



## Armenia

### Markets 4 Meghri

Inception phase

(January – September 2010)

## Disaster Risk Reduction Assessment Report

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inter  
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## 1. Introduction

The objective of the present report is to introduce and analyze the existing natural hazards occurring in Meghri region which are likely to hamper horticulture production and might negatively affect the intervention of the rural development project “Markets for Meghri”. The objective of Markets for Meghri project is to contribute to the increase of production and access to markets for producers of specific fruits in the horticulture sector in Meghri and thereby to generate increased and sustainable income.

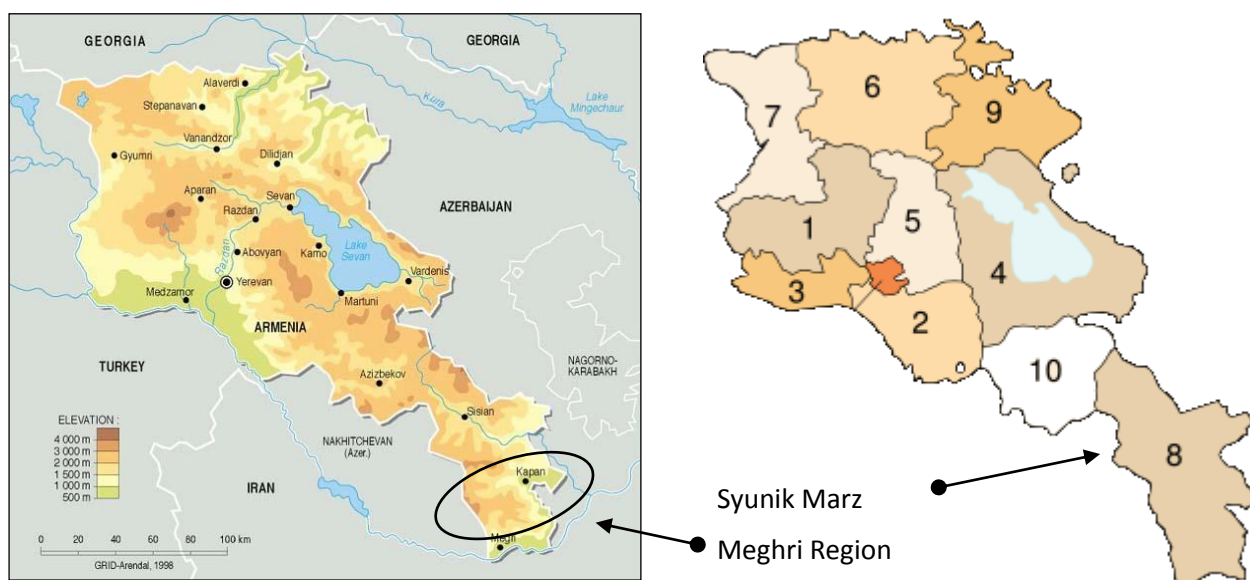
The region of Meghri is exposed to a variety of natural hazards – earthquakes, landslides, hail storms, frost, droughts, strong winds and floods – which threaten the communities and cause a considerable damage to their livelihoods and thus are a constant set-back of development efforts in the region. For this reason, disaster risk reduction (DRR) was selected as a transversal theme in the Rural Development Project.

A disaster risk assessment has allowed getting a better understanding of the current hazards in order to develop adequate measures and to promote a risk preventive culture in the project region. The purpose of this hazard assessment was to identify possible hazards which might inflict the project’s horticulture activities; in other words, to identify measures which positively contribute to increase the resilience of the population in the project area.

### Geography and climatic condition

The country is land-locked in the South Caucasus region, bordered on the north and east by Georgia and Azerbaijan, and on the south and west by Iran and Turkey. Armenia is a typical mountainous country. Around 90 percent of its territory is located at altitudes of about 1,000 m above sea level of which 40 percent are located above 2,000 meters. Because of its highly fragmented terrain, almost half of the territory is not suitable for settlements and economic activities. Armenia is characterized by distinctly underlined vertical distribution of six main types of climate – arid sub-tropical to high mountainous – and the corresponding temperature contrasts.<sup>1</sup>

