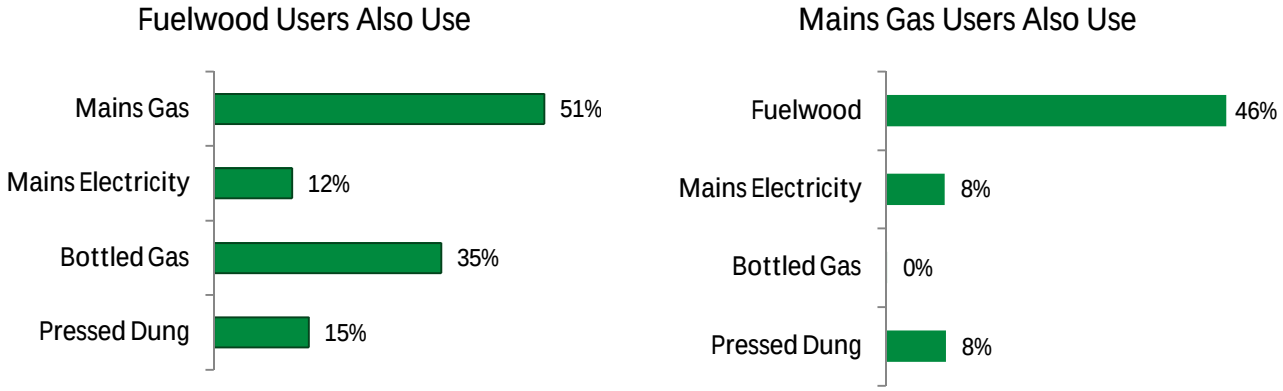
Bottled gas is the third most common source of fuel, which is mainly used by households who either have no access to mains gas or live below the poverty level (i.e. cannot afford mains gas). In 2003 bottled gas users were 31% of those surveyed, which slightly decreased in 2010 reaching to 23%. This 8% decrease over 7 year period is mainly because of increased access to mains gas.

The other least common sources of fuel reported by households include electricity, which declined from 28% in 2003 to 13% in 2010, pressed dung (14% in 2003 and 11% in 2010), wood shavings, charcoal, and generator (the last three are used by less than 5% of respondents).

The analysis of quantities of various fuel sources is a good starting point for devicing relevant policies. As noted above, mains gas, electricity, and bottled gas are close substitues for fuelwood. Hence, changing the price and access to these three substitutes would theoretically impact fuelwood consumption. To understand the relationship of these products in more details, it is necessary to analyze the households who use the combination of these fuel sources (as complements) and find patterns relevant for policies.

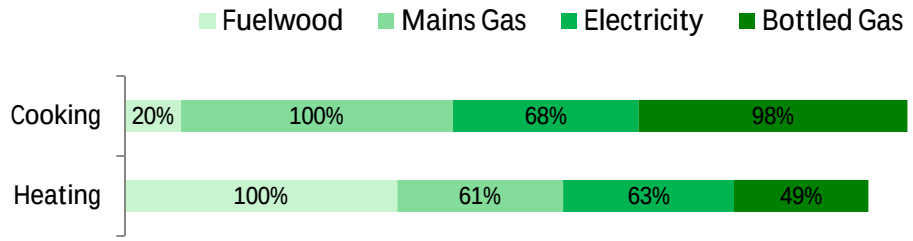
According to Figure 11, households who reported of using fuelwood largely complement it with other fuel sources. It can be noted that mains gas and bottled gas are two major fuel sources used by wood consumers. On the other hand, only 46% of those who use mains gas reported of using fuelwood as the complementary source of fuel (the other sources are used by less than 10% of mains gas users). Therefore, the list of substitute fuel products can be cut to two: fuelwood and gas (mains or bottled).

Figure 11: Percentage of Households Who Use More Than One Source of Fuel, 2010



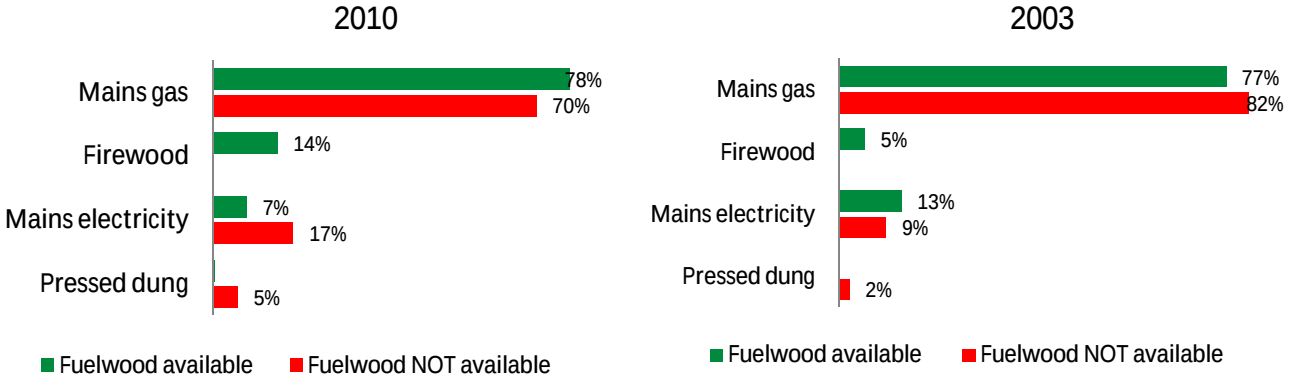
Analyzes of fuel sources by their intended use better illustrate the consumption patterns of households. Figure 12 presents the percentage of households who use the four major sources of fuel for heating and/or cooking. It can be observed that all the households (about 100%) who consume mains gas use it for cooking purposes, barely complementing it with other fuel types, and only 61% of them use it for heating largely relying on consumption of other fuel sources (mainly fuelwood, pressed dung, and electricity) for heating their dwellings. Fuelwood users, on the other hand, use it predominantly for heating (100%), complementing it with pressed dung and some mains gas, and only very few of them use it for cooking (20%) satisfying their fuel needs for cooking through mains gas, bottled gas and electricity. The gap of electricity users by intended use is quite small: 68% and 63% of electricity users use it for cooking and heating, respectively. Lastly, the bottled gas's intended use is mainly for cooking (98%) and only about half of the bottled gas users (49%) use it for heating purposes.

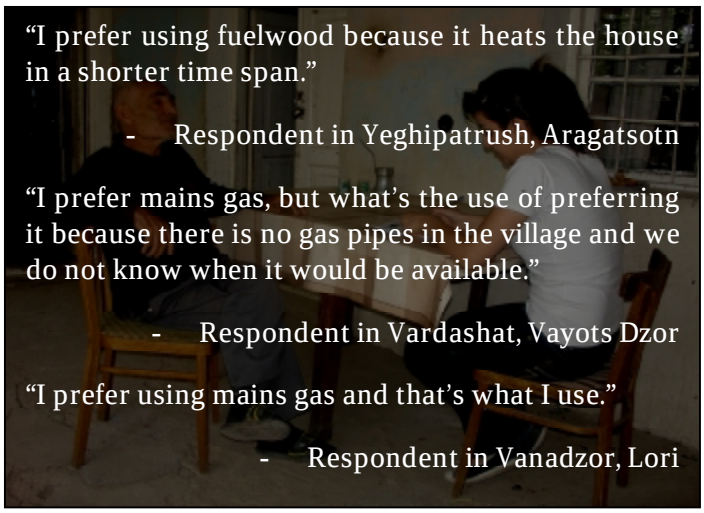
Figure 12: Main Uses of Fuelwood and Mains Gas, 2010



Most of those who use other sources of fuel besides fuelwood use them mainly for cooking purposes, while relying mostly on fuelwood for heating purposes. Moreover, the fuelwood used for cooking purposes is also used for heating. The same can be said about mains electricity – nearly 92% of electricity users use it both for cooking and heating. The policy implication from this analysis is that the role of substitute fuel sources for heating purposes should be accentuated to reduce the use of fuelwood, because it is mainly used for heating. This means that close substitutes for fuelwood are either too expensive for households or they are inclined in using fuelwood. The latter is analyzed based on the question of preferred type of fuel if prices were the same and preferred type of fuel if fuelwood is unavailable and the prices of alternative fuel remained the same.

Figure 13: Households' Preferences of Fuel Sources, 2003-2010



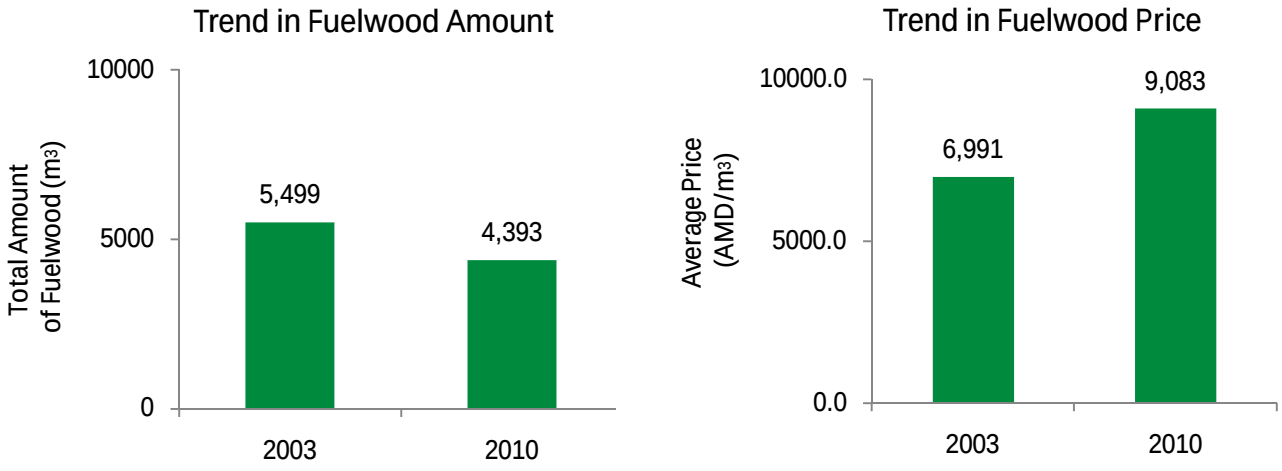


The hypothesis that households prefer fuelwood as a main source of fuel is rejected given that majority of households in both 2003 and 2010 preferred mains gas over the other types of fuel. The number of those preferring mains gas stayed the same over time which means that mains gas would have been used had the terms been favorable and affordable. Particularly, gas price increase over time can be considered to be the main reason that the majority of households still use fuelwood despite intensive gasification effort throughout the country. Given that the fuelwood and mains gas are the most common sources of fuel, further examination of both of them will likely pinpoint the causal structure through which one can influence the demand and supply factors to achieve projected results. In addition, partitioning the figures and numbers into marz/settlement level can be useful for devising local as well as national policies which ministries and government have attempted for such a long time.

FUELWOOD ANALYSIS

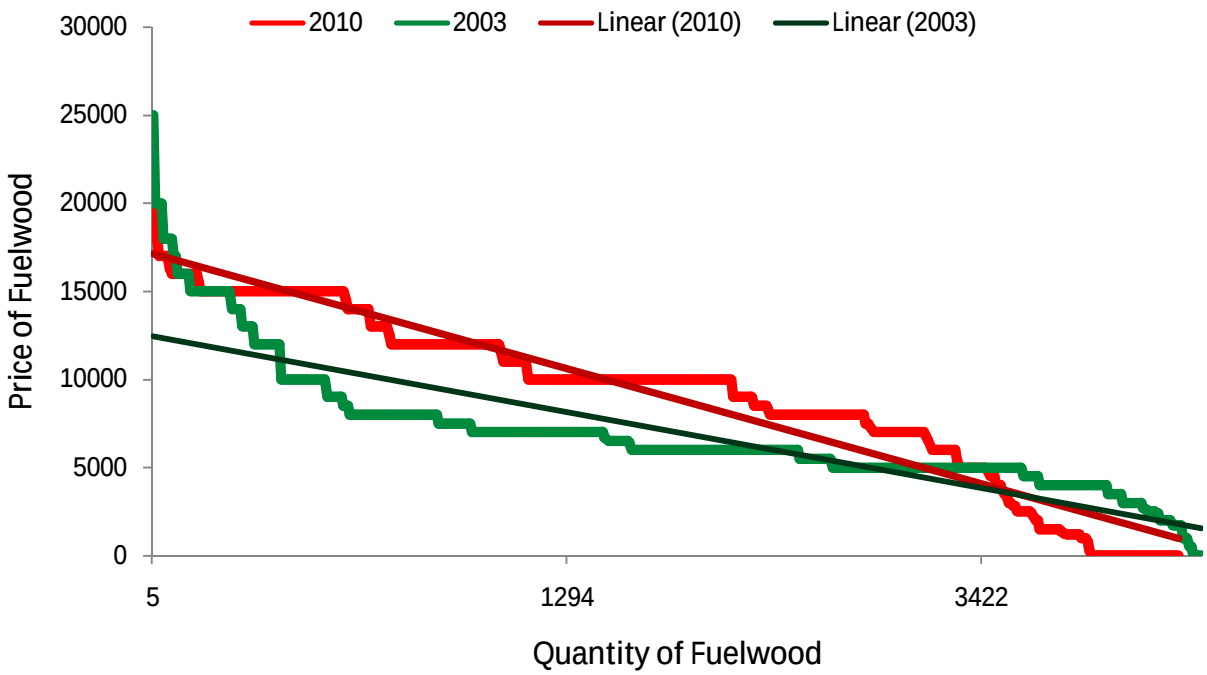
Fuelwood, as mentioned above, is currently used by 61% of the surveyed households. It has declined by 11% over 7 year period.

Figure 14: Fuelwood Quantity and Price, 2003-2010



According to Figure 14, total quantity of fuelwood used has also declined for 2003-2010 period by 25%, but average price of fuelwood for the same time period increased by 29.9%. The implication is that demand for fuelwood is inelastic.

Figure 15: Demand for Fuelwood, 2003-2010



The two demand curves, depicted in Figure 15, represent fuelwood quantity and price relationship in 2003 and 2010, respectively. It can be noted that demand curve of 2003 appears to be more elastic than that of 2010, which can also be seen from the linear trendline. Moreover, fuelwood prices and quantities reported by households in 2003 are more dispersed than those in 2010 (especially at the tails). Below are the estimated demand equations which were obtained using simple linear models[9]:

$$\boldsymbol{Q_{2003} = 13.47 - 0.00052P_{2003}} \qquad (1)$$

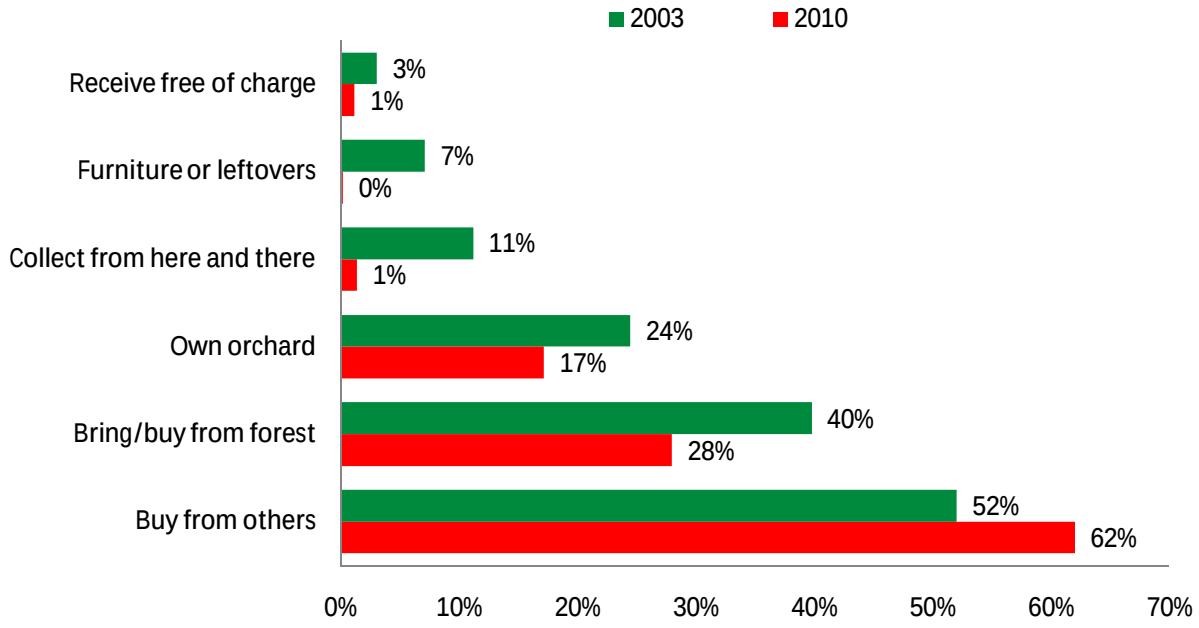
$$\boldsymbol{Q_{2010} = 11.37 - 0.00028P_{2010}} \qquad (2)$$

The equations are consistent with the demand curves in indicating the more elastic nature of demand in 2003 vs. 2010. For example, 20% increase in price of fuelwood (from 10,000 AMD to 12,000 AMD) in both years will result in 12.6% and 6.5% decline in average fuelwood quantity. In other words, consumers in 2003 were more responsive to fuelwood price changes than those in 2010. The major implication of this finding is that profit making possibility escalated for the fuelwood traders over the years. That is, the incentive of traders to increase the fuelwood price will not backfire; instead they will increase their profit as gains from price increase outweigh the loss from quantity decrease. Therefore, traders/processors (i.e. businesses and individuals involved in fuelwood trade) have significant pricing power in 2010 relative to 2003.

[9] Both the intercept and slope parameters for both years are statistically significant at 5% and 10% significance levels. Note, that equations are for marginal consumer, i.e. not reflecting the total demand and provide the average consumption.

The conclusion that fuelwood traders have pricing power is indeed important, but for meaningful conclusion it should be coupled with analysis of fuelwood sources, i.e. how and where households obtain their fuelwood supply.

Figure 16: Percentage of Fuelwood Users by Different Sources of Fuelwood, 2003-2010



The percentage of households who buy fuelwood from others (not including the forest enterprise) has increased since 2003 reaching to 62% in 2010. Hence, the traders with pricing power can influence 62% of the fuelwood users (the majority). Very few households (about 1%) receive fuelwood free of charge, use furniture or leftover supplies from previous years, or collect from various places. However, the numbers were somewhat high in 2003. Similarly, those who used to obtain fuelwood from their orchards or bring/buy from forest declined over 7 year period. The only source of fuelwood that increased over time is "buying from others", while the others declined. This finding can be explained by several possible hypotheses:

"The fuelwood is very expensive when I buy from the middlemen. Thus, I buy a ticket from Hayantar to collect fallen trees and branches from the forest"

- Respondent in Dilijan, Tavush

-

"I have no money to buy fuelwood nor do I have to use gas. I use old trees and branches from my own orchard. But in couple of years, I will run out of that supply. I don't know what will happen in future"

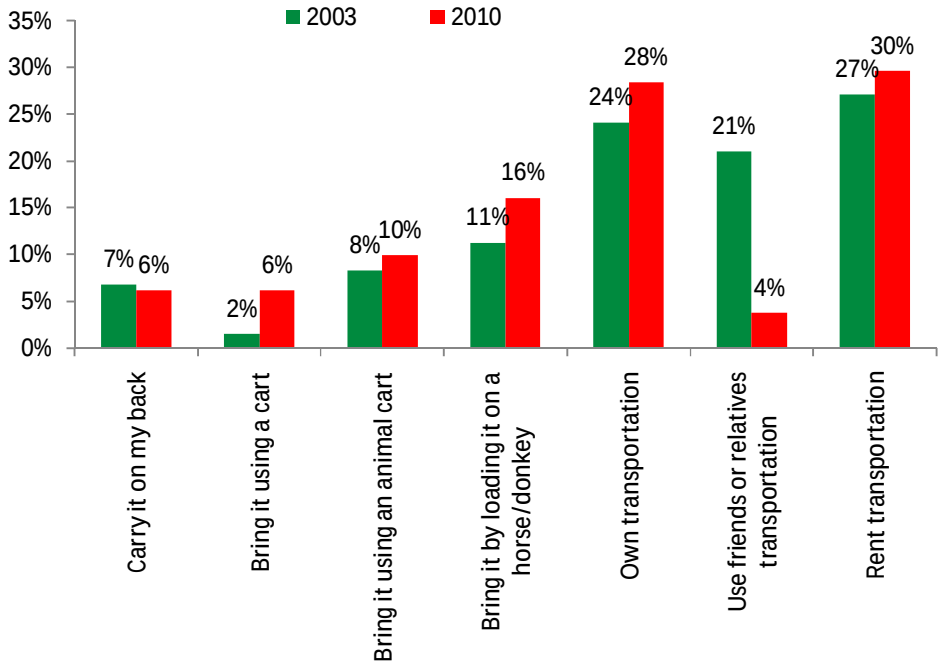
- Respondent in Vorotan, Syunik

1. It is cheaper (or costs about the same) to buy from others than obtain themselves,
2. Easier to buy from others, both in terms of time and legal issues than to obtain themselves,
3. Stricter rules have been enforced about forest use, that is why there is 12% decline in forest use as a source of fuelwood
4. Deforestation is mostly on the edges of the forest and for households it is hard to reach inaccessible parts of forests for collecting fuelwood.