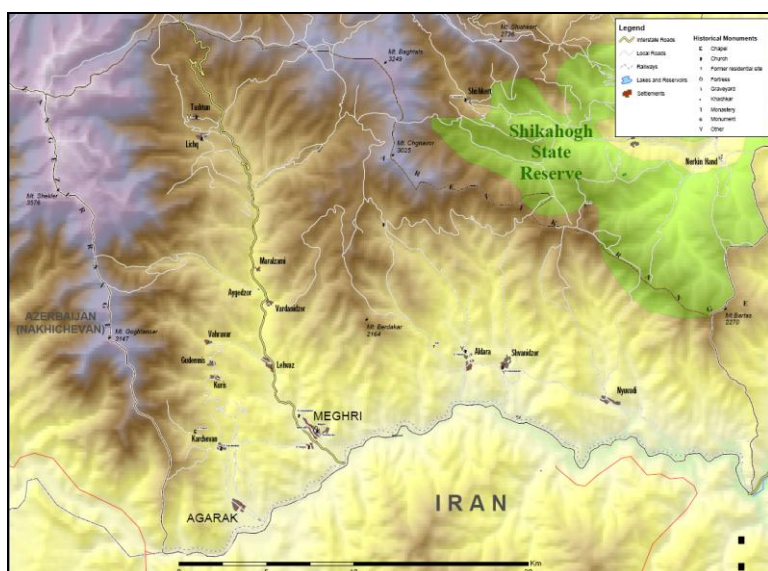
**Map 1: Armenia**



<sup>1</sup> United Nations Development Programme in Armenia, GEF

Meghri region, covering an area of 644 square kilometers, is located in the south of Armenia and part of the Syunik marz, the most southern Armenian province bordering Azerbaijan's Nakhichevan exclave to the west, the Karabakh region to the east and Iran to the south. The town of Meghri is nearly 400 kilometers far from the capital city of Yerevan separated by four high-mountain passes, which makes the region particularly remote from the main economic centres and markets. The area of Meghri region is fairly small compared to the other regions in Syunik and has only about 12,711 inhabitants. It encompasses 13 municipalities - 11 villages with a population of 2,811 and two towns (Meghri and Agarak) with together a population of 9,900.

**Map 2: Meghri region**



Meghri enjoys favourable climatic conditions, permitting the production of a rare variety of fruits – pomegranates, persimmons, figs, early varieties of apricots, peaches, cornelian cherries. 585 hectares are currently under cultivation for fruits (an increase of 29 percent from 2003 to 2007) and 60 hectares for vegetables (an increase of 16.6 percent). However, the region is characterized by a variety of hazards which can have a negative impact on the horticulture production:

Due to its geographical characteristics, **landslides** are a common phenomenon causing a considerable damage to the infrastructure (e.g. irrigation system, drinking water pipelines, and roads), but do not cause much harm to the horticulture production. **Mud and debris flows** are also quite typical in the region; 75 percent of mud flows occur in areas at the altitude between 1800 and 2000 meters. The number of days with **temperatures** above zero degrees Celsius is more than 250 in the towns of Meghri and Agarak, about 160 in the Araks riverside villages, and between 189 and 220 days in the central and northern regions. The amount of **precipitation** in the Araks riverside communities is about 300mm respectively between 400 and 700mm for the other communities<sup>2</sup>. On average, four **hailstorms** are annually registered in the central and northern regions respectively two in the south which can cause considerable damage to the horticulture production. In the Araks riverside area, the annual duration of a **dry period** is less than 60 days; in the area of the central and northern regions less than 30 days. The annual number of **dry wind days** in the Araks riverside area is about 80 and less than 40 days in the central and northern regions. Strong winds (east-west, south-north and northwest-southeast) frequently occur from February to June; however, they normally do not cause harm to the horticulture production.

<sup>2</sup> Armenian National Atlas, Yerevan (2007); Agricultural Atlas of the Soviet Armenia, Moscow - Yerevan (1984)

The presented climatic profile of Meghri clearly indicates that Meghri region is quite exposed to a variety of disaster risks; in other words, it entirely justifies that DRR has been selected as a transversal issue in the horticulture project. It is thus crucial to identify the types of hazards that can cause damage to the horticultural production. This requires a careful analysis of hazards occurring in the project region during the inception phase in order to take the necessary steps in the main project phase not to cause any negative set-back in the horticulture activities and, thereby, impede the successful implementation of the project.