It was mentioned (Figure 14) above that the average price of fuelwood has increased over time. The average prices of fuelwood are 9,083 AMD/m^3 and 6,991 AMD/m^3 in 2010 and 2003, respectively; while the average fuelwood consumptions[10] are 8.86 m^3 and 9.8 m^3 in 2010 and 2003, respectively. [11] The average fuelwood consumption declined, but the average price increase over 7 year-period. This prices and quantities are averaged over marzes, villages, sources of fuelwood, distance from forest, etc. To get more useful and insightful results, detailed analysis is necessary.

To analyze whether or not it is cheaper, it is important to examine the percentage of households by transportation mode they used. More than 60% of households transport their fuelwood from forest using costly methods and the dynamic between 2003 and 2010 is nearly intact. The only sharp difference noticed is the large decline (17%) in percentage of households who used relatives' or friends' transportation. Now, let's examine the amount and cost of fuelwood by the most common transportation modes. According to Figure 18, the cost of transporting fuelwood from forest to home has increased quite notably. It appears that relatives and friends charge you more to do you a favor, than if you used the other modes of transportation. Perhaps, this is the reason that the use of this transportation mode has dramatically declined reaching to 4% over 7 year period. Overall, it is quite clear that even if households loaded the track or other types of transporting device, the cost is still quite high. However, transportation is only one side of the story. If the forest-dependent community member goes to forest to collect fallen trees or branches or even to cut trees then they are likely to occur other costs, such as cost of official permit and opportunity cost[12].

Figure 17: Mode of Transportation Used to Bring Fuelwood from Forest, 2003-2010

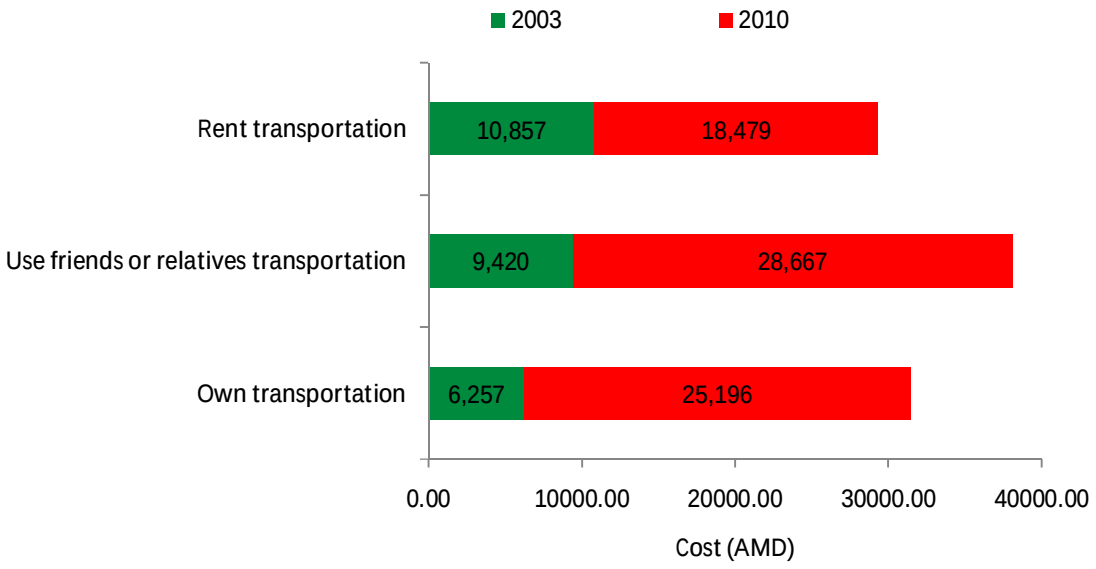


[10] Households, who use fuelwood, on average consume 8.86 m^3

[11] The quantity and price exhibit non-normal distribution, although not statistically significant. Hence, considering median price and median quantity might overcome this problem. The median price is 10,000 AMD/m^3 and median quantity is 8 m^3.

[12] The time spent on obtaining fuelwood from the forest is 8 and 8.20 hours in 2003 and 2010, respectively. This is the type of cost that is generally ignored and is not in monetary terms. However, if one could rather work for 8 hours and make, for instance, 2000 AMD for that time period, then this cost could also affect households' decision in deciding where to obtain fuelwood from and how.

Figure 18: Transportation Cost Per Load (AMD), 2003-2010



The percentage of households who use official permit to collect fuelwood from or cut trees in the forest has increased. Many of the households indicated that forest protection is quite strict and if one dares to illegally enter the forest for logging or even collecting (in some cases) fuelwood from the forest, penalty is quite large. This enforced law has been effective in reducing the number of illegal logging by households. It can be noted that only 1% (in 2010) compared to 15% (in 2003) of households, who indicated of using forests to bring fuelwood, mentioned that there were unofficial charges for collecting/cutting wood from the forest and they paid it. Improvement in reducing illegal logging by households is apparent from Table 2. Considering the average per unit cost of fuelwood collected from forest, which increased in 2010 relative to 2003, it can only be implied that potential penalty is viewed by households to be much higher than the price of official permit. In this sense, "Hayantar" SNCO can claim progress in successful forest management among households.

Considering the costs of permit and transportation, average cost of obtaining fuelwood from forest in 2010 nearly tripled compared to 2003. Transportation cost in 2010 comprises about 67% of the total cost, while permit cost, on average, did not change much compared to 2003 (Table 3). On the other hand, in 2003, permit price outweighed the cost of transportation. The major explanation is the deforestation on the edges of the forest, i.e. the location in the forest where fallen trees, branches, or trees can be accessed are in difficult-to-reach places. Thus, more expensive and special type of transportation is required to get to the logging spot. The cost of obtaining fuelwood from the forest already appears to be close to the average fuelwood price sold through middlemen who drive the truck full of logs to the village/city. If time to get the permit, possible payment to people who help one cut/collect and load, and time that could have been spent on some other activity are considered, the average price of fuelwood gathered from forest (P) becomes larger than the average price of fuelwood from middlemen (P>9,083).

Table 2: Proportion of Households With and Without Permit and Amount and Cost in Both Cases, 2003-2010

	Official Permit			
	2003	2003 (%)	2010	2010 (%)
Yes	33	25%	53	38%
No	97	75%	87	62%
Total	130	100%	140	100%
	Unofficial Payments			
	2003	2003 (%)	2010	2010 (%)
Yes and I pay	36	15%	1	1%
Yes , but it don't pay	24	10%	1	1%
No	30	13%	89	64%
Don't know	38	16%	4	3%
Missing	106	45%	45	32%
Total	234	100%	140	100%
	Average Amount Allowed by and Cost of Permit		Average Amount Illegally Cut and Cost of Illegal PaymentPermit	
	2003	2010	2003	2010
Quantity (m3)	9.03	11.40	135.13	N/A
Total Cost (AMD)	18153.13	32057.84	8228.57	N/A
Unit Price (AMD/m3)	2010.63	2812.09	60.89	N/A

Table 3: Calculation of Average Price of Fuelwood From Forest, 2003-2010

	2003	2010
Transportation cost (AMD/m3)	1385	5675
Permit cost (AMD/m3)	2011	2812
Fuelwood per collection (m3)	6.38	4.25
Number of people per load	3.11	2.87
Time to cut and load (hours)	8.20	7.99
Total cost	3396	8487

The above illustrations provided enough evidence of Hypothesis 1 to be accepted, i.e. it is cheaper (or nearly the same) to buy fuelwood from middlemen (others) than get oneself. Hypothesis 4 (inaccessible part of forests are hard to reach) is certainly true which is implied not only by increased transportation cost, but also the fact that few people choose to get fuelwood themselves. It is inconclusive whether reduction of household who get fuelwood themselves from the forests is a result of enforced Forest Codex and Forest Management (Sayadyan and Moreno-Sanchez, 2006), or it is a result of higher costs or inaccessibility of logging spots of forests. Consequently, Hypothesis 2 is also partly proven (easier to buy from others, both in terms of time and legal issues than obtain oneself), although there is no

quantitative evidence that it is hard to obtain permit or other legal documents required to get fuelwood oneself.

Above analysis confirm the wood traders' profit potential simply because fewer and fewer people would obtain fuelwood from forests and dependency on middlemen would be larger. However, this does not necessarily imply that if price of fuelwood skyrocketed, households would not switch to either forest for obtaining fuelwood themselves or other alternative sources of fuel.

While there were 5.3% respondents in 2003 who said they cut firewood for other purposes, in 2010 the number declined to 0%[13]. These households are small-scale operators who trade/sell fuelwood with small profit margin. The 0% in 2010 is mainly a result of more enhanced enforcement by "Hayantar" SNCO, elimination of unofficial payments, and hard-to-reach forest covers. Similar pattern is observed for households involved in either timber business or simply cutting timber. Only 0.5% and about 0.1% of respondents said they cut timber in 2003 and 2010, respectively. This is quite an insignificant number, but even this number dropped in 2010.

Given the statistical soundness and representativeness of the sample, the estimated numbers can be inferred to national level. However, it is quite informative to break the average fuelwood price, quantity, household size, and other key variables down into Marz/City/Village level. Table A3, presented in Appendix, contains information about all 64 settlements. The breakdown by marzes provides the following noteworthy observations:

1. Average quantity of fuelwood consumed is slightly higher in forest-rich marzes (i.e. Tavush, Lori, Syunik, and Kotayk) compared to the marzes with scarce forest-covers (i.e. Aragatsotn, Ararat, Gegharkunik, and Vayots Dzor)
2. Average fuelwood price is lower for households in forest-rich marzes compared to those with scarce forest cover.
3. The total household expenditure on fuel is somewhat higher for marzes with scarce forest-covers. In addition, the share spent on fuelwood vs. mains gas is also different depending on the marzes. Share of fuel costs spent on fuelwood is much higher for forest-rich marzes, whereas the expenditure on mains gas is much higher for marzes with scarce forest cover.

This observation indicated that there is relation between the distance from forest, price and quantity of fuelwood. To formally find connection between various key factors, further regression analysis will be necessary to conduct to find statistical causation.

MAINS GAS

Mains gas, being the main alternative to fuelwood, needs to be carefully analyzed to understand the dynamics and sensitivity of it and correlation with fuelwood. First, let's understand the dynamics of mains gas, evaluate the efforts of gasification, price changes over time, and linkage with fuelwood.

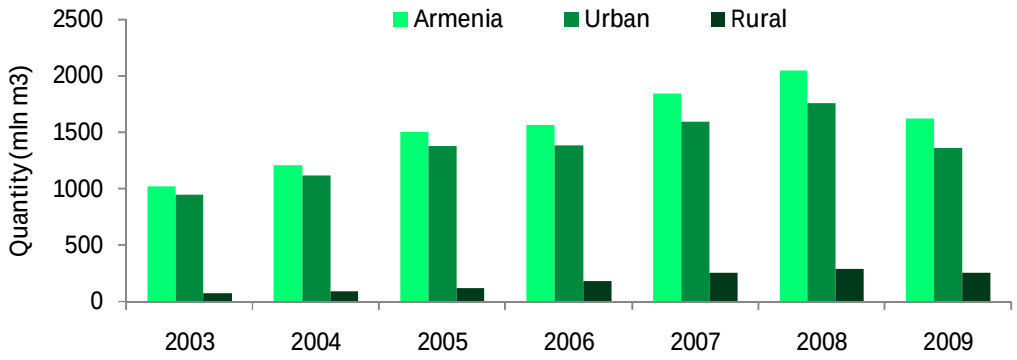
More and more villages/towns/cities are being gasified over time. Figure 19 displays the increasing trend of gas supply from 2003 to 2008. This means that more gas is consumed and more locations have access to gas due to extensive gasification efforts[14]. The evidence of the

[13] In 2003, 5% of respondents indicated that they cut firewood for other purposes. Selling to others was the major part of it (4%), while only 1% and less than 1% of them said they donate it to relatives and friends, respectively.

[14] Separate household gas supply follows exactly the same trend as the total supply. Figure A1 in Appendix includes the household gas supply which is retrieved from National Statistical Services website.

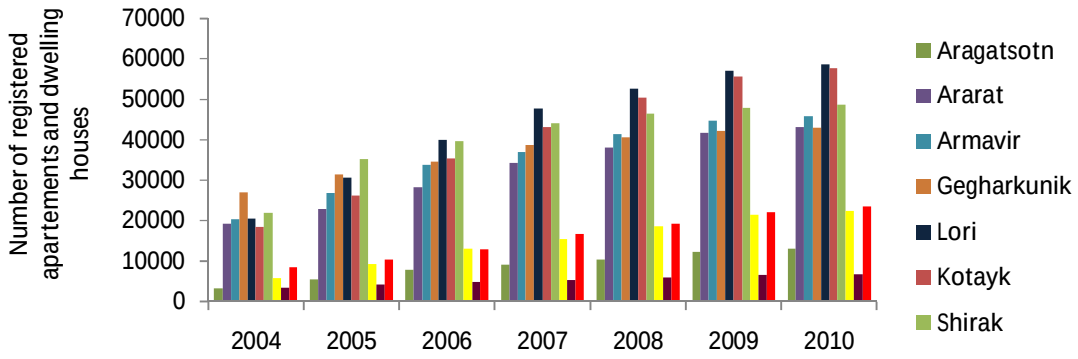
latter is provided in Figure 20 which, unlike the Gas Supply Figure, exhibits upward trend over selected 7 year period.

Figure 19: Gas Supply, 2003-2010



Source: National Statistical Services of RA, 2003-2009

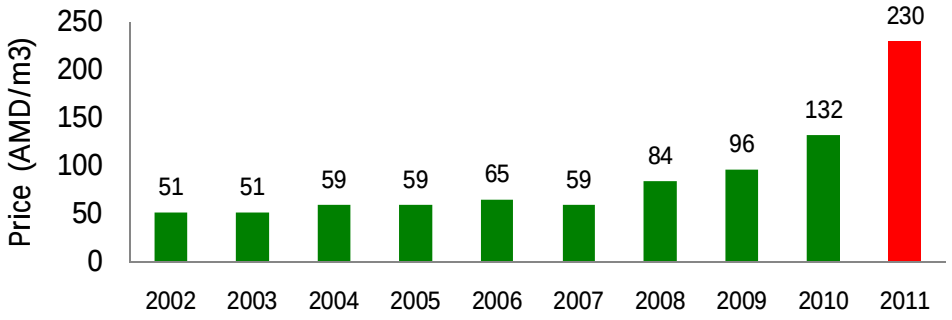
Figure 20: Gasification in Armenia by Marzes, 2004-2010



Source: National Statistical Services of RA, 2003-2009

Financial and economic crisis had its impact on gas supply among other things. Hence, only in 2009 there is backward shift in gas supply. The correction of 2009 decline could happen in 2010 and 2011 if only conditions are favorable. Given that gasification efforts have been increasing since 2004, it simply implies that few people use it, which could only be due to price because 79% of respondents preferred using gas if prices where the same.

Figure 21: Historical Gas Prices in Armenia, 2002-2011



It can be seen that gas price has been ascending since 2002, with sole exception of 2007. The

recent announcement of Gazprom JSC about charging Armenia, along with two other countries, European gas price starting from April 2011 is expected to greatly affect the consumption (Khojoyan, 2010). Moreover, many respondents have already bought fuelwood to substitute it for mains gas as the rumor of increase in gas prices has left many villagers wary. Hence, all the efforts of Hayantar/various ministries/donor organizations to reduce the demand for fuelwood and control the illegal logging will likely be eradicated as a result of 2011 gas price increase.

In 2003, many households used only fuelwood (about 20%) and mains gas usage was very small (10%). However, the efforts by government, price changes and accessibility of mains gas, household behavior has notably changed of 7 year period. Table 4 shows that many households have completely switched from fuelwood to mains gas, i.e. about 30% of households use only mains gas without substituting it with any other source of fuel.

Table 4: Distribution of Households Who Use Only One Type of Fuel Source, 2010

Fuel	Number of Households	%
Fuelwood	38	5%
Mains Gas	247	30%
Mains Electricity	10	1%
Bottled gas	1	0%
Dung	0	0%
Gas+Fuelwood	209	26%

To make a more direct comparison of gas and fuelwood, both fuel sources are converted into kilocalories to bring them into equal terms of heat exertion based on which they can be compared. According to US Department of Energy (Energy Efficiency and Renewable Energy Clearinghouse, 1996), the average heat contents of fuels are the following:

- Natural/mains gas – 7,336 kcal/m^3
- Hardwood (20% moisture) – 1,687,500 kcal/m^3
- Pine (20% moisture) – 1,265,625 kcal/m^3

Given the mixture of various fuelwood types reported by respondents, average of 1,300,000 kcal/m^3 is used for the analysis. Equivalent terms can be established from here. That is, 1 kcal/m^3 of fuelwood = 0.005643 kcal/m^3 of mains gas or 1 kcal/m^3 of mains gas = 177.21 kcal/m^3 of fuelwood. Similarly, prices can be transformed to reflect heat exerting equivalence of the mentioned sources. Mains gas costs 132 AMD/m^3, so if we convert it into equivalent terms with fuelwood, it will become 23,391 AMD/kcal/m^3. This means that to get the same heat content as 1 m^3 fuelwood, about 23,391 AMD worth of gas should be used[15]. The average consumption of fuelwood and gas can also be compared on equal terms. Average mains gas consumption is 1105 m^3 which in fuelwood equivalent terms is 6.24 m^3, whereas the average fuelwood consumption is 8.85 m^3. Figure 3A in appendix illustrates comparative analysis on the graph of 2010 demand function of fuelwood.

One of the ways to force households cut their demand for fuelwood, the price of fuelwood should increase leading to decline in quantity demanded. If the price of fuelwood increases to 24,000 AMD/m^3, which is slightly higher than that of gas, most people will switch to gas. According to

[15] Many households indicated that gas price is already high enough forcing them to switch to fuelwood and some said if it increase up to 200 AMD/m^3 that would be the maximum level after which they will switch to fuelwood. On the other hand, respondents said that the price of mains gas as preferred fuel should decrease on average to 75 AMD/m^3 (or about 13,000 AMD/m^3 in fuelwood equivalent terms) to make them switch from fuelwood to mains gas.

the established demand function, the quantity demanded by households, who reported of using fuelwood, will decline by 50%. In fact, the demand function could change having different elasticity, thus different quantity reduction due to 50% price increase. In either case, the gas consumption will increase. However, if the expected price increase by Gazprom JSC is incorporated into the graph, the equivalent to fuelwood price of gas will become about 40,000 AMD/m^3 which is absurdly higher than fuelwood price. In such a case, gas consumption will greatly decrease and it will be substituted for fuelwood. This clearly shows the connection of gas and fuelwood and projected changes in consumption.

GENERAL PERCEPTIONS OF HOUSEHOLDS

The numerical analysis of fuel use, price, factors that could affect the consumption of various types of fuelwood are important and presented above. However, the perception questions are no less important indicating the willingness or agreement of households with certain issues regarding to sustainable forest practices and illegal logging.

Some questions were designed to get the overall feel of illegal logging taking place in villages, cities, marzes and nationwide depending on a series of demographics. For example, opinion of fellow villagers cutting trees from forests for sale has favorably changed from 11% in 2003 to 2% in 2010. However, the number has slightly increased for those who cut trees for their own consumption (from 13% in 2003 to 18% in 2010). Related to forest cover, opinions remained nearly the same over the 7 year period. In 2010, cross-checking question was added about households in their villages who use fuelwood. Respondents thought that about 58% of fellow villagers (residents of the town or city) use fuelwood. However, there was clear difference between apartments and houses, meaning that those living in apartments were less inclined to use fuelwood or think that others use it as well, whereas those living in houses more frequently reported of using fuelwood and thought their neighbors or villagers in general used fuelwood.