The present report is structured as followed: after a short summary of the methodology, the main results of the different risk assessments are presented for the (i) central and northern region and (ii) Araks riverside areas. In a further step, existing secondary information about Armenia has also been considered and compared to the data collected during the workshops. The report ends with concrete recommendations for the main project phase starting in October 2010.<sup>3</sup>

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<sup>3</sup> The inception phase was extended until end of September 2010.

## 2. Methodology

For natural hazard assessment in Meghri region, the necessary data was collected through community workshops and field visits to the communities. In addition, the collected data was compared to the secondary information sources on climate change and disaster risk reduction.

Considering the geographical and climatic characteristics of Meghri region, a detailed risk analysis has been conducted for two particular regions:

- Communities of the central and northern area
- Communities of the Araks riverside

One-day workshops were held with each regional group. The workshop for central and northern communities was held in Vardanidzor (4th February 2010) where 27 community members (whereof three women) participated. In the case of the Araks riverside area, the workshop was held in Meghri (5th February 2010) which was attended by 31 participants (whereof four women). Both workshops were attended by community leaders and members. The representative of the Agricultural Support Centre (ASC), Gevorg Margaryan, was invited to the workshops as an expert.

In both the regions, a wide range of community members were invited to the workshop: men and women, younger and older community members, poor and extreme poor household representatives. According to the participants, the small number of female participants was due to the heavy snow on the days of the workshop. However, additional meetings were held with male and female groups in all 13 communities so that gender specific information could be collected. During the workshops and field visits, particular attention was given to the issue whether women are more exposed to some risks than men. Some of the below mentioned exercises were repeated during the field visits in order to collect gender specific information. For this reason, the exercises were done in female and male focus groups.

The workshop included the following exercises on disaster risk analysis:

- **Exercise 1:** Hazard analysis – Identification of natural hazards, their impacts and current coping strategies
- **Exercise 2:** Monitoring of natural disasters
- **Exercise 3:** Natural hazard seasonal calendar
- **Exercise 4:** Crop seasonal calendar
- **Exercise 5:** Assessment of each disaster impact
- **Exercise 6:** Group discussions based on specific questions

The different exercises and their results can be found in the annex (Annexes 1-3).

Prior to workshops, information on climate change (CC) and disaster risk reduction (DRR) for Armenia, particularly for Meghri region, was collected and analyzed. Information from the following sources was used: National Hydrometeorological Station in Armenia; Hydrometeorological Station in Meghri; reports about climate change and disaster risk reduction by government decrees, ministerial and state department; and geographical maps. The data from workshops were then cross-checked with the secondary data.

### 3. Hazard risk analysis

#### 3.1. Presentation of workshop results

Due to geographical diversity, the analyses were conducted for central and northern area and Araks riverside communities separately as previously mentioned. The two regions can be characterized as followed:

- **Central and northern area:** Central and northern area encompasses seven villages – Tashtun, Litchq, Vardanidzor, Lehvaz, Vahravar, Goudemnis and Kouris. Five of them are located at an altitude between 900 and 1,350 meters within a distance of less than ten kilometers from each other. Common horticulture products are apricot, peaches, grapes, walnut; in the villages of Lehvaz and Vardanidzor pomegranate, persimmon and fig are also cultivated. Tashtun and Litchq are located at an altitude between 1800 and 2000 meters and have only few horticulture products like apple, pear and walnut.
- **Araks riverside:** The Araks riverside area encompasses four villages – Kartchevan, Alvanq, Shvanidzor and Nrnadzor – and the two towns, Meghri and Agarak. All these communities are located at an altitude of about 550 meters within a distance of maximum 25 kilometers from each other; they all belong to the same climatic zone. Horticulture is the main occupation of these communities. Pomegranate, persimmon and fig are the main products.

The following information summarizes the results of different exercises and expresses the participant's observations, opinions and suggestions.

##### 3.1.1. Central and northern area

###### Hazard analysis

According to the community members, the following natural hazards, ranked according to their severity, are the most common in the central and northern area:

- Frost
- Hail-storm
- Drought
- Floods and overflowing
- Landslide

Considering the natural hazard seasonal calendar there are only four months without the occurrence of any hazards in the central and northern area (January, September, October and November). The three main hazards mainly occur during seeding and harvesting period of the production which explains their destructive impact on the horticulture production.

Various exercises also emphasize that all the seven villages are exposed to frost. Lehvaz, Karchevan, Vahravar and Vardanidzor communities suffer from frost in particular as the vegetation and blooming period of fruit trees falls into the period of spring frost, namely between March and April. April was indeed considered as the most critical month according to the participants. In the northern villages, the trees only start blooming in May when frosts hardly ever occur, so that their apple and pear trees get affected seldom.

**Hail storms** do most damage Lichq, Tashtun and Vahravar communities whereas the communities of the central zone are mainly affected by **droughts**.

To conclude, the occurrence of the three hazards gives the following pictures:

- **Frosts** occur in April once in about two year's time, causing severe damage; about 55 percent of the households are affected.

- **Hail storms** occur twice a year with mid-level severity and do the most damage in May and June. About 40 percent of households are affected.
- **Droughts** occur once in 2-3 year during May, June, July and August. The impact is rather weak and about 30 percent of households are affected.

In the second stage, the participants were asked to identify the three main impacts for each hazard as well as the corresponding current coping strategies the community relies on. The following answers were given.

**Table 1: The three major hazards, their impacts and coping strategies**

Hazards	Impacts	Current coping strategies
Frost	Loss of the harvest	Deep pruning
		Fertilization and intense irrigation
		Fuming/Smoking
		Use of warning information (meteorological forecast)
	Loss of next year's harvest	Deep pruning
		Fertilization and intense irrigation
	Complete destruction of several trees (subtropical)	Planting of new trees
Intense irrigation		
Hail-storm	Loss of the harvest	Deep pruning
		Intense fertilization and irrigation
		Chemicals against plant pests and diseases
		Anti-hail measures
	Loss of next year's harvest	Intense fertilization and irrigation
		Chemicals against plant pests and diseases
	Loss of the fruit's commercial look	Intense fertilization and irrigation
Drought	Loss of harvest	Hoeing
		Intense irrigation
		Fruit thinning
		Mulching
	Reduction of next year's harvest	Intense irrigation
		Intense fertilization
	Loss of the fruit's commercial look	Intense irrigation



		Fruit thinning
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## **Impacts**

### **Frost**

Spring frosts occurring in the vegetative and blooming period can totally destroy the annual harvest or essentially decrease it (up to 80-90 percent). During spring frosts, the trees which are in the stage of blooming get damaged. Fig, persimmon, pomegranate, walnut, grape and apricot trees suffer the greatest damage. According to the Armenian HydroMetereological station, the temperature on the ground surface is about one to two degrees Celsius lower and frost lasts longer than at the height of two or more meters so that younger trees and their flowers are exposed to a higher risk of frost. The severity of frost also depends on the location of the orchard, the wind strength and direction. This information was confirmed by examples described by the workshop participants explaining that some part of their orchards got affected by frosts while others did not.

It was also observed that spring frosts do more harm Vardanidzor, Lehvaz and Vahravar communities whereas the horticulture production in Gudemnis, Kuris, Tashtun and Lichq are less affected as they are located in high mountainous areas where subtropical trees do not grow and the vegetative and blooming stage of trees start about 20 to 30 days later (see Annex 6).

In case of severe winters and long-lasting frost, low branches of trees and sprout seedlings are damaged resulting in the loss of the next year's harvest. Due to such severe winters, the trunks of fig, pomegranate, and persimmon (to a lesser extent) are damaged. As a consequence, the trees need about four to five years to recover.

### **Hailstorm**

According to the participants, hailstorms can cause great damage, though they occur rarely in this area. This information was also confirmed by the Armenia HydroMeterological data stating that hailstorms are of medium strength and 1.2 hailstorms are registered per year.

If the branches and the sprouts of the trees are damaged, the harvest of the following year decreases. Under such circumstances, the fruits can only be sold for a much cheaper price (about 2-3 times cheaper) or cannot be sold anymore due to their damaged appearance.

### **Drought**

As a consequence of the drought, the nutrition of the trees is badly affected so that the fruit remains rather small and loses its commercial look. Consequently, they can only be sold two or three times cheaper or cannot be sold anymore. In case of a heavy drought, the trees can completely dry out.