Figure 22: Opinion of Respondents on Forest Cover, Logging for Own Use and Sale in Their Villages, 2003-2010

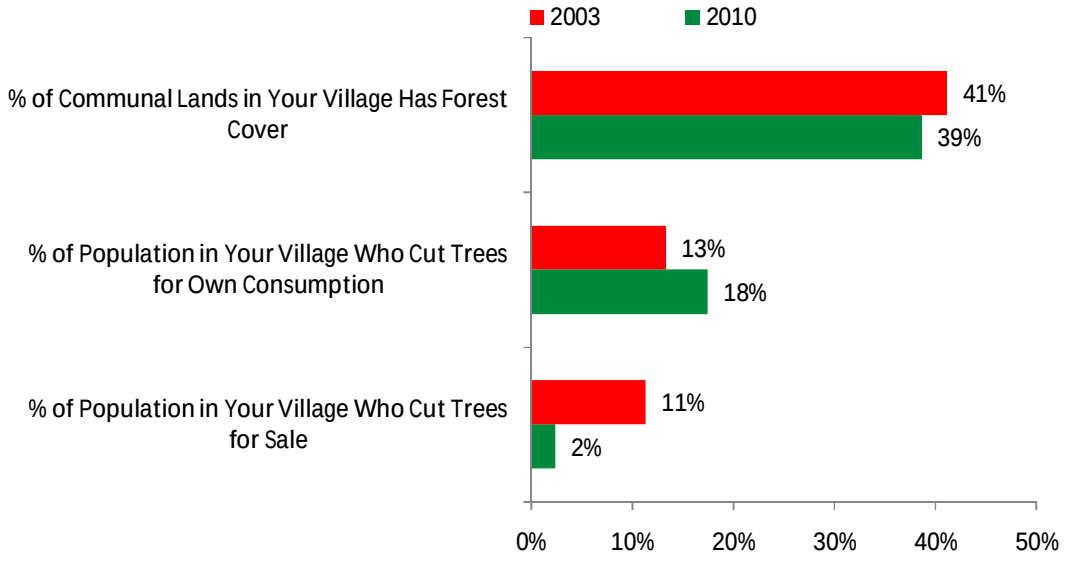
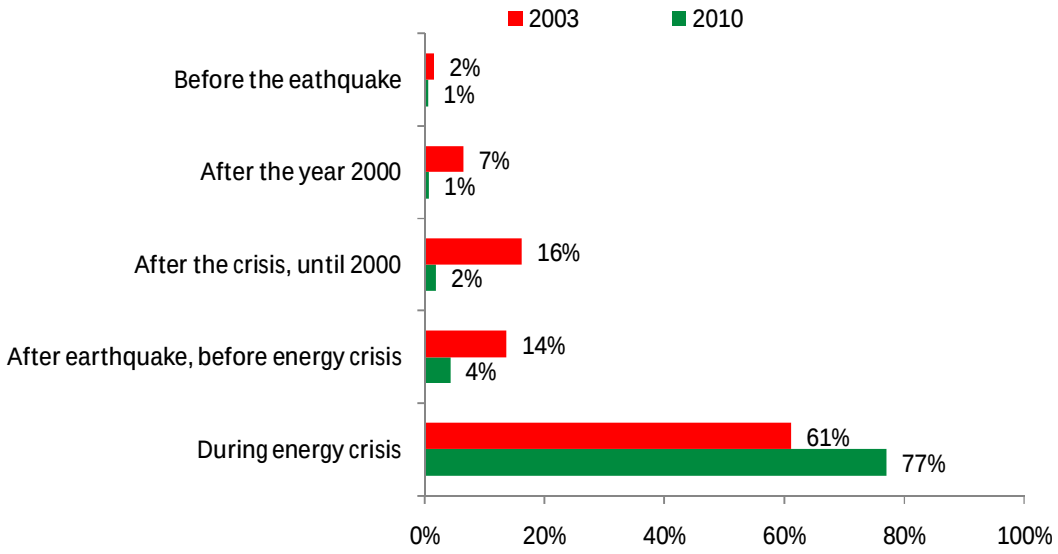
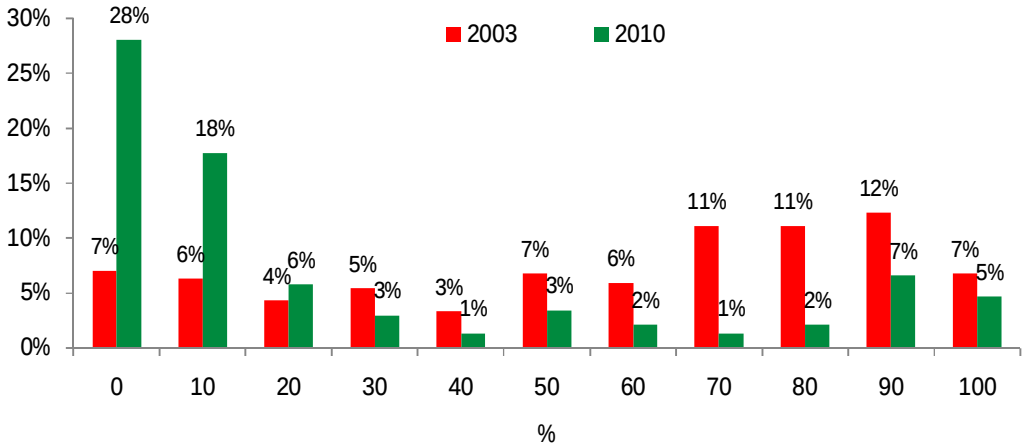


Figure 23: Opinion of Respondents on Nearby Forests Being Most Heavily Cut, 2003-2010



It can be seen, that many people still view the energy crisis period being the most devastating for the forestry sector causing large part of nation seek their fuel from forests. The only difference was that insignificant number of respondents who thought that after the financial crisis in 2009 and recent gas price increases will cause another wave of felling. On the other hand, about 90% of respondents expressed their opinion of decreased illegal logging during the last 5 years, and only very small percent (less than 10%) believed that illegal logging continued. In addition, 95% of respondents were concerned of deforestation in their area and in general. They said that something should be done and most believed that Government of RA, Ministry of Nature Protection, Hayantar, Forest Enterprise, forester and public have to come up with various method of fighting against deforestation[16].

Figure 24: Opinion of Respondents on % of Total Forest Cutting Representing Illegal Cutting, 2003-2010



[16] Note that the listed responsible bodies are presented in the descending order in terms of respondents' selection. In addition, they also mentioned nobody, somebody, Gazprom, police, environmentalist in their

Improvement in forest management and decline in illegal logging has been well reflected in the opinion of respondents about percentage of total forest cutting being illegal. Many respondents, 46%, in 2010 believed that less than 10% of total cuttings is illegal, which is much more than in 2003 (only 13%).

The level of awareness of respondents about the forests and what good do they do is quite high (about 97% in 2010 and 95% in 2003). Most households view forests being important for providing clean air, firewood, berries, leisure place, herbs, timber soil protection, and protection from winds. The order nearly stayed the same over 7 year period with clean air, firewood and berries being the top three picks.

The awareness about legalities and permissions on various forest-related issues has improved over time. Over 52% of respondents in 2010 vs. 38% in 2003 view forest cutting being restricted under all circumstances. On the other hand, fewer people in 2010 than in 2003 think that forests can be cut with special permits (38% vs. 50%).

Figure 25: Opinion of Respondents on Permissions under Law Regarding to Forest Cutting, 2003-2010

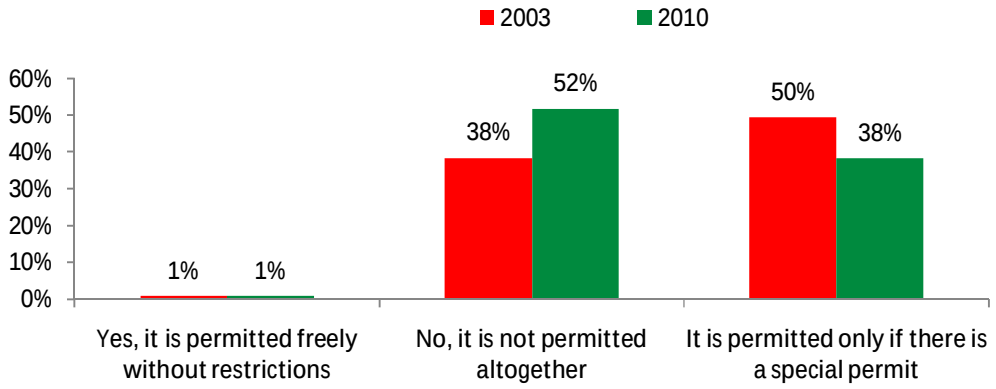
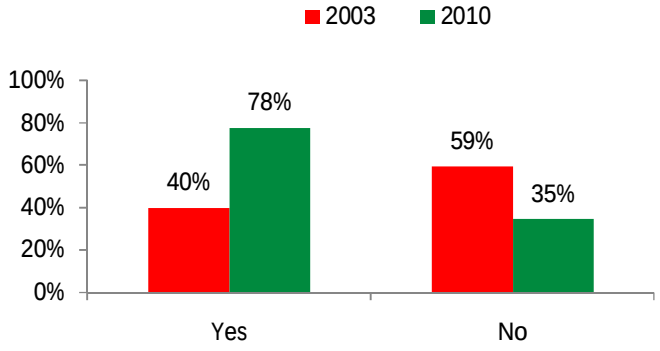


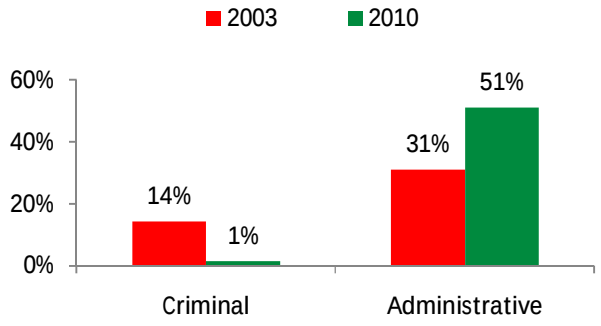
Figure 26: Awareness of Respondents on Punishment Type for Unlawful Cutting of Forests, 2003-2010



The positive trend in awareness of respondents about forests and its use is probably the main reason that percentage of households being punished for taking wood declined from 7.5% in 2003 to about 2% in 2010. Moreover, al the households being punished thought that the punishment was lawful, while in 2003 nearly 40% thought it was unlawful. Hence, it can be assumed that households are more aware of consequences (i.e. what is to be expected). In fact, Figure 26 shows that the percentage of households being aware of type of punishments for unlawful cutting of forests jumped from 40% to 78% over 7 year period. About 52% reported

exact punishment type in 2010. Most of them thought that the main form of punishment was administrative one, rather than the criminal punishment. The fact that more people are aware of the existence and type of punishment is already a significant improvement and positive news for forest protection and sustainable management. In addition, this should, under all circumstances, logically cut down the illegal logging by households.

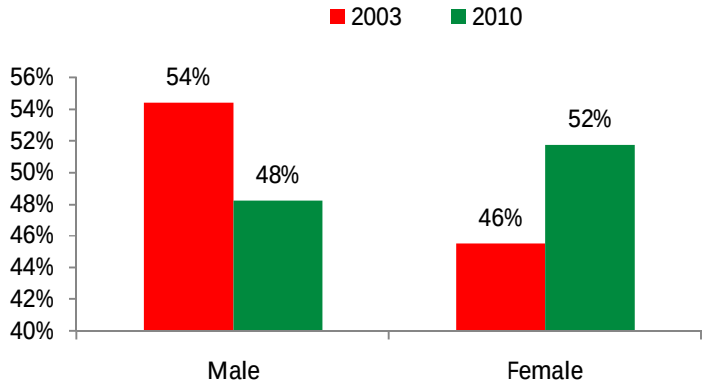
Figure 27: Awareness of Respondents on Specific Type of Punishment, 2003-2010



DEMOGRAPHICS OF HOUSEHOLDS

The proportion of respondents surveyed in 2010 by gender is similar to that of the entire nation: 52% of the respondents are females and 48% males. The average size of the household is 4.3 across the entire sample size.

Figure 28: Gender Distribution of Households Surveyed, 2003-2010



The level of education of respondents is nearly the same between 2003 and 2010. About 45% of the respondents completed at least secondary education, while only 16% graduated from higher educational establishments. Occupation has also remained quite stable over the 7 year period. Nearly same numbers of respondents were jobless or unemployed and retired in 2003 and 2010. Changes are observed in employment in both private and public sectors which declined in 2010 compared to 2003. In addition, number of housewives increased somewhat indicating either more women are unemployed, got married, or simply because more women respondents were included in 2010 survey.

Most households surveyed were very poor, hardly able to afford 1st necessity goods. The poverty rate did not seem to have improved since 2003 with similar 30% of respondents being below the poverty level. The most common situation was just at poverty level when respondents could only afford first necessity products. So, overall 72% of households surveyed were only able to

afford 1st necessity products or part of it. Very few of them (about 27%) live the life of middle class able to afford both food and clothing items and perhaps save some. In general, there seems to be no positive trend regarding the financial situation of households.

Figure 29: Occupation of the Respondents, 2003-2010

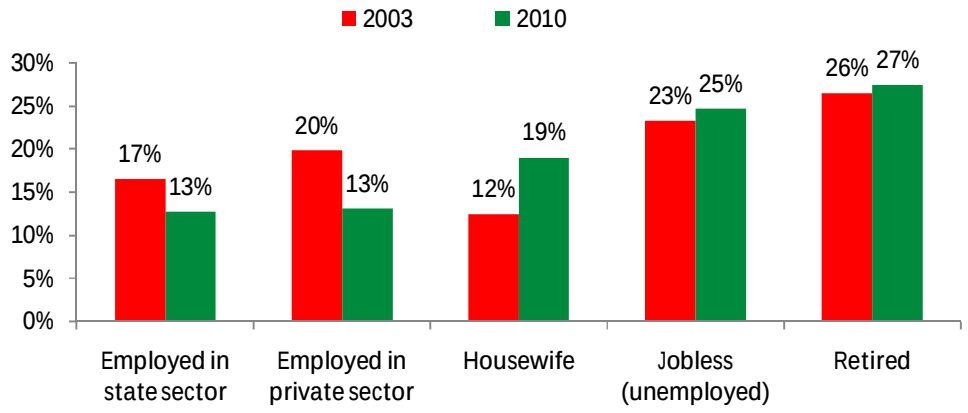
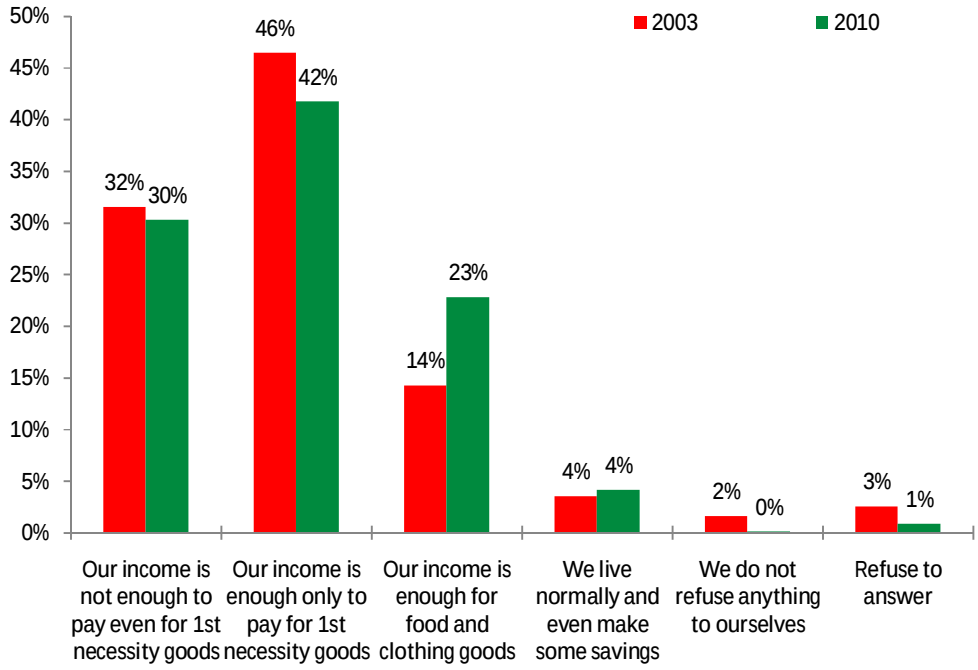


Figure 30: Financial Situation of Surveyed Families, 2003-2010

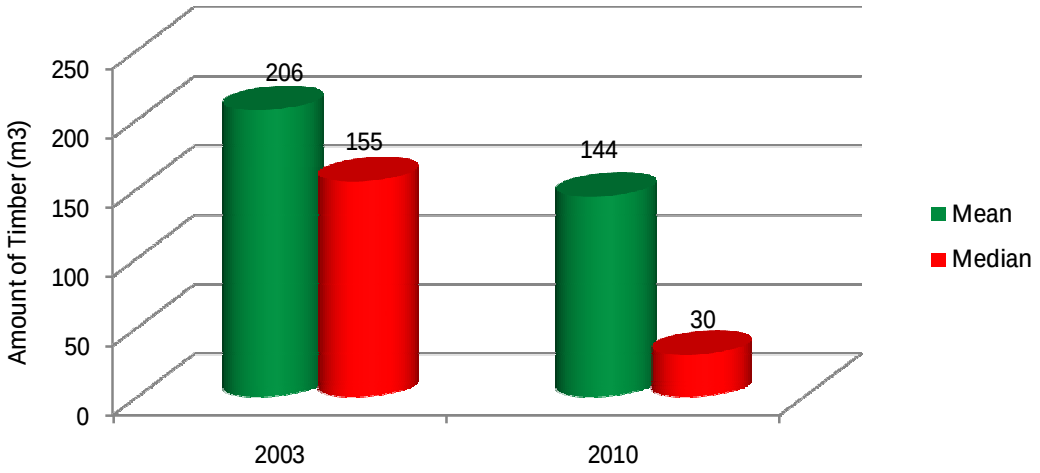


It can be seen from Table 1A in Appendix that even at this situation, fuel expenditure comprises quite large share of their total spending. In some cases, it is probably more than 50% of income being spent on fuel (any kind). The lack of employment opportunities and improper infrastructure do not make situation any better. In fact, if no major reforms are adopted to improve the rural livelihoods, migration from rural to urban areas as well as overall emigration can be quite drastic. Considering the border security and various strategic issues, it can be even dangerous if population in border-villages die out over time or migrate to urban areas with more promising job prospective. In devising policies for forest protection, this fact should certainly be considered.

SAWMILLS

While households consume fuelwood for heating and cooking purposes, businesses buy timber to make various kinds of processed wooden products, including veneer, parquets, barrels, frames, chairs, boards, etc. The definition of a "sawmill" is challenging given that many households own saws. Hence, the question is not only difficult to answer with certainty, but also complicated as many operate only under demand or just for certain seasons. The recent study of WWF indicated that there are 100 businesses in wood and wooden product industry. However, limited number of those businesses in the list operate and even fewer are sawmills. The survey team attempted to interview all the potential sawmills out there, but, as expected, the large non-response rate downsized the number of surveyed sawmills. Total of 20 sawmills were interviewed.

Figure 31: Mean and Median of Round Timber, 2003-2010



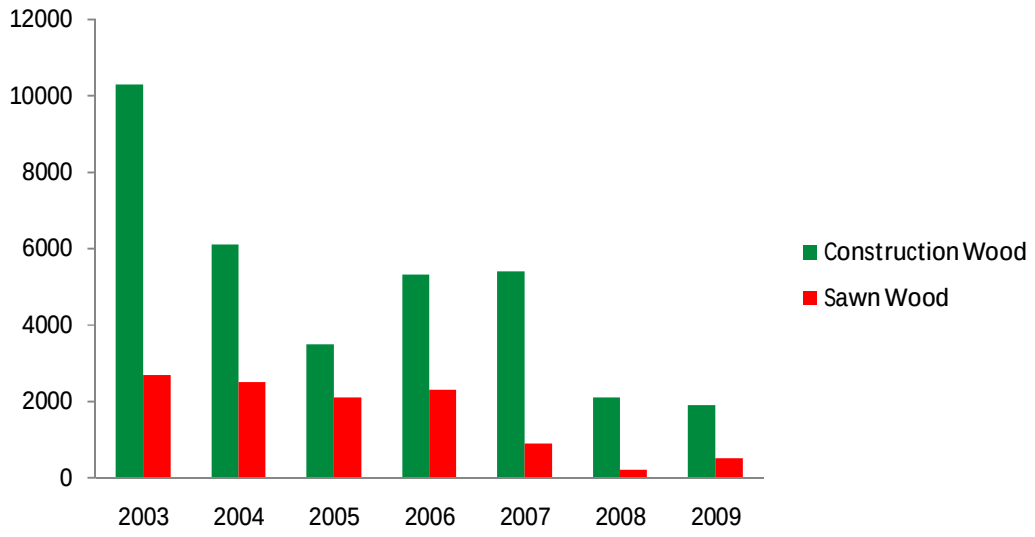
Total of 2,882 m^3 round timber has entered into total of 20 sawmills in 2010, whereas total of 6,605 m^3 round timber entered into total of 32 sawmills in 2003. Timber amount has non-normal distribution (skewness=2.945 and kurtosis = 8.957 for 2010 data), therefore, the median is a better measure of variable's central tendency than the mean. Figure 31 shows the mean and median of round timber entered in sawmills in 2003 and 2010. It is obvious that 2010 sawmills were more polarized in terms of timber input amount, while in 2003 it was more homogenous. Regardless of the comparison factor (i.e. mean or median), the clear trend is notable. Fewer round timber was entered into sawmills in 2010 compared to 2003 (206 m^3 vs. 144 m^3 or 155 m^3 vs. 30 m^3). Possible reasons for such an observed decline are difficulty of obtaining round timber, high costs and low profit margin, low demand for finished products, and fierce competition. The cost and profit margin would be easy to analyze based on the

survey data, while inference can be made on the last two hypotheses. According to the qualitative data on sawmills, there is not much demand for the products. However, the households had different opinion on this. According to households, many logs are sawn and transported to Iran or another place, implying that there is demand for sawmills' products. The competition is hardly the case because fewer known sawmills exist in 2010 than in 2003 and the capacity of each of the existing one is not larger than it was in 2003. Hence, fierce competition is not the cause of low average round timber input.

> "The machines in the sawmill are so old, that operating cost per unit of output becomes quite high. The profit margin per unit of output is small if 100% legality is maintained. Therefore, either the same ticket obtained from Hayantar is used multiple times, or some other ways we obtain more logs."
>
> - Respondent in Tavush

If we assume that the number of available sawmills in Armenia is about 50 in 2010 (midpoint of WWF's reported range 45-55), then the estimated total volume of round timber used in sawmills gets closer to 1500 m^3 (if median is used) or 7200 m^3 (if mean is used). The official statistics of industrial output production on sawn wood and construction wood between 2003 and 2010 is presented in Figure 32.

Figure 32: Industrial Output Production, 2003-2009



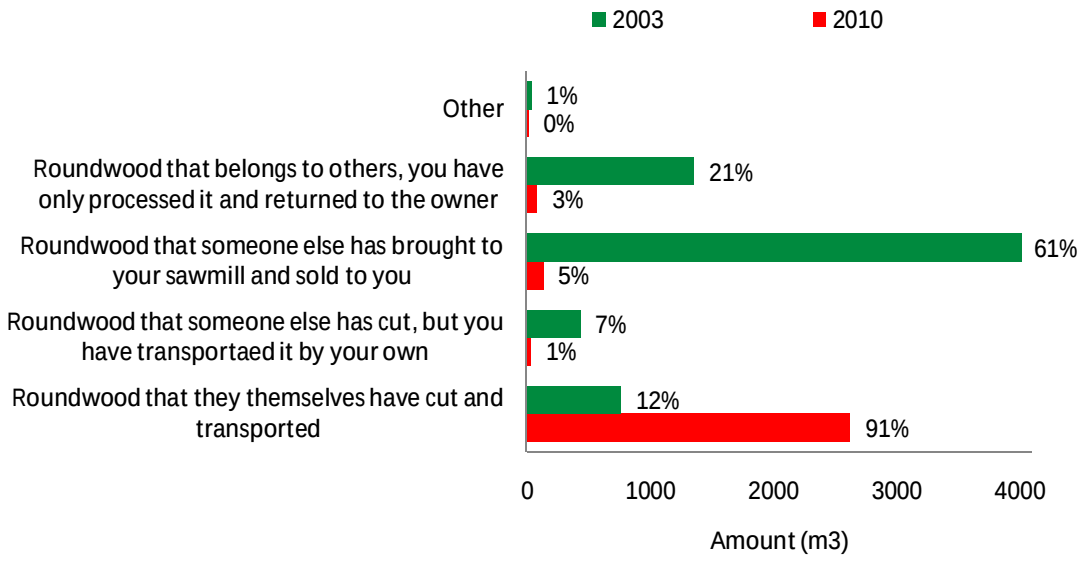
Source: National Statistical Services of RA

Although the last available date in the official statistic is 2009, method of extrapolation can be used to estimate the most likely industrial output of these two products for 2010. Stricter enforcement and increased efforts to protect forests is unlikely to lead to amounts higher than 2009 m^3. Hence, with liberal assumption of 20% increase in sawn wood and construction wood in 2010 (relative to 2009) result in total amount of 2,880 m^3. This amount is equal to the total timber reported by the 20 surveyed sawmills. If the official statistics indicates the production of all the existing businesses in this sphere, our survey results indicate the input of 20 businesses in this sphere. There seems to be consistency issue between the end results of the two statistics.

Further analysis of sawmills survey data shows that, in 2010, 91% of the total round wood is cut and transported by sawmills themselves (Figure 33). The other sources of obtaining round wood by sawmills comprise less than 5% of the total round wood by 20 sawmills. The figures are very different from those of 2003. In 2003, 61% of sawmills were sold the round timber by someone

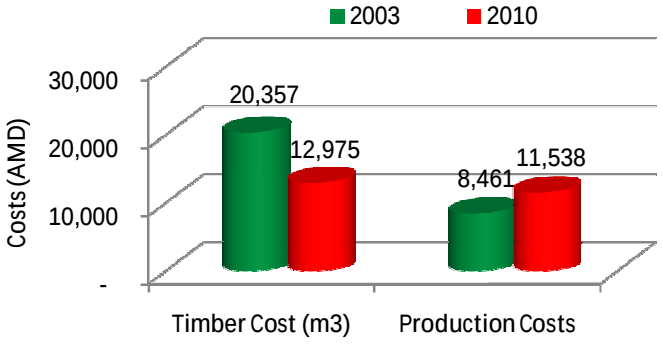
else and 21% of them only processed the round wood and returned it to the owner. Overall, it can be seen that the nature of sawmills has changed over the 7 year period. More sawmills cut and transport in 2010, while most sawmills used to get their input through others. Is this due to simplified procedure of getting a ticket from "Hayantar" SNCO or other factors?

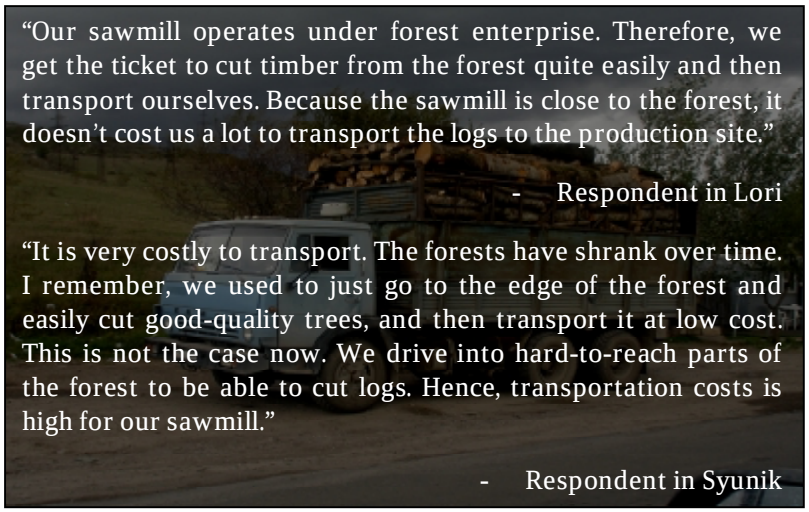
Figure 33: Round Wood Amount by Means It Entered Sawmills, 2010



The average production cost per cubic meter, including employee payment, fuel costs, food costs, and so on, comprise about 8,460 AMD and 11,540 AMD in 2003 and 2010, respectively. The average price paid for 1 m^3 timber is 20,360 AMD and 12,975 AMD in 2003 and 2010, respectively. Logically, due to inflation, production costs increases over the 7 year period. Unlike the production costs, cost of round wood has declined. If in 2003 sawmills had to pay on average 20,360 AMD/m^3 of timber, in 2010 they pay only 12,975 AMD/m^3 of timber. This is quite surprising considering the reduced allowable cuts by "Hayantar" SNCO, i.e. the supply, which, according to basic economic theory, should be translated into higher price per cubic meter. This, however, does not seem to be practical in case of Armenia. One possible reason is significant difference in species of tree. The most common species of tree used by the interviewed sawmills in 2010 are Beech and Hornbeam and in 2003 is Beech. In fact, 44% of sawmills in 2003 and 35% of sawmills in 2010 used Beech. The difference is not so large that could affect the observed timber cost differential. Hence, there is perhaps some other "hidden" reasons for such difference.

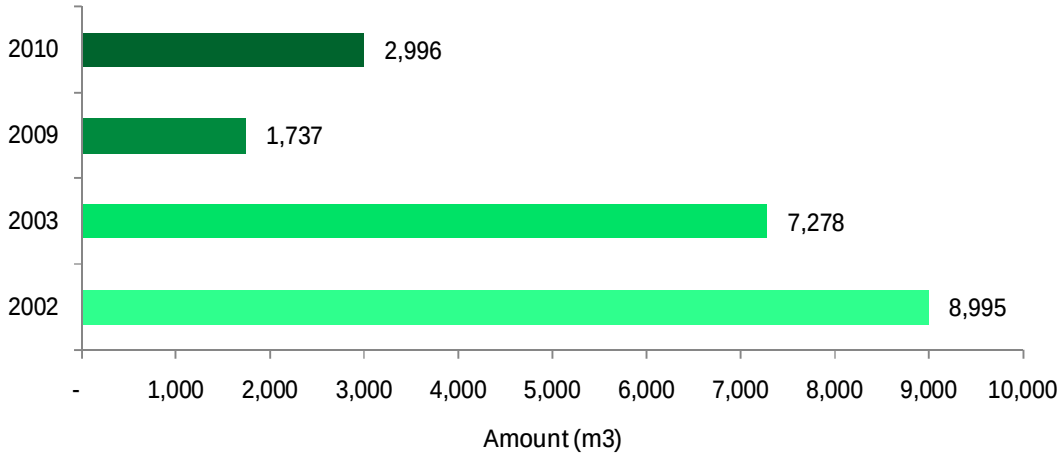
Figure 34: Production and Timber Costs, 2003-2010





Could it be that more sawmills purchased timber from "Hayantar" SNCO directly at lower ticket price in 2010 compared to 2003? Essentially, about 70% of timber in 2010 is purchased from forest enterprise, whereas in 2003 only 44% of the total timber is purchased from them. The majority of suppliers in 2003 were individuals or private suppliers and Hayantar is the major supplier of timber in 2010. This difference could potentially explain the cost differential of timber, as it is probably cheaper to buy timber from "Hayantar" SNCO compared to buying it from middlemen.

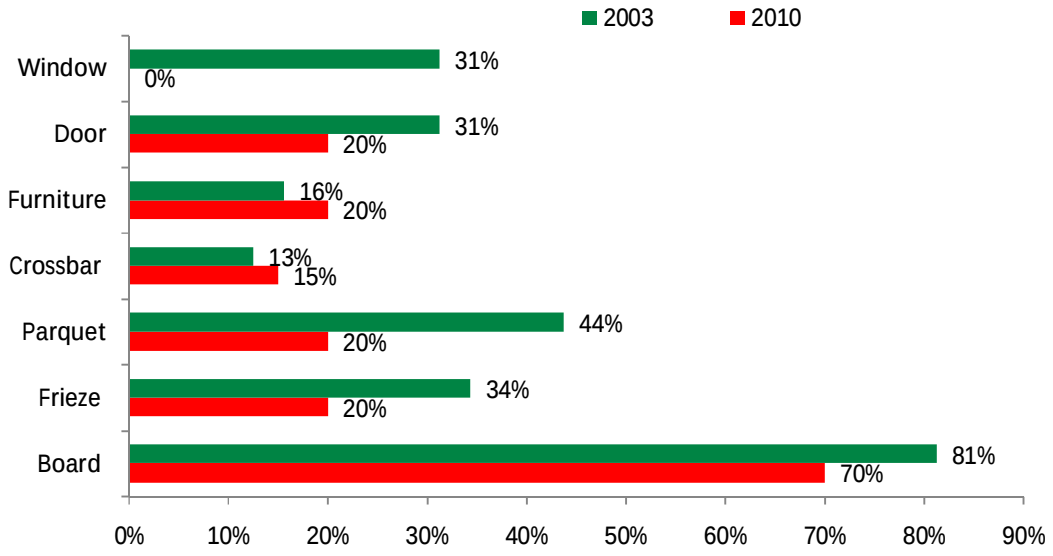
Figure 35: Timber Processing by Sawmills, 2002-2010



The average price sawmills pay for the purchase of logs delivered to the mill yard in 2010 is 38,000 AMD/m^3 in 2010 and 25,300 AMD/m^3 in 2003 (Figure 34). It would be noteworthy to examine the timber processing give above timber costs.

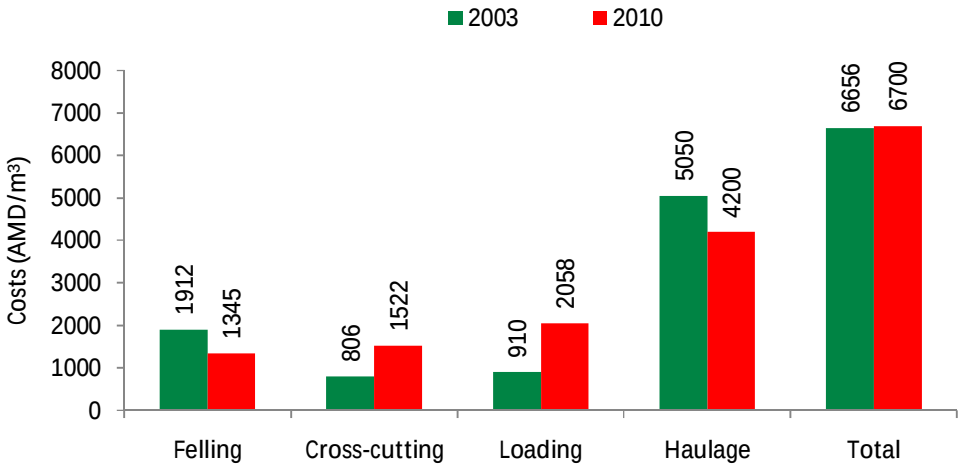
It is apparent from Figure 35 that timber processing has declined by more than three times between 2002 and 2010. However, slight increase is noted in 2010 relative to large decline in 2009. The majority of sawmills in both 2003 and 2010 produced boards (81% and 70%, respectively). Other types of wooden products include parquets, which in 2003 was the second largest, frieze (third most common product in 2003), doors (forth most common product in 2003), and others. According to Figure 36, window frame production was quite common in 2003, whereas no surveyed sawmill in 2010 reported of producing it.

Figure 36: Percentage of Wooden Products Produced in the Mill, 2003-2010



Apart from producing finished product, sawmills also provide various services. The cost of various operations at the mills is provided in Figure 37. It can be seen that the most expensive operation is the haulage, while the cheapest is felling. Costs of operations stayed nearly the same over the 7 year period.

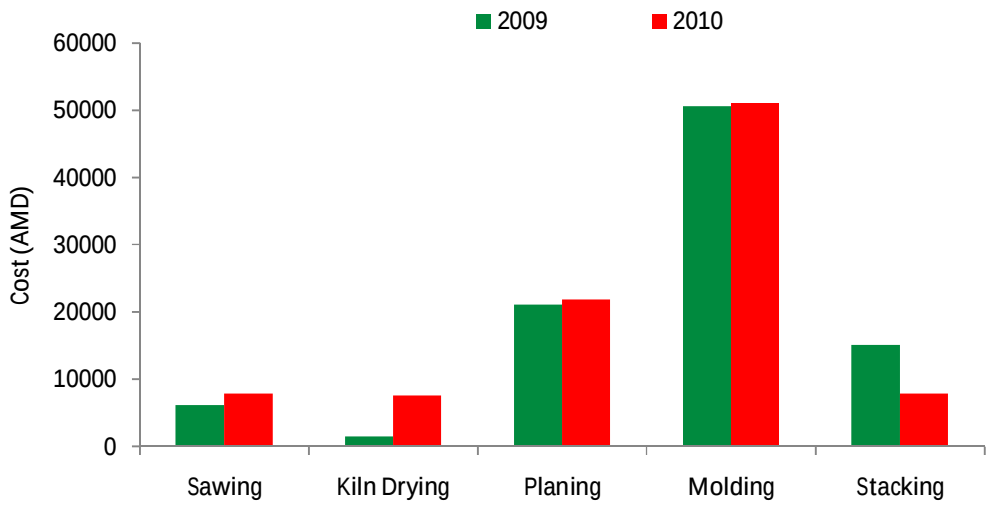
Figure 37: Average Cost of Various Operations, 2003-2010



On average, sawmills get 0.64 m³ timber for each m³ round wood. The number is nearly unchanged over time (in 2003 it was 0.65). This means that total amount of processed timber (output) for the 20 sawmills surveyed is about 1,874 m³. Further costs, such as sawing, planning, molding, or transporting the finished products to markets are presented in Figure 38. Molding appears to be the most expensive operation of timber processing. Moreover, average costs didn't change much from the period of 2009-2010, but it changed greatly from 2003 to 2009.[17]

[17] In 2002 and 2003 the timber processing costs by activities were very high. For example, the average annual cost of sawing in 2002 was 508,000 AMD and 304,000 AMD in 2003. Even within the two year

Figure 38: Average Annual Cost of Timber Processing by Activities, 2009-2010

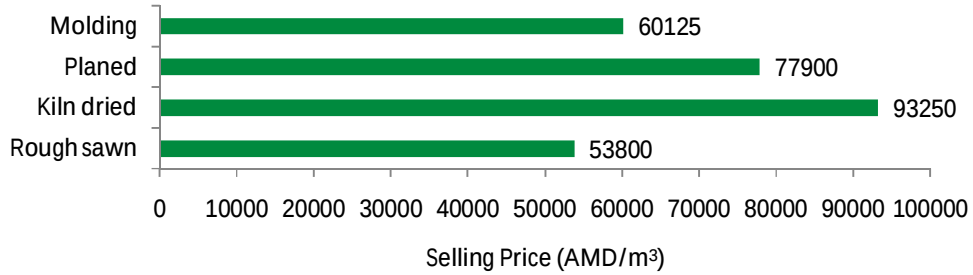


Sawmills also occur transportation costs to take their product to market. Only few of them indicated the destination and costs associated with transportation. On average, it costs them about 20,000 AMD to transport to Yerevan (this is the only location mentioned, although the missing values for this category is quite large). The indicated cost is not significantly different from that of 2003, which is 29,000 AMD.

The surveyed sawmills in 2010 employ, on average, 3.3 employees, which is very close to the reported number in 2003 (3.5).[18] The average amount of timber produced during one shift in both 2003 and 2010 is 6 m^3. Only 1 brigade works for each sawmills, monthly. Average timber produced by 20 sawmills is 92.2 m^3 (in 2009) and 125.8 m^3 (in 2010), respectively. The numbers are much lower compared to either 2002 or 2003 (200 m^3 and 168 m^3, respectively). However, median is a better measure of tendency in this case, which is 30 m^3 (2002 and 2003 data is close to normal distribution, and using mean or median didn't change much the results).

45% of the interviewed sawmills indicated their wish to increase the level of production.[19] Machines are old generating some problems for sawmills. About 65% complained about sawmills' functioning problems. If there were no problems and sawmills operated in a normal manner, the median timber producing capacity of sawmill would have been about 1200 m^3 annually.

Figure 39: Average Selling Price of Sawmills' Output At the Point of Leaving the Mill , 2010



[18] Maximum number of workers hired by sawmills both in 2003 and in 2010 was 6.

Although the average is rough estimate due to refusals, it provides general picture of prices charged by sawmills. The most expensive, among others, is the processed kiln dried wood (timber), whereas rough sawn wood is the cheapest. If the transportation costs were to be added to the selling price at mill site, then final prices would have been much higher (about 20,000 AMD/Total Amount Transported).

The majority (70%) of sawmills said they needed official permit to run sawmills, while 30% of them said they don't need one. The permits are mostly purchased from "Hayantar" SNCO. Only 65% said they had the official permit, 15% said they don't have one, and 20% refused to answer. Only 5% of them said that there are unofficial charges, but he didn't pay, while others said there is none (and 6 refused to answer). Some sawmills contain unofficial checks, but they comprise 10% of all sawmills, while the rest said they don't have any unofficial checks. Only 15% of sawmills said they don't check for the official permit of round wood entering into their sawmills, while the rest do.

Unlike households, all the surveyed individuals representing sawmill were well aware of the consequences of illegal logging. Nearly everybody thought that logging is allowed by law with permit. The majority of the respondents also indicated that portion of illegal logging in total forest cuttings is very small, nearly 5%. Like households, they are also greatly concerned about the deforestation and think something should be done and stricter rules should be enforced.

Most of the respondents are at level above the poverty. Only 10% of the respondents are not able to afford even the first necessity product, while the rest reported of living with somewhat "normal" life. Typical for this business, 95% of the respondents are male with at least secondary degree (85% have at least secondary degree).

Overall, the condition for sawmills is not promising. In fact, the number of sawmills and businesses in wooden products has dwindled over the years. Given the relatively low quality of timber in Armenia, sawmills are not as competitive, especially if costs are taken into account. On the other hand, fuelwood business appears to be more opportunistic and profitable at least from the eyes of log transporting truck drivers. Hence, forecast of sawmills dying out or being converted into "fuelwood" providing businesses is quite realistic if the status quo in the forestry sector remains intact.

ANALYSIS OF CARGO/TRANSPORTATION SECTOR

Initially, the study was not designed to include cargo/transportation sector. However, the overwhelming number of trucks on the major highways transporting big logs inflicted interest in examining transportation sector as well. While on the mission of conducting surveys across 8 marzes, survey team had to travel each day from Yerevan (capital) to various marzes. On the highways, at least 5-6 trucks were noted on a daily basis. The team approached truck drivers at various locations (even in villages), including markets in Yerevan, marz centers, villages, roads, by forest enterprises, etc. Total of 30 truck drivers were approached and only 8 of them agreed to provide "informal"

"The prospects of forestry sector is very gloomy given the shrinking forests and increased transportation costs. I think the businesses that would survive and continue existing would be the one operating under the forest enterprise. The ones like ours with small capacity will be wiped out."

- Respondent in Tavush

"I think illegal logging has gone down by small scale operators and households, but they have increased by large and powerful players in the market. There is huge money involved in this business, hence it will be very hard to fight the corruption in this sector."

- Respondent in Lori

information. The team had no formal questionnaire for cargo, nor did they have specific methodology devised. The main purpose of interviewing them was to get additional information to understand the entire market of wood.

Clearly, the sample is not representative, but given the homogeneity of the market and some prior data, it is possible to pinpoint some specific issues. Each of the 8 truck drivers interviewed confessed of using the same ticket issued by "Hayantar" SNCO multiple times. Specifically, the ticket for 20 m^3 wood is used to get almost 40 m^3 or 60 m^3 wood. In the books, though, only the initial sale or initially issued ticket is registered. The other uses of the same ticket enter into the informal market entailing no official record. Moreover, the 20 m^3 which is the number officially registered does not even correspond to the real one even if the ticket is used only once. One normal size truck can contain up to 30 m^3 logs if they are accurately and precisely stacked. Truck drivers want to save as much as possible while increasing the profit margin to maximum. They all are motivated to load the truck to the maximum, i.e. 30 m^3. The deal is then negotiated with the forester (representative and not the guard) and in most cases they are successful in loading 30 m^3 instead of 20 m^3 with informal payment. The price of logs on average is about 6,200 AMD/m^3. However, when 20 m^3 is increased to 30 m^3, informal payment is paid, which brings the total cost to 150,000 AMD/truck load, i.e. 5,000 AMD/m^3.