## **Current coping strategies**

Current coping strategies mentioned by the participants are mainly based on traditional measures passed on from generation to generation. Most coping strategies which require financial investments are only applied by a few producers. Fertilizers and pesticides are either unavailable in Meghri region, of bad quality or too expensive. Some other coping strategies mentioned by the participants such as anti-hail activities or the use of weather forecast information are hardly applied for various reasons. In some regions, anti-hail activities are provided by the government; however, Meghri region has not yet profited from this service. In case of the early warning system, information dissemination in Meghri region has also not functioned yet in an organized manner.

It is striking that many of the coping strategies applied are used for a variety of impacts. It gives the impression that the measures are not carefully chosen and are not the most efficient and appropriate ones and thus do not have the expected positive impact of reducing the vulnerability of the communities.

To conclude, various exercises clearly show that the coping responses by the farmers are rather limited and in some cases not appropriate. The producers in Meghri region have hardly developed effective coping strategies and do not apply new methods and technologies to cope with natural hazards.

All the results of the exercises for the central and northern area can be found in annex 2.

### 3.1.2. Araks riverside area

#### Hazard analysis

At the beginning of the workshop, the participants mentioned all the possible natural hazards that occur in their communities.

- Frosts
- Hailstorms
- Floods
- Droughts
- Landslides
- Lightning

The natural hazard seasonal calendar shows that the months of February, October and November are the only months without the occurrence of any hazard.

Mapping of the most common hazards entirely confirms that frosts, droughts and floods cause major damages to all communities in the Araks riverside area. The most severe damage is caused by **frosts** mainly because the flourishing period of most fruit species occurs during the frost period (March to April) (see annex 6). Further, winter frosts are seldom; however, they can cause a major damage to pomegranate, persimmon and fig trees which are of high importance to the country. In case of hail, Agarak is the only location where no particular damage is caused.

To conclude, the occurrence of the four hazards gives the following pictures:

- **Frosts** occur once in two years during January, March and April and can cause significant damage to the horticulture production; about 60 to 70 percent of households are affected.
- **Hail storms** occur every year during May and August; they are of medium intensity and cause damage to about 40 percent of households' orchards.
- **Droughts** are typically not severe and occur once in two years. They mostly occur during July, August and September. 40 to 50 percent of households suffer from this natural hazard.
- **Floods** are not heavy; they occur on average once in two years, mainly between May and June. 30 percent of the households are affected by these floods.

Based on intense discussions, the community members selected the four most severe natural hazards which occur frequently and have the strongest impacts on their horticulture activities.

**Table 2: The four major hazards, their impacts and coping strategies**

Hazards	Impacts	Current coping strategies
	Loss of the harvest	Deep pruning and further forming
		Fertilization (NPK – Natrium, Phosphorus, Potassium fertilizers)
		Intense irrigation

<b>Frost</b>		Fuming/Smoking
		Chemical against plant pests_and diseases
	Withering of trees	Intense irrigation
		Fertilization
		Chemical against plant pests_and diseases
	Loss of next year's harvest	Intense irrigation
		Fertilization
		Chemical against plant pests_and diseases
	<b>Hail-storm</b>	Loss of the year's harvest
Chemicals against plant pests and diseases		
Intense irrigation		
Partial loss of next year's harvest		Intense irrigation
		Chemicals against plant pests and diseases
Loss of marketable state		Intense irrigation
Destruction of newly planted trees		Planting of new trees
		Intense irrigation
<b>Drought</b>		Partial loss of harvest
	Cleaning of brooks	
	Mulching	
	Drop-by-drop irrigation	
	Partial withering of several types of trees	Intense irrigation and cleaning of brooks
		Drop-by-drop irrigation
	Loss of the fruit's commercial look	Intense irrigation
<b>Floods</b>	Demolition of water canals and field tracks	Construction of bank protecting layers
		Planting of field protecting and bank protecting forest layers trees
	Washing away and destruction of humus layer of soil	Planting of field protecting and bank protecting forest layers trees
		Intense fertilization
	Loss of harvest and demolition of	Planting of new trees

	orchard trees	
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### **Impacts**

In general, the impacts mentioned by the communities of Araks riverside region mostly correspond to the answers given by the communities of central and northern region. For this reason, only the additional information in particular is mentioned below.

The communities of the Araks region suffer more seriously from spring frosts as orchards of fig, pomegranate and persimmon are very common to this region.