There are some regulations regarding to transportation within the marz or outside of marz. Apparently, if it is within marz where the logs are purchased, then it is possible to buy logs at the price of fallen trees which normally is about 1,500/m^3 (officially, the price of fallen trees is 1,200 m^3). However, if the truck transports fuelwood to another marz, then the minimum ticket price is around 6,200 AMD/m^3. Moreover, log transporters face difficulties of arranging more than 1 or 2 visits to the loading or forest enterprise site. They said that if they used ticket, being transparent and "clean", then they would only get one option per month to buy logs/fuelwood. On the other hand, if they use the same ticket multiple times, than they get more visits per month. They said that forest enterprise actually encourages them to use the "multiple-time-ticket" scheme.

The respondent said that there are many truck drivers waiting in line. In fact, each day about 20 trucks leave a particular forest enterprise point. This means that if there are at least 10 active forest enterprises (officially, there are about 22 forest enterprises), then about 200 trucks per day transport logs to various destinations. This is in the peak season. Furthermore, 200 trucks each with average of 25 m^3 sums up to about 5000 m^3 daily log volume being transported. If the peak season lasts 2 months, then the minimum amount of

logs/fuelwood transported would be 60*5000 = 300,000 m³ (stacked).[20] Hence, if only these minimums are calculated we arrive to greater amount than current maximum supply. Hence, this shows, rather confirms the fact that illegal logging is yet to be eradicated and it is mainly done by truck drivers/sellers (through the help of forest enterprises, police and other sides) rather than households. According to the truck drivers, forests are full of fallen wood and branches, and if the law is adopted enforcing no cuttings, the fallen wood alone will be enough for at least 10 years. Not only will this provide fuelwood for households, but also will enable the steady growth of the forests.

CALCULATION OF DEMAND AND ILLEGAL LOGGING

The demand for wood and wooden products derived from Armenian forests incorporate households' demand for fuelwood, industrial demand for timber for processing and production of various wooden products, and demand for wood by restaurants and hotels (Hergnyan et al., 2007). On the other hand, supply is comprised of stated AAC by "Hayantar" SNCO for sanitary purposes and fallen wood (fuelwood).[21] According to theory of supply and demand, the equilibrium price and quantity over time should be reached. This will imply that supply and demand at the equilibrium price must be equal. Let's try to construct the demand. It should be noted that because restaurants and other businesses were not included in our sample, the amount of wood demanded by them is ignored in this calculation.

DEMAND FOR FUELWOOD BY HOUSEHOLDS

Given the representativeness of household sample, calculated average household size, quantity and price of fuelwood can be extended to the national level, i.e. meaningful inferences can be made. In calculating the demand for fuelwood, emphasizing only the household section, we offer multiple stage calculation. Each stage will represent some portion of national data and finally, the last stage will be the national stage.

Stage 1: Sample size range – 819

Table 5: Fuelwood Consumption by Households Surveyed, 2010

	Number of Households	Average Size of Households	Number of People from Surveyed Households	Number of Households Who Do Not Use Fuelwood	Number of Households Who Use Fuelwood	Total Fuelwood Reported by Surveyed Households (m3)	Average Fuelwood Amount for All Surveyed Households (m3)	Average Fuelwood Amount for Households That Use Fuelwood (m3)
Total Average	819	4.33	3499.4	319	500	4391	5.4	8.8

[20] In calculations, only the very minimums are taken. Normally, the peak season is longer than 60 days and there are more forest enterprises.
[21] Note that imports are means of meeting the local demand, but imported wooden products are not obtained from local forests. Similarly, exports are part of supply as well.

As Table 5 indicates, total fuelwood consumption is 4391 m^3 by 819 households, each being comprised on average of 4.33 members. Hence, total population surveyed includes 3499 (average household size*Number of households surveyed = 4.33*819). Average fuelwood consumption by households using fuelwood is 8.8 m^3, but if the total fuelwood is spread over all the surveyed households including also those who do not use fuelwood, i.e. spreading it over the entire sample, then the fuelwood consumption per households for 819 surveyed households is 5.4 m^3.

Stage 2: Population of selected settlements – 104,612

Population of each of 64 settlements are provided in Table 6. Total of 452,994 people (de facto) live in the selected settlements. The mean household size and fuelwood consumption is the same as in stage 1. Now, calculations should be extended from 3499 people to 425,994 people of the same selected settlements and marzes.

Table 6: Fuelwood Consumption by Total Population of Sample Settlements, 2010

Marzes	Settlements	Population	Distance from Forest (m)	Number of Households	Average Size of Households	Total Number of People Surveyed	Number of Households Who Do Not Use Fuelwood	Number of Households Who Use Fuelwood	Total Fuelwood Reported by Surveyed Households	Average Fuelwood Amount for All Surveyed Households	Average Fuelwood Amount for Households That Use Fuelwood
Aragatsotn	Aragatz	2,727	8,531	9.0	4.3	39.0	0.0	9.0	61	6.8	6.8
Aragatsotn	Byurakan	3,920	1,944	10.0	3.6	36.0	1.0	9.0	43	4.3	4.8
Aragatsotn	c. Aparan	5,711	1,966	10.0	5.5	55.0	8.0	2.0	5	0.5	2.5
Aragatsotn	c. Ashtarak	18,915	9,210	24.0	4.3	103.9	16.0	8.0	35	1.5	4.4
Aragatsotn	Yeghipatrush	714	1,389	7.0	6.4	45.0	3.0	4.0	32	4.6	8.0
Aragatsotn Total		**31,987.0**		**60.0**	**4.8**	**278.9**	**28.0**	**32.0**	**176**	**3.5**	**5.3**
Ararat	c. Ararat	19,573	18,130	18.0	4.7	85.0	10.0	8.0	38	2.1	4.8
Ararat	c. Vedi	12,281	10,681	13.0	5.6	72.9	7.0	6.0	25	1.9	4.2
Ararat	Shaghap	803	11,137	7.0	5.2	36.1	1.0	6.0	37	5.3	6.2
Ararat	Surenavan	2,257	20,814	8.0	4.4	35.0	0.0	8.0	73	9.1	9.1
Ararat	Vardashat	230	15,453	7.0	4.0	28.0	2.0	5.0	36	5.1	7.2
Ararat	Vosketap	4,110	18,550	8.0	4.9	39.0	3.0	5.0	31	3.9	6.2
Ararat Total		**39,254.0**		**61.0**	**4.8**	**295.9**	**23.0**	**38.0**	**240**	**4.6**	**6.3**

Gegharkuniq	c. Chambarak	6,198	5,321	10.0	5.5	55.0	2.0	8.0	72	7.2	9.0
Gegharkuniq	Daranak	205	45	5.0	4.2	21.0	0.0	5.0	42	8.4	8.4
Gegharkuniq	Martuni	11,117	0	6.0	4.5	27.0	0.0	6.0	42	7.0	7.0
Gegharkuniq Total		**17,520.0**		**21.0**	**4.7**	**103.0**	**2.0**	**19.0**	**156**	**7.5**	**8.1**
Kotayk	c. Hrazdan	43,926	986	40.0	4.3	171.0	32.0	8.0	32	0.8	4.0
Kotayk	c. Tsakhadzor	1,578	0	10.0	4.8	48.0	7.0	3.0	21	2.1	7.0
Kotayk	Garni	6,877	5,134	13.0	5.2	68.0	3.0	10.0	75	5.8	7.5
Kotayk	Geghadir	652	8,035	11.0	4.1	45.1	6.0	5.0	19	1.7	3.8
Kotayk	Meghradzor	2,707	125	6.0	5.8	35.0	0.0	6.0	90	15.0	15.0
Kotayk	Solak	2,312	1,301	10.0	4.0	40.0	4.0	6.0	38	3.8	6.3
Kotayk Total		**58,052.0**		**90.0**	**4.7**	**407.1**	**52.0**	**38.0**	**275**	**4.9**	**7.3**
Lori	Antaramut	385	242	8.0	4.8	38.0	0.0	8.0	64	8.0	8.0
Lori	c. Akhtala	2,225	0	11.0	3.6	40.0	0.0	11.0	125	11.4	11.4
Lori	c. Alaverdi	14,835	0	10.0	3.5	35.0	1.0	9.0	89	8.9	9.9
Lori	c. Shamlugh	841	0	10.0	3.5	35.0	0.0	10.0	106	10.6	10.6
Lori	c. Stepanavan	13,934	0	20.0	3.3	66.0	16.0	4.0	18	0.9	4.5
Lori	c. Tashir	7,856	8,483	15.0	3.5	53.0	14.0	1.0	1	0.1	1.0
Lori	c. Tumanyan	1,705	0	10.0	4.6	46.0	6.0	4.0	13	1.3	3.3
Lori	c. Vanadzor	93,823	0	123.0	4.3	522.8	85.0	38.0	255	2.1	6.7
Lori	Yeghegnut	1,162	8	8.0	2.6	21.0	0.0	8.0	54	6.8	6.8
Lori	Margahovit	3,332	828	10.0	4.5	45.0	3.0	7.0	50	5.0	7.1
Lori	Pambak	363	500	8.0	4.4	35.0	0.0	8.0	94	11.8	11.8
Lori	Sverdlov	969	8,797	8.0	4.9	39.0	4.0	4.0	8	1.0	2.0
Lori	Haghpat	730	189	6.0	4.8	29.0	0.0	6.0	98	16.3	16.3
Lori	Tsaghashat	270	0	8.0	4.1	33.0	0.0	8.0	110	13.8	13.8
Lori	Odzun	4,757	659	11.0	3.6	39.1	3.0	8.0	37	3.4	4.6
Lori Total		**147,187.0**		**266.0**	**4.0**	**1076.7**	**132.0**	**134.0**	**1122**	**6.7**	**7.8**
Syunik	c. Goris	20,840	0	25.0	4.3	107.0	9.0	16.0	130	5.2	8.1
Syunik	c. Kapan	34,656	0	46.0	3.9	180.0	25.0	21.0	178	3.9	8.5
Syunik	c. Meghri	4,514	469	9.0	3.9	35.0	2.0	7.0	48	5.3	6.9
Syunik	c. Qajaran	7,916	271	11.0	3.7	41.0	10.0	1.0	10	0.9	10.0
Syunik	Kaghnut	118	418	10.0	2.9	29.0	0.0	10.0	113	11.3	11.3
Syunik	Khndzoresk	1,954	0	10.0	4.1	41.0	0.0	10.0	83	8.3	8.3
Syunik	Shikahogh	274	0	10.0	2.9	29.0	0.0	10.0	130	13.0	13.0
Syunik	Tandzaver	225	0	10.0	3.5	35.0	0.0	10.0	209	20.9	20.9
Syunik	Vorotan Sisian	280	1,232	11.0	4.6	50.9	0.0	11.0	108	9.8	9.8
Syunik Total		**70,777.0**		**142.0**	**3.8**	**548.0**	**46.0**	**96.0**	**1009**	**8.7**	**10.8**
Tavush	Artsvabert	3,216	0	8.0	5.1	41.0	0.0	8.0	70	8.8	8.8
Tavush	Aygehovit	3,170	43	8.0	4.1	33.0	2.0	6.0	74	9.3	12.3
Tavush	Bagratashen	3,046	2,431	10.0	3.7	37.0	0.0	10.0	82	8.2	8.2
Tavush	c. Berd	8,435	0	9.0	4.4	40.0	0.0	9.0	112	12.4	12.4
Tavush	c. Dilijan	14,846	0	20.0	5.4	107.0	3.0	17.0	182	9.1	10.7
Tavush	c. Ijevan	15,370	0	18.0	4.0	72.0	7.0	11.0	89	4.9	8.1
Tavush	c. Noyemberyan	5,156	23	10.0	4.2	42.0	1.0	9.0	88	8.8	9.8
Tavush	Chinari	1,165	1,070	8.0	3.3	26.0	0.0	8.0	90	11.3	11.3
Tavush	Gandzaqar	3,244	0	10.0	5.0	50.0	2.0	8.0	82	8.2	10.3
Tavush	Haghartzin	3,394	0	8.0	4.9	39.0	0.0	8.0	102	12.8	12.8
Tavush	Koghb	4,389	38	8.0	5.0	40.0	1.0	7.0	68	8.5	9.7
Tavush	Sevqar	2,104	3,389	9.0	4.1	37.0	3.0	6.0	70	7.8	11.7
Tavush	Voskepar	883	152	8.0	4.5	36.0	0.0	8.0	147	18.4	18.4
Tavush Total		**68,418.0**		**134.0**	**4.4**	**600.0**	**19.0**	**115.0**	**1256**	**9.9**	**11.1**
Vayots Dzor	Areni	1,730	16,223	5.0	4.4	22.0	0.0	5.0	33	6.6	6.6
Vayots Dzor	c. Jermuk	6,150	0	7.0	3.1	22.0	7.0	0.0	0	0.0	0.0
Vayots Dzor	c. Vayq	5,458	10,951	8.0	5.1	36.0	5.0	3.0	8	1.0	2.7
Vayots Dzor	Chiva	809	14,271	6.0	4.3	26.0	0.0	6.0	31	5.2	5.2
Vayots Dzor	Eghegis	488	6,161	6.0	4.0	24.0	0.0	6.0	37	6.2	6.2
Vayots Dzor	Gndevaz	960	1,458	6.0	5.7	34.0	3.0	3.0	10	1.7	3.3
Vayots Dzor	Malishka	4,204	13,573	7.0	3.7	25.9	2.0	5.0	38	5.4	7.6
Vayots Dzor Total		**19,799.0**		**45.0**	**4.3**	**189.9**	**17.0**	**28.0**	**157**	**3.7**	**4.5**
Grand Total / Average		**452,994.0**		**819.0**	**4.33**	**3499.4**	**319.0**	**500.0**	**4391**	**5.4**	**8.8**

The population number is converted into household number by considering the same average size. Hence, in the sample settlements there are 104,612 households (425,994/4.33). Now, inferences are extended from 819 households to 104,612 households. Average fuelwood consumption for the selected settlements considering the population and households sizes is 564,907 m^3. This is stacked wood and if we convert it into solid wood, then total consumption by households in 64 settlements in 8 marzes will be 395,435 m^3. So, only considering the population of the sample locations and extending the average figures to the extended sample results high enough demand which goes way beyond the allowable cuts reported by "Hayantar" SNCO. Considering the fact that there are other villages/cities near forests, the estimated solid wood demand will surely surpass 395,435 m^3 threshold.[22]

Stage 3: Population of all cities/towns/villages of selected marzes – 128,863

Table 7: Fuelwood Consumption by Total Population of Sample Marzes, 2010

	Total	0-5 km	%	5 - 10 km	%	>10 km	%
Tavush	121963.0	102936.0	84%	14513.0	12%	4514.0	4%
Lori	253351.0	131489.0	52%	58270.0	23%	63592.0	25%
Syunik	134061.0	41156.0	31%	40486.0	30%	52419.0	39%
Gegharkunik	215371.0	14000.0	7%	34675.0	16%	166696.0	77%
Vayots Dzor	53230.0	7186.0	13%	18151.0	34%	27893.0	52%
Kotayk	241337.0	36200.0	15%	33787.0	14%	171350.0	71%
Aragatsotn	126278.0	14774.0	12%	10355.0	8%	101149.0	80%
Ararat	252665.0					252665.0	100%
Total	**1398256**	**347741**	**25%**	**210237**	**15%**	**840278**	**60%**

The entire population of each of the 8 sample marzes is included Table 7. It is partitioned into sub-populations based on the distance from the forest. About 40% of the population in 8 marzes lives within 10 km distance from the forest. Only the 40% will be considered for calculating the demand for fuelwood by households of these 8 marzes. Hence, total population within 10 km from forest is 557,978 (347,741+210,237). Using the average households size of 4.33, number of households in settlements of 10 km vicinity from forests becomes 128,863 (557,978/4.33). To calculate the demand by forest-dependent households in 8 marzes, 5.4 m^3 per household is used, yielding total of 695,861 m^3 of stacked wood and 487,103 m^3 solid wood (128,863*5.4).

The above calculations were based on the assumption that households beyond 10km are less likely to rely on fuelwood. Hence, only households within 10 km distance were included. However, observations and control study indicated that households farther from forests tend to use fuelwood as well. Moreover, households from marzes that are not included in the study (Shirak and Armavir) tend to rely on fuelwood as well, obviously not as heavily as those near forests. Therefore, the consumption figure of 487,103 m^3 is largely understated and represents the absolute minimum average consumption.

Statistically evaluating the fuelwood consumption by forest-dependent communities, confidence intervals, standard errors and other parameters are considered. Table 8 shows the mean, 95% and 99% estimated values for household size and fuelwood consumption for 2003 and 2010 data. The decline in average fuelwood consumption as well as household size between 2003 and

[22] Note that the conversion rate from stacked to solid wood is considered the same 70% used in Mitchell,

2010 indicates that demand in 2010 is lower relative to 2003. Table 9 shows the calculation of demand at different confidence levels.

Table 8: Average, Min, Max Fuelwood Consumption and Household Size, 2003-2010

Statistic	2003		2010	
	Number / hhld	Firewood (m^3 / yr)	Number / hhld	Firewood (m^3 / yr)
Average (mean)	4.5	6.8	4.3	5.4
95 % confidence level +/-	0.16	0.46	0.13	0.42
99 % confidence level +/-	0.21	0.60	0.16	0.55

Table 9: Calculation of Minimum Consumption by Forest-Dependent Households, 2003-2010

Statistic	2003					2010				
	Household Size	Households within 10 km	Household Firewood Consumption (m^3 / yr)	Stacked Fuelwood Consumption (m3 / yr)	Solid Fuelwood Consumption (m3 / yr)	Household Size	Households within 10 km	Household Firewood Consumption (m^3 / yr)	Stacked Fuelwood Consumption (m3 / yr)	Solid Fuelwood Consumption (m3 / yr)
Average (mean)	4.5	123,961	6.8	840,413	588,289	4.3	130,381	5.4	698,631	489,041
95 % C Upper level	4.7	119,754	7.2	866,918	606,843	4.4	126,671	5.8	731,569	512,099
95 % C Lower Level	4.3	128,474	6.3	811,979	568,385	4.2	134,314	4.9	663,705	464,593
99 % C Upper level	4.7	118,509	7.4	874,766	612,336	4.4	125,565	5.9	741,393	518,975
99 % C Lower Level	4.3	129,939	6.2	802,748	561,923	4.1	135,580	4.8	652,457	456,720

The absolute lowest possible level of fuelwood consumption in 2010, considering only population of 8 marzes within 10 km distance from forest, is 652,457 m^3 stacked wood or 456,720 m^3 solid wood. There clearly is positive change from 2003 to 2010 of about 105,000 m^3 reduction in fuelwood consumption (solid wood). However, there is still large consumption of fuelwood surpassing the maximum level of supply. If AAC by "Hayantar" SNCO is considered to be the only source of supply (35,000 m^3), the minimum level of illegal logging will be about 420,000 m^3 (456,720 – 35,000). If we include all the other possible sources of supply, including the legal sales of forest enterprise, national parks, other land, the reported illegal cuttings, fallen wood, and imports, then maximum possible supply doesn't even exceed 210,000 m^3. In fact, that number includes all the potential supply, not just the part that is relevant to households as fuelwood, but parts related to construction as well. However, even in the case of exaggerated supply, the minimum level of illegal logging comprises about 240,000 m^3 annually (456,720-210,000).

Figure A2 in the Appendix illustrates the demand and supply relationship. If the true supply curve is fixed at say 210,000 m^3, then market forces would cause the equilibrium price and quantity to be established. In such case, price of fuelwood would have to be high and quantity – lower. However, we see that average prices are lower and total quantity (demanded) is much higher. This only implies that supply is either not fixed or it is much higher than it is shown according to official statistics. The only vivid change has been between 2003 and 2010 both in terms of elasticity of demand, fuelwood consumption and prices.

It should be noted that in these calculations, entire rural population or other marzes are not considered. If all the villages/towns without mains gas connections, with high rate of poverty and lack of alternative sources of fuel are considered and included in the calculations, one can imagine what would happen with the estimated number of fuelwood consumption, thus level of illegal loggings. It could skyrocket beyond 1 million m^3 (285,000 rural households x 5.4) implying illegal cuts as large as 700,000-800,000 m^3. However, quantifying the exact amount of illegal logging is beyond the scope of this study. Hence, we will use the absolute minimum level of loggings to observe potential trend between the 2003 study and this one.

The parallel could be drawn on this minimum estimated number of illegal logging (240,000 m^3) and the illegal cuts reported by "Hayantar" SNCO and "State Forest Monitoring Center" SNCO which is maximum of 3,000 m^3 (according to official statistics). Clearly, the official statistics is nearly 80 times lower than the actual minimum level of illegal cuts. Hence, it can be concluded that even if fuelwood demand is lower in 2010 relative to 2003, it does not necessarily mean that level of illegal cuts is lower. In fact, in 2003, the officially reported supply and illegal logging part was much higher compared to 2010, which implies that in reality, changes are probably only "illusions".

QUALITATIVE ANALYSIS

Statistical analysis are conducted based on the quantitative data, however, the overall description of the villages, households, and some nuances that are not included in the survey form are included in the qualitative section. Each interviewer provided observational comments on households, village, and marz. This section of the report illustrates brief qualitative analysis.

The analyses indicate that most of the interviewed households were in unfavorable financial situation. The poverty rate tends to increase with the remoteness of the settlements from main roads and major cities. Coincidently, many of these villages do not have mains gas connection and households are left with limited choices of fuel source.

Closeness to forests is not necessarily an indicative measure of illegal logging by households. Most households expressed that they are afraid to go to forests and illegally log trees or even collect trees. They said the punishment was too high to risk it. They either get tickets from "Hayantar" SNCO or local Mayor's office to collect leftover wood, or they buy through middlemen.

The price of fuelwood actually varies depending on the location, although according to Hayantar's price list, the prices are fixed. Most of these households are faced with limited choices of fuel sources, but many prefer using mains gas. They said that mains gas is cleaner and safer than fuelwood, but given either the inaccessibility or high prices of gas, many simply use fuelwood or other means of fuel.

Most respondents mentioned that strict forest government is good and necessary for recovering the forests, but the law should be universal to all people. They all seem to acknowledge the fact that forests are being exploited by higher authorities or people "beyond" law. Also, they complained that sometimes the law is so strict that they are not allowed to go to forests collect fallen trees or branches, instead they get rotten over time and nobody benefits. They suggested relaxing the branch collection policy which will benefit both rural households and forests (i.e. "Hayantar" can do forest cleaning at no cost if the community collects the branches).

ARAGATSOTN MARZ

Despite the massive gasification across country, there are still two villages in this marz that have no gas connection. The marz is not richly covered by forests, but the selected settlements are within 10 km from the forest. Overall, this is perhaps one of the few marzes which has low per capita consumption of fuelwood. Among all the surveyed households in Aragatsotn, about 3.5 m^3 is the average fuelwood consumption, whereas 5.3 m^3 for those who use. They said "if we had gas connection, what would we be doing with this dirty, polluting fuelwood". The price for cubic meter of fuelwood is one of the highest prices observed across the surveyed marzes. The households complained that those oligarchs cut the fuelwood at nearly no cost, and sell to use at very high price. Overall, most people either bought firewood from middlemen, mainly those outside the village, or use their own orchards. Some indicated that if it continued this way, they would not have trees anymore. Many households complained about spending large sum of money to heat up their houses.

ARARAT MARZ

The population of this marz is generally not very poor, although in some villages they still are. Shghap was very poor village with many households living at subsistence level. Some houses had no floors, only cement. Many claimed that due to fuelwood price increase, trees from own orchards are used. Farming is a popular means of income generation. For example, in Vardashat nearly every household seemed to be engaged in animal farming. Houses were surrounded by piles of dung and hay. On the contrary to houses, residential apartments were visited in Ararat city. Many respondents indicated that cement factory provides employment for the residents. However, if gas price rises, many households, even in residential apartments, plan on switching from gas to fuelwood and dung.

The marz is not lavishly covered with forests, and most of the villages and cities are at more than 10 km distance from forests. Overall, this is perhaps one of the few marzes where the fuelwood price per cubic meter is the highest. The villages with no gas rely on fuelwood and bottled gas. Hence, the fuelwood consumption is not very high (not higher than the calculated average for the entire sample). Many households complained about spending large sum of money to heat up their houses.

Many of those who use fuelwood buy it from trucks that come from Karabagh, Ijevan or other places, and some use trees from their own orchards. Some even claim that these sellers do not have any license and most of them cut trees illegally. The perception was that no illegal forests cutting was taking place by people/residents, only by government officials.

GEGHARKUNIK MARZ

Two of three settlements visited in this marz were quite poor. Daranak had no gas connection and in Chambarak, only few had connection, while the rest of houses lacked access to gas. Villagers said the lump-sum fee to get connection was quite high. Many use animals and the source of income in these two poor settlements was agriculture. "Ashtarak Kat" dairy company has a large milk-collection center in this marz, which motivates households to engage in animal farming. Martuni, on the other hand, is relatively in better condition and animal farming is not as popular there. Instead, agriculture (fruits and vegetables) is developed. They have been negatively affected by the hails which significantly reduced the amount of available produce.

The marz has forests, national parks, and some "woods" as defined by respondents. Due to increasing water level of the lake Sevan, some trees were cut by Forest Enterprise as part of the necessary sanitation procedure. The remaining (branches, little parts of trees) of the cut trees were left for the village people to take home, although some residents claimed that they were

not allowed to go there and the forest ranger was quite strict and did not allow any villagers to collect leftover thins. Some villagers claimed that there were no illegal loggings by ordinary people. However, the oligarchs are notorious for illegal logging even in this marz. Some villagers said they buy fuelwood from trucks that come to the village and those are mostly sold by the "Hayantar" SNCO oligarchs.

KOTAYK MARZ

The marz has very diverse setting extending from forest-rich cities to natural preserves with many touristic spots. All the selected settlements have connection to gas. Fuelwood usage is mainly common in some villages/cities, but mostly gas is used. Income level varies across settlements, however, relative to other marzes and other villages, the availability of touristic spots, favorable weather for agriculture, and farming has been the main income drivers.

Interestingly, those who buy fuelwood from trucks say that trucks bring fuelwood from Dilijan and Ijevan, and only some from Hanqavan or other locations in Kotayk. Some claimed that the sellers had license, while others said they did not.

The attitude of people towards illegal logging in general was varying. Some suggested that unequal and bad social conditions force people cut trees, thus they should not be punished. While the rest suggested that cutting trees illegally should be harshly punished because forests play very important role in providing clean air. The perception of respondents was that the expected gas price increase will certainly contribute to the illegal logging.

LORI MARZ

The marz has the largest forest covered areas in Armenia. It had experienced overwhelming number of cuts during the energy crisis. It is also one of the marzes with rich mineral deposits. The latter creates problems for forests and their protection. There are many mining companies operating, along with other large canneries, dairy companies, etc. The general level of income is at moderate level, hence, poverty level should in general be much lower compared to other marzes.

The settlements had no gas connection, whereas some that had, only some percentage of households actually could afford connection fee. Despite being the largest forest covered marz in Armenia, only 50% of respondents reported of using fuelwood. The rest, rely on gas. Unlike Tavush, Lori has perhaps stricter rules and forest management and fewer people reported illegally cutting trees in this marz. The average price per cubic meter is lower than the sample average but higher than that in Tavush.

Illegal logging is quite striking in this marz, but not by households rather by others – trucks. Lori is a popular destination for track drivers next to Tavush. Something should be implemented in this marz such that neither the mine operators, nor the businesses could take advantage of nature's beauty.

SYUNIK MARZ

The situation in this marz is quite different from city to village. Cities, where mining companies operate providing employment opportunity for residents, exhibit above average income for residents who can afford using gas instead of fuelwood. Hence, fuelwood is mostly used by villages with no gas connection. About 5 of the selected settlements had no gas connection.

Similar to Tavush, many people collect their fuelwood from forests with or without permit. Some indicate that illegal logging continues, while others disagreed. Some respondents even indicated

that neighbors collect fuelwood from forests and sell to others. Many indicated that the source of their fuelwood is mainly orchards, forests, or due to extremely high price (e.g. Meghri), even electricity.

TAVUSH MARZ

Overall, the marz is in relatively good economic condition. It is one of the hot touristic spots. Only three villages did not have gas connection, while those villages that had, not all households within them had connections. Thus, many households still rely on fuelwood. Average price per cubic meter of fuelwood is probably one of the lowest among the other marzes.

Most of the respondents use fuelwood both for cooking and heating. A sizeable portion of them collect fuelwood from forests with or without permit, and some buy. Some residents in Gandzaqar confessed that massive logging is happening in this village by higher authorities of Forest Enterprise. A minor portion of logging is done by poor people who have no other means of living.

Some individuals at various parts of Tavush marz tried to do something about the disappearing forest. One respondent said that he established an NGO which was engaged in environmental programs. He brought and planted nearly 7000 trees. The type grows really fast and is very good for timber production. In addition, the NGO planned on planting other types of trees, but the operation didn't last long due to the lack of financial support.

VAYOTS DZOR MARZ

The marz is not very rich with forests and about four settlements are located at more than 10 km distance from forests. Three of the selected villages had no gas connection, while another one is partly connected. In much poorer parts of the marz, people switched from fuelwood to dung due to lack of gas and high prices of fuel. Some villages are very poor, while Jermuk is relatively progressed. It includes residential apartments and many people even use either gas or electricity. Those, who indicated buying fuelwood, said they buy from trucks most of which come from Syunik.

There is general fear among people to cut trees in the forest as it is very well protected. Residents of Jermuk and Gndevaz have also indicated that it is nearly impossible to illegally log trees from forest. In fact, residents of Gndevaz indicated that they are actively involved in forest protection process and under the leadership of the village "oligarch", they even planted new trees of about 3 ha. On the other hand, most villagers in Yeghegis claimed that they only collect fallen trees or branches for fuelwood without any license, but they do not log any trees. The perception is that government officials (such as Forest enterprise) cut trees mainly for timber and fuelwood which is then sold to the residents of villages and other places.

PILOT PROJECTS

The review of existing literature and analyses of this survey results universally indicate the dominance of demand for fuelwood among other types of wood uses. The major drivers for such demand level are high prices of alternative fuels and high level of poverty (especially in rural areas). These drivers of demand have been found to be universal across developing nations with some country-specific nuances (Chomitz et al., 2007).

Certainly these problems could be solved or at least minimized at lowest possible level. However, it should be noted that households are not the major illegal loggers of the forest. Instead, profit-opportunists who operate under the shades of Hayantar are responsible for large share of illegal logging. Logically, one can suggest enforcing more effective laws of forest protection to limit these loggers' illegal operations. This option would work should the government adopt the "transparent operation" policy to combat the corrupt acts. However, given the large sum of money that goes into the pockets of individual officers, this option is not viable at least until there are serious steps of reducing corruption in forestry sector as well as overall economy.

If the illegal logger cannot be controlled, then what can be done to indirectly affect the illegal act of forest felling? Demand for fuelwood by households, considerably large portion of the logged wood, is the major feasible lever to cut down illegal logging. Specifically, improving the livelihoods of rural population will increase the disposable income of households. Hence, alternative fuel, being more expansive than the fuelwood for most households, will become affordable. Provided that over 75% of households prefer mains gas over fuelwood, the switch from fuelwood to gas or other alternative fuel sources will be apparent. Hence, demand for fuelwood would decline, forcing the illegal loggers and profit-seekers to cut down the supply of fuelwood. Similarly, making alternative fuel available in villages where the only option is fuelwood or bottle gas, will have similar impact on the illegal logging.

To increase the efficiency of forest protection and combat against illegal logging, we suggest several pilot projects. They are briefly presented in this report to enable the reader to assess projected chain effect on reduction of illegal logging. Each project will ultimately improve the condition of forests directly or indirectly. Further examination and thorough plan of action for each suggested pilot project is necessary.

LIVELIHOOD IMPROVING PROJECTS

The following projects are intended to improve the financial condition of households. Most of the suggested projects are either in existence in some communities with successful operation or are proposed for certain locations as means of improving household welfare. All of these projects are dependent on NTFPs and other uses of forests. Specifically, projects promote sustainable and profitable side of forest use by communities/households.

BEEKEEPING

Population of bees is in decline in many countries posing serious threats to agriculture sector (UC Davis, 1994; Brady-Myerov, 2006; Collura, 2008). Bees play significant roles in not only honey production but pollination as well. Sequentially, the shortage of bees and honey in the international market will lead to high prices for honey. The international market is quite promising for beekeepers to commercialize on making honey.

In Armenia, beekeeping has been identified as profitable business by USAID in 2001. As part of Small and Medium Enterprise (SME) in Armenia, USAID funds were centered on analyzing the sector for potential business opportunity to be made possible to small, rural and poor households (Poghosyan and Sommers, 2006).

Over 4 year period, Armenian Beekeepers Association was established with the aim of promoting beekeeping in Armenia. In 2005, there were more than 600 beekeepers and honey enterprises, who, prior to the beekeeping business, were in poverty. In addition, USAID helped Armenian beekeepers to export honey to premium price markets as well as establish brand name for domestic market. Production of honey has increased by 30% and still one of the challenges considered by ASME is the expansion of honey keepers. This study was conducted in 2005. Ever since then, beekeeping business was on rise in Armenia.

IMPACT ON FOREST-DEPENDENT COMMUNITIES

Forests in Tavush and Lori marzes are very rich with good quality flowers. Specifically, good quality of honey is obtained from “loreni” trees, which are particularly found in forests. As an alternative use of forests, beekeeping can be income-generating business for rural and forest-dependent communities. It requires small initial investment, low operating costs, is not perishable and labor-intensive. In fact, beekeeping is considered to be a hobby for some people. The demand for honey in Armenia is quite strong and the average price is 2500 AMD/kg. Moreover, foreign demand for good quality of honey is also high implying available export markets. Organic honey is another type that can be produced in Armenia yielding international popularity. Hence, the development and emphasis on beekeeping could help poor, forest-dependent communities generate income and provide employment for them.

BERRY/FRUIT/VEGETABLE COLLECTION CENTERS

Forests in Armenia are rich with assorted varieties of wild crops. Some respondents indicated that they collect berries and other NFTPs from forests either for own use or sale. They indicated that they only collect very small percent of what is available. Many lack the motivation to utilize the free goods to generate income simply because of difficulty of accessing a market. Some said they use fruits for home-made vodka, others use for jam, and so on. Very few of them actually use these NTFPs for sale.

MOTIVATION

The varieties available at the forests include blackberry, raspberry, cornelian cherry, rosehip, walnut, as well as vegetables, such as hornbeam and parsnip chervil, with unique maturing cycles that secure harvest throughout the year. In general, utilization of NTFPs is very low due to several reasons. Markets near the forests are small-scale and limited amounts of products can be sold through them. On the other hand, large markets are either inaccessible or inefficient to access for small quantity of collected goods, which is typically the case among those who collect for sale. If they collect large quantities of such products, most of the produce will become rotten by the time it reaches to the final consumer outside of the region.

The necessity to establish a collection and logistics center is to solve the above mentioned problems. The collection centers will encompass cool storage facility which will enable non-perishable storage of produce before transporting them to the market. To save on transportation cost, collection centers will cool all the goods until there is sufficient quantity to transport through refrigerating truck. Specifically, the center would organize the collection, consolidation, storage, and delivery of the raw products. It will normally have two main delivery points: supermarkets and processing companies. Supermarkets will purchase cooled berries and fruits in packaged and aesthetic containers transported by refrigerator trucks. Processors, on the other hand, will purchase products from the centers in various containers and conditions. There are about 30 canneries in Armenia which can play an important role in fueling the value chain development.

IMPACT ON FOREST-DEPENDENT COMMUNITIES

Existence of such centers would allow rural communities, especially the ones near the forests, to generate income by collecting demanded NTFPs. Not only will these centers become potential income-hubs for unemployed and poor rural population, but they will also promote communities to care

more about the forests given their income-generating potential. In addition, the improved livelihoods of forest-dependent communities will change the source of fuel used by them into more preferred one – mains gas.

ALTERNATIVE FUEL PROMOTING PROJECTS

Armenia faces increasing demand for energy. The most popular and common sources of energy are fuelwood, mains gas and mains electricity. The former is troublesome given that the country has one of the smallest forest cover areas in the world, which is not being used in a sustainable manner. The second option posits various risks including exchange rate risk, dependence (national security) from gas supplying country, and price risk. In addition, it is not even available in all the villages of Armenia. Mains electricity, on the other hand, is the environmentally safe but could become expensive related with the renovation or construction of the nuclear power plants. Hence, the need for better, more sustainable, independent, and environmentally safe source of fuel is critical. In addition to alternative energy, a method of conserving heat inside the houses is another method to reduce the consumption of fuelwood. For example, window insulators, which are relatively cheap ($17-$20) and can reduce the need for fuel, are applicable and quite appropriate for the case of Armenia. This is especially relevant for houses in rural areas. However, there are other more solid solutions which involve alternative energy.

Various other nations were or are in similar situation as Armenia in terms of energy challenges. Proposed and implemented solutions to such problems vary depending on the country-specific characteristics. However, through the international donor organizations, several common alternative fuel sources have been introduced as solutions to the increasing energy demand.

SOLAR ENERGY

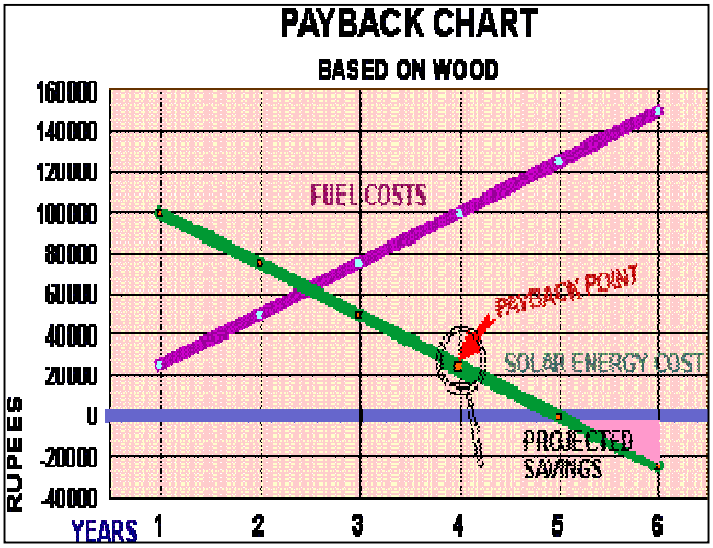
Location of Armenia in subtropical zone entails favorable climate conditions for use of solar energy. The feasibility and economic justification of the solar energy capacity was analyzed in 2007 through USAID program (Odabashyan and Khachatryan, 2008). The estimated solar energy plant with 100 MW power capacity can generate about 270 million kWh annual electricity and reduce CO_2 emissions of 42,960 tons. This enables the country not only benefit from clean energy alternative, but also from potential carbon trade. There are several companies in Armenia that produce and/or develop solar panels or photovoltaic tubes. Ghana, Zimbabwe, Kenya, Ethiopia and many other nations successfully introduced solar energy in their countries with the main target being rural population (Madamombe, I., 2006; Shiferaw, T., 2009).

FEASIBILITY

Numerous studies, scientific articles, businesses have analyzed many features of solar power.

Feasibility, which is especially critical in the case of rural population living on low income levels, is largely analyzed and consensus for the payback period is reached: on average in 4 years (maximum of 7 years) the initial investment for setting up the solar energy plant will be completely paid off (EEREC, 1996; Kayema Energy Solutions LTD, 2009; Ali et al., 2009). Moreover, in long run, solar energy cost falls off leading to positive savings, while the fuelwood or other fuel costs increase over time.

There are many types of equipments for capturing solar energy. Some are more improved than the others, provide more "services", etc. For example, solar water heaters allow the household to use sunlight in order to warm up water and even convert it into electricity. Solar panels or photovoltaic tubes, on the other hand, only capture the solar energy converting it into electricity (Clean Energy for Eternity Inc., 2007). In either case, sunlight is necessary. Luckily, Armenia gets enough amount of radiation annually making it a potentially successful project for the country.



IMPACT ON FOREST-DEPENDENT COMMUNITIES

Investments in solar heating systems especially in places where fuelwood consumption is the largest, will tremendously reduce the need for wood, thus, will curtail the demand. The initial investment in solar heating system is obviously large, but through the intervention of government/NGOs/donor organizations, the project is quite doable and promising for Armenia. In Armenia, it can become a major fuel source which not only makes Armenia less dependent on other countries for gas, but also environmentally safe country, and demand for fuelwood will decline putting forests back on the path of recovery and sustainable growth.

BIOGAS

This form of alternative energy has been successfully introduced in Nepal quickly becoming one of the most efficient ways of supplying energy. Biogas can be created with organic material, which is then set to ferment with waste inside a digester. Since 1992, Nepal has been heavily focusing on biogas and nearly 100,000 biogas plants have been installed within the country. The plants are small enough to set up in the yard of houses and are directly connected to the kitchen (TED Case, 2003; University of Cambridge, 2005; FAO; Clean Energy for Eternity Inc., 2007). The

dung of a cow is mixed with water and allowed to ferment in an underground tank. In addition to animal manure, human waste can also be used to generate gas (this was the case for Nepal, India and many other countries). The residue that is not converted into gas is used as a fertilizer for plants. On average, it can provide gas for 5 hours of cooking each day. Cost of the biogas plant is lower than that of solar energy ($600-$700 according to University of Cambridge, 2005).

Agriculture is the main occupation of rural population in Armenia. Animal farming is common in the mountainous regions of Armenia including Lori and Tavush marzes. Some households use the manure of animals for heating purposed in the ovens along with fuelwood or sometimes separately. In addition to animal waste, human waste can also be connected to the biogas plant to convert the mass into gas and fertilizer.

The viability of biogas plants is explained by its relatively low set up costs and short payback period (7-10 years by Odabashyan and Khachatryan, 2008). "According to the 2007 USAID program, the biogas potential in Armenia for 2006-2020 was estimated as follows: an investment of $34.17 million would provide generation of 38.34 million m^3 of biogas annually, which will reduce greenhouse gas emissions by 544.6 thousand tons per annum in CO_2 equivalent" as indicated in Odabashyan and Khachatryan, 2008.

IMPACT ON FOREST-DEPENDENT COMMUNITIES

The Armenian rural families will experience no indoor pollution from burning fuelwood. They will turn waste into gas and receive fertilizer as free by-product. In addition, time spent on collecting fuelwood (if they are going to forest) could be used to get other jobs done. The future of biogas plants for colder regions of Armenia can be incorporated with solar panels to provide uninterrupted source of fuel (Buysman, 2009). As a result of these plants, households who demand fuelwood for heating or other purposes, will now have relatively cheaper alternative, thus will reduce their consumption of fuelwood leading to significant improvement in fight against illegal logging.

RECOMMENDATIONS

Fuelwood is and will probably be in demand by households (at a moment ignoring the businesses), unless some steps are taken in efficiently reducing the need for it. The reasons for the prevailing demand for fuelwood include:

1. Relatively lower prices compared to mains gas, electricity or other common fuel alternatives (economic issue)
2. Alarming poverty rates in many forest-dependent villages/cities (social issue)
3. Lack of and/or limited access to alternative fuel (infrastructure/social issue)
4. Inadequate/lack of government programs in isolated, far-reaching villages/cities (governmental issue)
5. Inadequate tools for forest guard to do his job (economic issue)
6. Disengagement of communities in forest management and cleaning (economic and governmental issues)
7. Lack of subsidies/low prices of alternative fuel for forest-dependent community, especially the ones at the boarders.

Unless steps are taken by government to address the above listed problems and many more relevant ones, the demand for fuelwood will prevail driving the illegal logging by profit-seekers.

Worldwide, poverty is considered to be one of the main driving forces of fuelwood demand by households. Armenia, being a developing country, has serious poverty issues. Moreover, severe income disparity among population (esp. between rural and urban areas) divides the country into very poor and very rich. The former are the main consumers of fuelwood for heating and cooking purposes, while the latter are the major ones who are likely to consume processed wooden products. Hence, twofold solution needs to be in place. Household demand for fuelwood, which is driven by poverty, is linked with point 1 – lower fuelwood prices relative to alternative fuel sources. This in turn means that either prices of alternative fuel have to decrease, fuelwood prices should increase, or income level of households should increase with enforced forest protection. Gas or other alternative fuel prices are unlikely to change in a favorable direction (unless a new alternative fuel is introduced). Thus, income is the only lever to improve the affordability of alternative fuel.

Various studies (Hergnyan, 2007; Danielian and Dallakyan, 2007; Hazarashen, NGO (Kharatyan), 2010) indicated the importance of Non-Timber-Forest Products (NTFPs) as income sources. The survey results of this study also showed that many households use forests for collecting fruits, plants, berries, etc. Unfortunately, some of the villages are isolated from major cities or major highways, making it nearly impossible to transport the collected NTFPs to markets or consumers.

To create businesses and improve the livelihoods of rural households, establishment of berry/fruit/vegetable collection centers and beekeeping business are viable options. These types of businesses will work especially in Syunik, Lori, and Tavush, which are the three main forest-covered marzes in Armenia. The forests are very rich with various sorts of plants, flowers, berries, and fruits. Currently, incentive to collect berries and other things from forest (NTFPs) by communities is nonexistent due to lack of opportunities to market these products. According to various sources (Hrgenyan, 2007; Danielian and Dallakyan, 2007; Hazarashen, NGO (Kharatyan), 2010), many NTFPs remain in the forest and rotten. Hence, the potential use of forests is not realized and not implemented efficiently by the forest-dependent communities. Therefore, if

there is collection center nearby which would be equipped with large refrigerators and cleaning system, then households living close to forests would be incentivized to go to forests to collect berries, plants, fruits, etc. This type of business has been thoroughly analyzed by ICARE Foundation for some other donor organization and it was proven to be quite profitable business. Hence, it is worth considering as a possible income-increasing project for forest-dependent communities in three forest-rich marzes.

Besides policies centered on creating employment opportunities for the villagers and potentially cutting the poverty level in Armenia, government can affect fuelwood reduction by increasing the available choices of fuel. International donor organizations supported many developing countries to implement projects that promote environmentally safe fuel alternatives. For example, through the efforts of many international organizations, many African villages now use solar heating systems as a cheap, environmentally safe fuel. Although in many other developed countries, which are highly dependent on oil (specifically imported), fuelwood is considered a renewable fuel and people are being promoted to switch from oil to fuelwood, in Armenia fuelwood is not being used in a sustainable way and people should be prompted to use other sources. Given the fact that access to gas is still an issue for several villages, the only real fuel options that they have include fuelwood, dung, bottled gas, electricity, and potentially solar energy. Investments in solar heating systems (especially for places where fuelwood consumption is the largest) will greatly reduce the need for wood and thus, will cut the demand for fuelwood. Given the large initial investment, it is clear that this policy can only be successfully implemented with the help of financial resources by donor organization. At the initial stage, households in the rural areas shall be provided with the equipments/plants, etc. after which they will be responsible for its maintenance and further replacement. This way Armenia will be less dependent on other countries for gas and environmentally savvy and safe country with recovering forests.

Lack of proper infrastructure in far reaching villages, cities, etc. is a major pushback for economic development as well. Investment in infrastructure is the key to develop villages or other rural areas. Specifically, construction of roads (especially the ones connecting to major cities) in rural areas, establishment/improvement of proper education system where students would be taught about various consequences of certain acts on environment to educate aware and responsible citizens, and creation of employment opportunities for rural population are all key to country's overall development. With such improvements government would be able to impose restrictions on households to switch from fuelwood to other sources of fuel.

It is worth mentioning that the best recommendation would have been the identification of illegal loggers, which are large enough groups to be easily tracked, if the political will was present. If there are serious steps taken by government to handle this issue, then usage of the same ticket by truck drivers will not be possible and all the volume of logs sold by "Hayantar" SNCO will be recorded. This suggestion points out the set-up of proper timber tracking system. In addition, exports of wood and wooden products should be banned, instead promoting imports. Engaging communities in the process of forest management to clean and collect the fuelwood materials from the forest is yet another policy implemented successfully in many other countries. However, the last list of recommendations is dependent upon politics and requires government's undue attention and serious will to carry on. Based on the cases of Brazil, Ghana, Kenya, and many other nations (including Armenia), large sum of money is being generated informally. Hence, conclusion can be drawn that the will of Armenian government to undertake serious steps to reducing corruption in forestry sector is largely dependent upon the level of

corruption of the other sectors and the overall country situation. At the moment, that Armenia is ranked among highly corrupt countries in the world, this last set of recommendations merely seem to be viable (Transparency International, 2010). Therefore, we strongly recommend implementing the suggested pilot projects and the other suggested policies which are relatively immune to political hodgepodge and are more practical even in the case of corruption.

"Hazarashen" Armenian Center for Ethnological Studies, 2007. "Knowledge, Attitude and Perception of People Living in Communities Adjacent to Forests", by request of IUCN, June 2010.

Adams, J.S. and McShane, T.O., 1996. "The Myth of Wild Africa", Norton, New York, 266.

Ali, B., Sopian, K., Al Ghoul, M., Othman, M. Y., Zaharim, A., Razali, A. M., 2009. "Economics of Domestic Solar Hot Water Heating Systems in Malaysia", European Journal of Scentific Research 26(1), 20-28.

AM Partners Consulting Company, 2010. "Wood Processing Sector Survey", by request of WWF Armenia, November 2010.

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., et al., 2009. "The Economic Contribution of Forest Resource Use to Rural Livelihoods in Tigray, Northern Ethiopia", Forest Policy and Economics 11(2), 109-117.

Baird, M., 2001. "Forest Crime as a Constraint on Development. Presentation at the Forest Law Enforcement and Governance Conference Held in Bali, Indonesia", September 2001.

Brady-Myerov, M., 2006. "Beekeeper Trends to a Dwindling Work Force", NPR, November 16, 2006. http://www.npr.org/templates/story/story.php?storyId=6496934.

Bruinsma, J., 2003. "World Agriculture: Towards 2015/2030 – An FAO Perspective", London: Earthscan.

Buysman, E., 2009. "Biogas for Developing Countries with Cold Climates", GERES in Cambodia, 1-6.

Caucasus Research and Resource Center, 2007. "Caucasus Barometer", Retrieved in December, 2010.

Cavendish, V., 2000. "Empirical Regularities in the Poverty-Environment Relationship of Rural Households: Evidence from Zimbabwe", World Development 28(11), 1979-2003.

Chomitz, K.M., Buys, P., De Luca, G., Thomas, T.S., and Kanounnikoff, S.W., 2007. "At Loggerheads: Agricultural Expansion, Poverty Reduction, and Environment in the Tropical Forests", World Bank Policy Research Report, World Bank, Washington, D.C.

Clean Energy for Eternity Inc., 2007. "Clean Energy Action Plan: Towards 50/50 by 2020 in the Bega Valley Shine", February, 2007. http://www.solarthermalworld.org/files/Bega%20Valley%20Shire.pdf?download.

Collura, H., 2008. "U.S. Losing Bees and Beekeepers", USA Today, April 9, 2008 http://www.usatoday.com/news/nation/2008-04-08-beekeepers_N.htm.

Cordero, W., 2003. "Control de Operaciones Forestales Ilegales Con énfasis en la Actividad Illegal", Documento Técnico de BOLFOR 120.

Danielian, L. and Dallakyan, A., 2007. "Report on Nationwide Survey Findings: Deforestation and Protection of Forests," Turpanjian Center for Policy Analysis, American University of Armenia. Available at:

http://www.armeniatree.org/thethreat/resources/2007_aua_forest_survey_ecoarmenia.pdf

Energy Efficiency and Renewable Energy Clearinghouse (EEREC), 1996. "Solar Water Heating", FD 119, March, 1-8.

Energy Efficiency and Renewable Energy Network (EREN), 2002. "Consumer Energy Information, EREC Reference Briefs". Available at http://www.fullerheating.com/fhonline/hvac/residential/information/DOE/doecomparfuel.html.

FAO, "The Wood for Energy: Energy for Subsistence, Nepal: A Case Study", Corporate Document Repository, Q4960 http://www.fao.org/docrep/q4960e/q4960e00.htm#Contents.

Food and Agriculture Organization of the United Nations (FAO), 2005. "Products and Trade Statistics", Country Profile.

Gutierrez-Velez, V.H. and MacDicken, K. 2008. "Quantifying the Direct Social and Governmental Costs of Illegal Logging in the Bolivian, Brazilian and Peruvian Amazon", Forest Policy and Economics 10, 248–256.

Hansen, C. P. and Treue, T., 2008. "Assessing Illegal Logging in Ghana", International Forestry Review 10(4), 573-590.

Harutyunyan, A., 2007. "Cutting into Truble: Illegal Logging Decreases, but Forests Still in Dnager", ArmeniaNow, October 10.

Hergnyan, M. et al., 2007. "The Economics of Armenia's Forest Industry Report," Economic Values and Research Center. Available at: http://www.armeniatree.org/thethreat/resources/ev_forest_industry121007.pdf

http://www.illegal-logging.info

International Labor Organization, 2011. "Unemployment Rate in Armenia", www.armstat.am/en/?nid=126&id=08010.

International Monetary Fund Database, http://www.imf.org/external/pubs/

Kamara, J. S., Kamara, E. S., Mosenene, L., and Odoo, F. K., 2010. "Chainsaw Milling and National Forest Policy in Liberia", European Tropical Forest Research Network News 52, December, 174-180.

Kayema Energy Solutions (PTY) LTD, 2009. "Domestic Solar Water Heater Financial Analysis: Retrofit External Heat Exchanger Versus Electrical Geyser Comparison", December, 1-4.

Khojoyan, S., 2010. "New Expenses: Gas Price Hike in 2011 Worry Armenian Residents", ArmeniaNow, December 22, 2010. Available at http://www.armenianow.com/economy/26679/gas_tariffs_price_increase_armenia

Langbour, P., Roda, J-M., Koff, Y. A., 2010. "The Chainsaw Milling in Cameroon: The Northern Trail", European Tropical Forest Research Network News 52, December, 129-137.

Lescuyer, G., Cerutti, P. O., Mendoula, E. E., Atyi, R. E., and Nas, R., 2010. "Chainsaw Milling in the Congo Basin", European Tropical Forest Research Network News 52, December, 120-128.

Lori Mayor's Office, 2009. "Socio-Economic Development Program of Lori, 2010-2013".

MacKinnon, K., 2005. "Parks, People and Politics: Conflicting Agendas for Forests in Southeast Asia", In E. Bermingham, C. W. Dick, and C., Moritz, eds., Tropical Rainforests. Past, Present and Future. Chicago: University of Chicago Press.

Madamombe, I., 2006. "Solar Power: Cheap Energy Source for Africa", Africa Renewal 20(3), 10.

Mamo, G., Sjaastad, E., and Vedekd, P., 2007. "Economic Dependence on Forest Resources: A Case from Dendi District, Ethiopia", Forest Policy and Economics 9(8), 916-927.

Marfo, E., 2010. "Chainsaw Milling in Ghana: Context, Drivers and Impacts", Tropenbos International, Wageningen, 76.

McSweeney, K., 2004. "Forest Product Scale as Natural Insurance: The Effects of Household Characteristics and the Nature of Shock in Eastern Honduras", Society and Natural Resources 17(1), 39-56.

Ministry of Nature Protection/SIDA, 2004, "Illegal Logging – Survey and Analysis", Forest Institutional Support Project .

Mitchell, A., 2004. "Illegal Logging – Survey and Analysis", Draft Final Report, Ministry of Nature Protection/SIDA.

Moreno-Sanchez, R. and Sayadyan, H., 2005. "Evaluation of the Forest Cover in Armenia", International Forestry Review 7(2), 113-127.

National Statistical Services of RA, www.armstat.am

Norton-Griffiths, M., and Southey, C., 1995. "The Opportunity Costs of Biodiversity Conservation in Kenya", Ecological Economics 12 (2), 125-139.

Odabashian, V. and Khachatryan, S., 2008. "Renewable Energy in the Republic of Armenia", 21st Century 1(3), 108-120.

Papinyan, H., 2003. "Requiem For Armenia's Forests", at Hetq. Available at www.Hetq.am

Pattanayak, S.K. and Sills, E.O., 2001. "Do Tropical Forests provide Natural Insurance? The Microeconomics of Non-Timber Forest Product Collection in the Brazilian Amazon", Land Economics 77(4), 595-612.

Pearce, J., Putz, F. E., and Vanclay, J. K., 2003. "Sustainable Forestry in the Tropics: Panacea or Folly?" Forest Ecology and Management 172 (2-3), 229-247.

Poghosyan, A. and Sommers, P., 2006. "From Honey to Money: a Sweet Case from Armenia", Global Food Chain Partnership, Cairo, Egypt, January 29 - February 2, 2006. http://www.globalfoodchainpartnerships.org/cairo/papers/ArsenPoghosyanArmenia.pdf.

Reddy, S.R.C. and Chakravarty, S.P., 1999. "Forest Dependence and Income Distribution in a Subsistence Economy: Evidence from India", World Development 27(7), 1141-1149.

Sayadyan H. and Moreno-Sanchez R., 2006. "Forest Policies, Management and Conservation in Soviet (1920-1991) and Post-Soviet (1991-2005) Armenia", Environmental Conservation 33 (1), 1-13.

Sayadyan, H. Y., 2005. "Illegal Logging in Armenia", Draft Report In: World Bank Project "Ensuring Sustainability of Forests and Livelihoods through Improved Governance and Control of Illegal Logging for Economies in Transition". World Bank, Yerevan, Armenia.

Schwarze, S., Shippers, B., Weber, R., Faust, H., Wardhono, A., Zeller, M., Kreisel, W., 2007. "Forest Products and Households Incomes: Evidence from Rural Households Living in the Rainforest Margins of Central Sulawesi" In: Tscharntke, T., Leuschner, C., Zeller, M., Guhardjy, E., Bidin, A., (Eds.), The Stability of Tropical Rainforest Margins, Linking Ecological, Economic and Social Constraints of Land Use and Conservation. Springer Verlag, Berlin, 209-224.

Shiferaw, T., 2009. "Sun Energy Empowers Ethiopian Village", BBC News, July 16. http://news.bbc.co.uk/2/hi/8150391.stm.

Takasaki, Y., Barham, B.L., and Coomers, O.T., 2004. "Risk Coping Strategies in Tropical Forests: Floods, Illnesses and Resource Extraction. Environment and Development Economics 9(2), 203-224.

TED Case Study, # 708, 2003. "Alternative Fuel Sources in Nepal". http://www1.american.edu/TED/new-fuelwood.htm.

Transparency International, 2010, "Global Corruption Barometer 2010" Available at http://www.transparency.org/policy_research/surveys_indices/gcb/2010/in_detail.

United States Department of Agriculture, 1996. "UC Small Farm Program: Bees", University of California at Davis. Available at http://sfp.ucdavis.edu/pubs/brochures/bees.html.

University of Cambridge, 2005. "Project Proposal: Biogas Generator", India. Available at http://home.btconnect.com/engindia/biogas.htm.

Vardanyan N., and Sharoyan M., 2005. "Issues on the New Forest Code and National Forest Plan", Armenian Forests, NGO.

Vardanyan, Zh. and Sayadyan, H., 2005. "The Educational Methodological Aspects of the Development of Higher Forestry Education in Armenia", Bulletin of Armenian Agricultural Academy, N3, Yerevan, 7-8 (In Russian, resume in English).

Völker, M. and Waibel, H., 2010. "Do Rural Households Extract More Forest Products in Times of Crisis? Evidence from the Mountainous Uplands of Vietnam", Forest Policy and Economics 12(6), 407-414.

www.ecolur.org
www.antarner.net
www.news.am
www.hetq.am

About ENPI FLEG Program

The ENPI FLEG project supports governments of participating countries, civil society and the private sector in the development of sound and sustainable forest management practices, including the prevention of illegal forestry activities. Participating countries include Armenia, Azerbaijan, Belarus, Georgia, Moldova, Russia and Ukraine. This project is funded by the European Union.
www.enpi-fleg.org

Project Partners

European Commission

The European Union is the world's largest donor of official development assistance. EuropeAid Development and Cooperation, a Directorate General of the European Commission, is responsible for designing European development policy and delivering aid throughout the world. EuropeAid delivers aid through a set of financial instruments with a focus on ensuring the quality of EU aid and its effectiveness. An active and proactive player in the development field, we promote good governance, human and economic development and tackle universal issues, such as fighting hunger and preserving natural resources.

World Bank

The World Bank is one of the world's largest sources of funding for the developing world. Its primary focus is on helping the poorest people and the poorest countries. It uses its financial resources, its staff, and extensive experience to help developing countries reduce poverty, increase economic growth, and improve their quality of life.
www.worldbank.org

IUCN

IUCN, International Union for Conservation of Nature, helps the world find pragmatic solutions to our most pressing environment and development challenges. IUCN works on biodiversity, climate change, energy, human livelihoods and greening the world economy by supporting scientific research, managing field projects all over the world, and bringing governments, NGOs, the UN and companies together to develop policy, laws and best practice. IUCN is the world's oldest and largest global environmental organization, with more than 1,000 government and NGO members and almost 11,000 volunteer experts in some 160 countries. IUCN's work is supported by over 1,000 staff in 60 offices and hundreds of partners in public, NGO and private sectors around the world.
www.iucn.org

WWF

WWF is one of the world's largest and most respected independent conservation organizations, with almost 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the earth's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.
www.panda.org

FLEG
Forest Law Enforcement & Governance

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of **ICARE Foundation** and can in no way be taken to reflect the views of the European Union. The views expressed do not necessarily reflect those of the Implementing Organisations.

APPENDIX

Figure A1: Household Gas Supply, 2003-2009

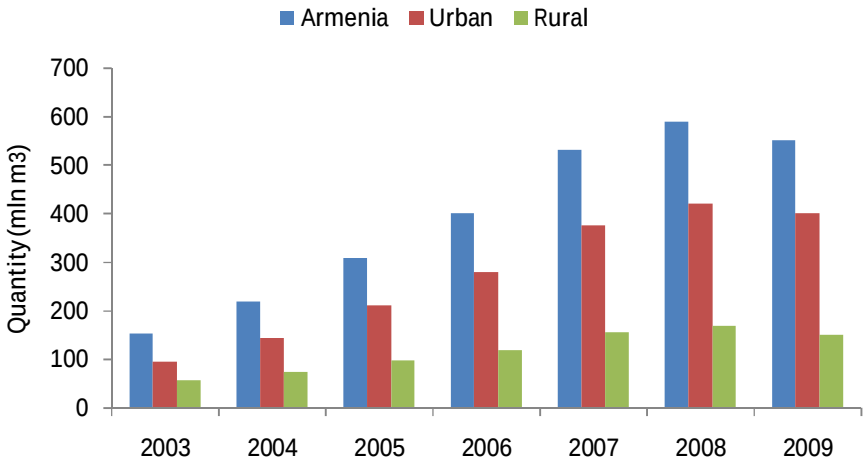


Table A1: Key Figures by Marz and Settlement Level, 2010

Marz	City / Town/ Village	Distance (Meters)	Number of Households					Firewood (m3/year)										Total Amount of Mains Gas Consumed (m3/year)	% of Households with Gas Connection	Average Price of Bottled Gas (AMD/m3)	Total Amount of Bottled Gas (m3/year)	Average Households Total Expenditure on Fuel (AMD/year)	Average Households Total Expenditure on Gas (AMD/year)	Average Households Total Expenditure on Fuelwood (AMD/year)
			Number of Households	Average Size of Households	Total Number of People Surveyed	Number of Households Who Do Not Use Fuelwood	Number of Households Who Use Fuelwood	Total Fuelwood Reported by Surveyed Households	Average Fuelwood Amount for All Surveyed Households	Average Fuelwood Amount for Households That Use Fuelwood	Average Fuelwood Price	% of Households Who Buy Fuelwood	% of Households Who Bring Fuelwood from Forest	% of Households Who Obtain Fuelwood from Own Orchards	% of Households Who Collect Fuelwood from Here and There	% of Households Who Use Old Furniture	% of Households Who Receive Fuelwood as Gift							
Aragatsotn	Aragatz	8,531	9.0	4.3	39.0	0.0	9.0	61	6.8	6.8	14,778	100%	0%	0%	0%	0%	0%	0	0%	667	695	171,922	57,967	97,222
Aragatsotn	Byurakan	1,944	10.0	3.6	36.0	1.0	9.0	43	4.3	4.8	13,667	40%	0%	50%	0%	0%	0%	9,455	60%	666	379	208,219	150,119	44,900
Aragatsotn	c. Aparan	1,966	10.0	5.5	55.0	8.0	2.0	5	0.5	2.5	7,500	10%	0%	10%	0%	0%	0%	12,063	100%	0	0	206,978	159,178	3,000
Aragatsotn	c. Ashtarak	9,210	24.0	4.3	103.9	16.0	8.0	35	1.5	4.4	9,625	17%	0%	25%	0%	0%	0%	27,653	83%	562	522	186,163	162,079	9,958
Aragatsotn	Yeghipatrush	1,389	7.0	6.4	45.0	3.0	4.0	32	4.6	8.0	12,250	57%	0%	0%	0%	0%	0%	0	0%	633	1,225	216,886	112,000	69,286
Aragatsotn Total			**60.0**	**4.8**	**278.9**	**28.0**	**32.0**	**176**	**3.5**	**5.3**	**11,564**	**37%**	**0%**	**20%**	**0%**	**0%**	**0%**	**49,171**	**60%**	**506**	**2,821**	**198,033**	**128,269**	**44,873**
Ararat	c. Ararat	18,130	18.0	4.7	85.0	10.0	8.0	38	2.1	4.8	13,187	39%	0%	6%	0%	0%	0%	12,266	67%	575	332	158,684	99,795	29,333
Ararat	c. Vedi	10,681	13.0	5.6	72.9	7.0	6.0	25	1.9	4.2	13,167	31%	0%	8%	0%	0%	0%	12,093	92%	825	144	174,677	155,146	25,077
Ararat	Shaghap	11,137	7.0	5.2	36.1	1.0	6.0	37	5.3	6.2	14,333	57%	0%	29%	0%	0%	0%	0	0%	627	835	142,957	80,671	50,000
Ararat	Surenavan	20,814	8.0	4.4	35.0	0.0	8.0	73	9.1	9.1	14,812	100%	0%	25%	0%	0%	0%	0	0%	712	897	226,550	79,175	135,625
Ararat	Vardashat	15,453	7.0	4.0	28.0	2.0	5.0	36	5.1	7.2	14,200	71%	0%	14%	0%	0%	0%	0	0%	700	300	130,571	29,857	76,429
Ararat	Vosketap	18,550	8.0	4.9	39.0	3.0	5.0	31	3.9	6.2	12,200	50%	0%	25%	0%	0%	0%	7,177	100%	0	0	151,672	118,172	51,500
Ararat Total			**61.0**	**4.8**	**295.9**	**23.0**	**38.0**	**240**	**4.6**	**6.3**	**13,650**	**52%**	**0%**	**15%**	**0%**	**0%**	**0%**	**31,536**	**52%**	**573**	**2,508**	**164,185**	**93,803**	**61,327**
Gegharkunik	c. Chambarak	5,321	10.0	5.5	55.0	2.0	8.0	72	7.2	9.0	10,625	80%	0%	0%	0%	0%	0%	1,058	30%	800	48	103,960	16,560	78,600
Gegharkunik	Daranak	45	5.0	4.2	21.0	0.0	5.0	42	8.4	8.4	8,600	60%	60%	60%	20%	0%	0%	0	0%	750	162	107,960	25,400	70,000
Gegharkunik	Martuni	0	6.0	4.5	27.0	0.0	6.0	42	7.0	7.0	11,750	83%	50%	0%	0%	0%	0%	5,096	100%	0	0	216,365	112,032	79,333
Gegharkunik Total			**21.0**	**4.7**	**103.0**	**2.0**	**19.0**	**156**	**7.5**	**8.1**	**10,325**	**76%**	**29%**	**14%**	**5%**	**0%**	**0%**	**6,154**	**43%**	**517**	**210**	**142,762**	**51,331**	**75,978**
Kotayk	c. Hrazdan	986	40.0	4.3	171.0	32.0	8.0	32	0.8	4.0	12,375	13%	3%	5%	0%	0%	0%	54,302	98%	420	72	188,125	175,100	10,550
Kotayk	c. Tsakhadzor	0	10.0	4.8	48.0	7.0	3.0	21	2.1	7.0	4,000	10%	0%	0%	0%	0%	20%	23,081	100%	0	0	314,400	304,800	9,600
Kotayk	Garni	5,134	13.0	5.2	68.0	3.0	10.0	75	5.8	7.5	13,779	8%	0%	77%	0%	0%	0%	13,185	100%	0	0	205,308	130,923	52,692
Kotayk	Geghadir	8,035	11.0	4.1	45.1	6.0	5.0	19	1.7	3.8	9,000	9%	0%	36%	0%	0%	0%	12,112	100%	0	0	178,255	130,618	11,000
Kotayk	Meghradzor	125	6.0	5.8	35.0	0.0	6.0	90	15.0	15.0	10,000	100%	17%	17%	0%	0%	0%	2,472	100%	0	0	191,667	91,000	114,167
Kotayk	Solak	1,301	10.0	4.0	40.0	4.0	6.0	38	3.8	6.3	7,833	40%	0%	40%	0%	0%	0%	8,308	60%	800	102	153,700	118,400	29,800
Kotayk Total			**90.0**	**4.7**	**407.1**	**52.0**	**38.0**	**275**	**4.9**	**7.3**	**9,498**	**20%**	**2%**	**23%**	**0%**	**0%**	**2%**	**113,460**	**94%**	**203**	**174**	**205,242**	**158,474**	**37,968**
Lori	Antaramut	242	8.0	4.8	38.0	0.0	8.0	64	8.0	8.0	2,125	100%	0%	0%	0%	0%	0%	772	25%	767	123	45,425	24,375	21,050
Lori	c. Akhtala	0	11.0	3.6	40.0	0.0	11.0	125	11.4	11.4	8,555	82%	18%	0%	9%	0%	0%	65	9%	785	402	135,671	31,671	93,273
Lori	c. Alaverdi	0	10.0	3.5	35.0	1.0	9.0	89	8.9	9.9	4,744	40%	50%	10%	0%	0%	0%	1,786	50%	683	212	83,644	38,308	28,900
Lori	c. Shamlugh	0	10.0	3.5	35.0	0.0	10.0	106	10.6	10.6	4,530	40%	30%	30%	10%	10%	0%	0	0%	783	560	102,880	41,080	53,200
Lori	c. Stepanavan	0	20.0	3.3	66.0	16.0	4.0	18	0.9	4.5	11,250	15%	5%	0%	0%	0%	0%	20,735	95%	0	0	151,311	138,061	10,250
Lori	c. Tashir	8,483	15.0	3.5	53.0	14.0	1.0	1	0.1	1.0	17,000	7%	0%	0%	0%	0%	0%	19,263	100%	0	0	173,476	169,542	1,133
Lori	c. Tumanyan	0	10.0	4.6	46.0	6.0	4.0	13	1.3	3.3	2,167	0%	40%	0%	0%	0%	0%	7,547	80%	0	0	112,904	99,604	3,300
Lori	c. Vanadzor	0	123.0	4.3	522.8	85.0	38.0	255	2.1	6.7	10,591	26%	2%	3%	0%	0%	0%	141,331	98%	0	0	169,425	141,759	20,057
Lori	Yeghegnut	8	8.0	2.6	21.0	0.0	8.0	54	6.8	6.8	7,125	50%	38%	13%	13%	0%	0%	0	0%	737	543	70,350	50,125	28,875
Lori	Margahovit	828	10.0	4.5	45.0	3.0	7.0	50	5.0	7.1	9,714	40%	30%	0%	0%	0%	0%	7,401	100%	0	0	159,398	98,918	48,600
Lori	Pambak	500	8.0	4.4	35.0	0.0	8.0	94	11.8	11.8	3,487	13%	88%	13%	13%	0%	0%	227	25%	762	147	89,438	48,500	40,938
Lori	Sverdlov	8,797	8.0	4.9	39.0	4.0	4.0	8	1.0	2.0	7,000	13%	0%	38%	0%	0%	0%	8,065	100%	0	0	129,500	125,500	4,000
Lori	Haghpat	189	6.0	4.8	29.0	0.0	6.0	98	16.3	16.3	8,000	67%	33%	17%	0%	0%	0%	0	0%	800	198	192,633	26,400	130,667
Lori	Tsaghashat	0	8.0	4.1	33.0	0.0	8.0	110	13.8	13.8	5,041	13%	88%	0%	0%	0%	0%	0	0%	750	280	94,825	26,825	66,875
Lori	Odzun	659	11.0	3.6	39.1	3.0	8.0	37	3.4	4.6	9,500	55%	18%	0%	0%	0%	0%	8,959	82%	700	120	150,909	115,091	34,182
Lori Total			**266.0**	**4.0**	**1076.7**	**132.0**	**134.0**	**1122**	**6.7**	**7.8**	**7,389**	**31%**	**15%**	**5%**	**2%**	**0%**	**0%**	**216,151**	**75%**	**451**	**2,585**	**124,119**	**78,384**	**39,020**

Table A1: Key Figures by Marz and Settlement Level, 2010 (cont.)

Marz	City / Town/ Village	Distance (Meters)	Number of Households					Firewood (m3/year)										Total Amount of Mains Gas Consumed (m3/year)	% of Households with Gas Connection	Average Price of Bottled Gas (AMD/m3)	Total Amount of Bottled Gas (m3/year)	Average Households Total Expenditure on Fuel (AMD/year)	Average Households Total Expenditure on
			Number of Households	Average Size of Households	Total Number of People Surveyed	Number of Households Who Do Not Use Fuelwood	Number of Households Who Use Fuelwood	Total Fuelwood Reported by Surveyed Households	Average Fuelwood Amount for All Surveyed Households	Average Fuelwood Amount for Households That Use Fuelwood	Average Fuelwood Price	% of Households Who Buy Fuelwood	% of Households Who Bring Fuelwood from Forest	% of Households Who Obtain Fuelwood from Own Orchards	% of Households Who Collect Fuelwood from Here and There	% of Households Who Use Old Furniture	% of Households Who Receive Fuelwood as Gift						
Syunik	c. Goris	0	25.0	4.3	107.0	9.0	16.0	130	5.2	8.1	11,000	48%	16%	4%	0%	0%	0%	24,729	88%	700	20	200,650	134,
Syunik	c. Kapan	0	46.0	3.9	180.0	25.0	21.0	178	3.9	8.5	9,800	28%	13%	11%	0%	0%	0%	34,509	89%	620	180	150,770	106,
Syunik	c. Meghri	469	9.0	3.9	35.0	2.0	7.0	48	5.3	6.9	12,286	78%	0%	11%	0%	0%	0%	0	0%	703	640	167,489	48,
Syunik	c. Qajaran	271	11.0	3.7	41.0	10.0	1.0	10	0.9	10.0	12,000	9%	0%	0%	0%	0%	0%	11,902	91%	600	240	212,296	156,
Syunik	Kaghnut	418	10.0	2.9	29.0	0.0	10.0	113	11.3	11.3	6,390	40%	70%	0%	0%	0%	0%	0	0%	651	528	85,840	33,
Syunik	Khndzoresk	0	10.0	4.1	41.0	0.0	10.0	83	8.3	8.3	11,000	80%	20%	0%	0%	0%	0%	4,470	100%	0	0	148,800	59,
Syunik	Shikahogh	0	10.0	2.9	29.0	0.0	10.0	130	13.0	13.0	5,850	50%	60%	10%	0%	0%	0%	0	0%	722	592	95,550	36,
Syunik	Tandzaver	0	10.0	3.5	35.0	0.0	10.0	209	20.9	20.9	2,460	10%	90%	0%	0%	0%	0%	0	0%	620	451	86,930	28,
Syunik	Vorotan Sisian	1,232	11.0	4.6	50.9	0.0	11.0	108	9.8	9.8	9,727	64%	0%	55%	0%	0%	0%	0	0%	768	557	145,018	35,
Syunik Total			**142.0**	**3.8**	**548.0**	**46.0**	**96.0**	**1009**	**8.7**	**10.8**	**8,946**	**41%**	**24%**	**10%**	**0%**	**0%**	**0%**	**75,610**	**58%**	**598**	**3,208**	**143,705**	**70,**
Tavush	Artsvabert	0	8.0	5.1	41.0	0.0	8.0	70	8.8	8.8	8,937	38%	63%	0%	0%	0%	0%	4,612	88%	800	60	163,500	81,
Tavush	Aygehovit	43	8.0	4.1	33.0	2.0	6.0	74	9.3	12.3	6,258	50%	25%	25%	0%	0%	0%	9,567	88%	700	100	209,618	166,
Tavush	Bagratashen	2,431	10.0	3.7	37.0	0.0	10.0	82	8.2	8.2	8,350	100%	0%	0%	0%	0%	0%	0	0%	800	482	97,690	38,
Tavush	c. Berd	0	9.0	4.4	40.0	0.0	9.0	112	12.4	12.4	6,580	78%	22%	11%	11%	0%	0%	1,182	22%	763	162	65,954	17,
Tavush	c. Dilijan	0	20.0	5.4	107.0	3.0	17.0	182	9.1	10.7	6,147	50%	35%	0%	0%	0%	0%	18,514	95%	0	0	163,571	124,
Tavush	c. Ijevan	0	18.0	4.0	72.0	7.0	11.0	89	4.9	8.1	7,091	50%	11%	6%	0%	0%	0%	17,440	89%	750	156	171,288	132,
Tavush	c. Noyemberyan	23	10.0	4.2	42.0	1.0	9.0	88	8.8	9.8	6,100	50%	40%	0%	0%	0%	0%	5,769	100%	0	0	123,620	74,
Tavush	Chinari	1,070	8.0	3.3	26.0	0.0	8.0	90	11.3	11.3	9,937	75%	38%	0%	0%	0%	0%	0	0%	700	70	117,375	6,
Tavush	Gandzaqar	0	10.0	5.0	50.0	2.0	8.0	82	8.2	10.3	6,730	40%	50%	0%	0%	0%	0%	7,962	80%	575	144	176,206	113,
Tavush	Haghartzin	0	8.0	4.9	39.0	0.0	8.0	102	12.8	12.8	4,350	13%	88%	0%	0%	0%	0%	1,696	63%	700	128	79,425	39,
Tavush	Koghb	38	8.0	5.0	40.0	1.0	7.0	68	8.5	9.7	5,886	38%	50%	0%	0%	0%	0%	7,850	100%	0	0	177,796	92,
Tavush	Sevqar	3,389	9.0	4.1	37.0	3.0	6.0	70	7.8	11.7	6,918	33%	33%	0%	11%	0%	0%	9,934	78%	800	72	203,603	152,
Tavush	Voskepar	152	8.0	4.5	36.0	0.0	8.0	147	18.4	18.4	7,187	75%	25%	0%	0%	0%	0%	0	0%	721	370	171,713	33,
Tavush Total			**134.0**	**4.4**	**600.0**	**19.0**	**115.0**	**1256**	**9.9**	**11.1**	**6,959**	**53%**	**34%**	**3%**	**1%**	**0%**	**0%**	**84,526**	**66%**	**562**	**1,744**	**147,797**	**82,**
Vayots Dzor	Areni	16,223	5.0	4.4	22.0	0.0	5.0	33	6.6	6.6	14,400	100%	0%	0%	0%	0%	0%	0	0%	700	384	162,360	53,
Vayots Dzor	c. Jermuk	0	7.0	3.1	22.0	7.0	0.0	0	0.0	0.0	0	0%	0%	0%	0%	0%	0%	5,681	100%	0	0	183,011	106,
Vayots Dzor	c. Vayq	10,951	8.0	5.1	36.0	5.0	3.0	8	1.0	2.7	5,000	13%	0%	25%	0%	0%	0%	15,199	100%	0	0	260,100	250,
Vayots Dzor	Chiva	14,271	6.0	4.3	26.0	0.0	6.0	31	5.2	5.2	12,333	50%	0%	50%	0%	0%	0%	0	0%	750	423	113,100	54,
Vayots Dzor	Eghegis	6,161	6.0	4.0	24.0	0.0	6.0	37	6.2	6.2	12,000	83%	0%	17%	0%	0%	0%	0	0%	633	460	139,833	43,
Vayots Dzor	Gndevaz	1,458	6.0	5.7	34.0	3.0	3.0	10	1.7	3.3	14,000	17%	17%	17%	0%	0%	0%	6,225	100%	0	0	151,707	136,
Vayots Dzor	Malishka	13,573	7.0	3.7	25.9	2.0	5.0	38	5.4	7.6	13,600	57%	29%	0%	14%	0%	0%	5,461	57%	850	208	198,429	127,
Vayots Dzor Total			**45.0**	**4.3**	**189.9**	**17.0**	**28.0**	**157**	**3.7**	**4.5**	**10,190**	**42%**	**7%**	**16%**	**2%**	**0%**	**0%**	**32,566**	**56%**	**419**	**1,475**	**172,649**	**110,**
Grand Total / Average			**819.0**	**4.33**	**3499.4**	**319.0**	**500.0**	**4391**	**5.4**	**8.8**	**9,083**	**39%**	**16%**	**10%**	**1%**	**0%**	**0%**	**609,174**	**68%**	**486**	**14,725**	**155,001**	**93,**

Figure A2: Estimated (Hypothesized) Demand and Supply of Fuelwood, 2003-2010

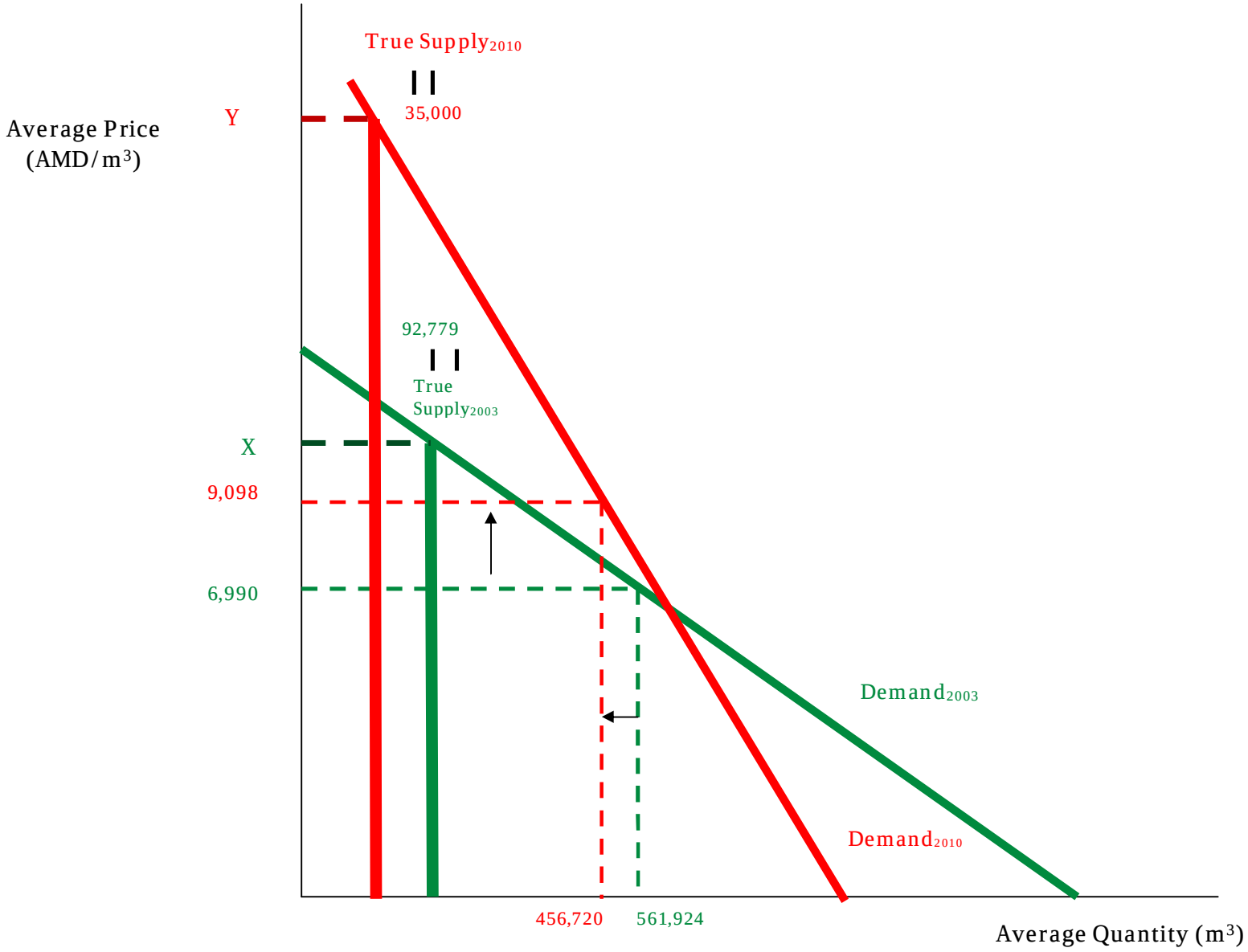


Figure A3: Fuelwood and Equivalent Gas Price (Current and Expected), 2003-2010