The geographical mountainous condition of Meghri region creates favourable conditions for floods which not only cause considerable damage to the horticulture production, but also make roads to commercial centres inaccessible.

### **Current coping strategies**

Current coping strategies mentioned by the participants of this workshop are also similar to those mentioned by central and northern communities. Instead of creating favorable conditions or implementing preventive activities to minimize the impact of expected natural hazards, current coping strategies are rather focused on minimizing and coping with the consequences already caused by these natural hazards.

Regarding coping strategies for floods, the participants have mentioned some measures; however, they have so far not been applied, mainly due to financial constraints.

To conclude, it becomes obvious that the communities do not have efficient coping strategies and rather act after a natural disaster has occurred instead of developing planned preventive measures.

The results of all the exercises of Araks riverside region are attached in Annex 3.

### **3.1.3. Gender specific information collected through female and male focus groups**

One of the objectives of hazard assessment was to investigate whether men and women are differently exposed to certain hazards. For this reason, the impact of each hazard on different social groups was defined by means of female/male focus group discussions during field visits to all 13 communities. In addition, semi-open questions were discussed in focus groups. In general, the answers about hazards and their intensity given by male/female focus groups corresponded to the information collected during the workshop with community representatives.

Both male and female groups shared the opinion that families with many children, elderly members, those with no additional income besides horticulture, refugees and single mothers are the most vulnerable to natural hazards and their impacts. Further, both groups mentioned the financial setbacks for families which are caused through the impacts of hazards. Female respondents particularly emphasized the reduction of spending on health care and education for families due to the impact of natural disasters. For example, they only make use of health services in case of emergencies. They cannot afford preventive or long-term and qualified treatments for chronic diseases. In terms of education, families cannot afford to pay for the tuition so children often have to drop school; in other cases, they simply do not apply to a college or university after high school for the same reason. Family members also leave the villages in order to substitute the loss of income or borrow money which often is an additional burden for female family members who are left behind.

To conclude, comparing responses of male and female focus groups, there is no obvious evidence that women are essentially more exposed to hazard impacts than men. If there is any difference, it is conditioned by the roles of men and women in the household. Since it is women that take care of food, clothing, health and education problems, they become more vulnerable when the family budget is reduced.

The detailed answers collected with male and female groups can be found in Annex 4 and 5.

## 3.2. Analysis of workshop results

### 3.2.1. Short summary of secondary climate change information

Prior to the analysis of the results of workshops and field visits, secondary information on climate change (CC) and natural hazards has been analysed. Having ratified the UN Convention on Climate Change in 1993, Armenia has conducted various climate change analyses: National Communication (approved in 1998); different studies under the Global Facility for Disaster Reduction and Recovery (GFDRR).

In regard to natural disasters, from 1975 to 2006, the total quantity of natural hazards such as frosts, hailstorms, heavy rains and strong winds increased by 13 to 15 percent according to Armhydromet<sup>4</sup>. Hailstorms are among the greatest natural hazards for the agricultural sector — average annual losses are between US\$ 30 to 40 million<sup>5</sup>. Some 368 villages are located in hailstorm hazardous areas<sup>6</sup> and an estimated 15 to 17 percent of Armenia's agricultural area suffers from hail damage<sup>7</sup> (c.f. GFDRR 2009: Disaster Risk Reduction and Emergency Management).

Particularly in Meghri, significant reduction of precipitation has been reported during the summer months, where rainfall has reduced by 60 percent in June. The number of summer days with a daily maximum above 25 degrees Celsius has significantly increased by 10 during the same period in Meghri.

The hazard matrix developed for Armenia's ten marzes and Yerevan city, nicely confirms that besides droughts, hailstorms are presented as one of the major hazards in Syunik which has been strongly confirmed by our workshop participants.

**Table 3: Hazard Matrix by marzes and Yerevan City**

Marz	HAZARD											
	Earth quake	Hail storm	Flood	Land slide	Chem. waste	Snow	Flash flood	Cold	Swamp	Wind	Dro ught	Ave rage
Yerevan	1	0.35	0.7	0.7	0.35	0.35	0.35	0	0.35	0	0	0.37
Shirak	1	0.7	0.7	0.35	0.7	1	0.7	1	0.7	0.7	0	0.68
Kotaik	0.7	0.35	1	0.7	0.35	0	0.7	0.7	1	1	0	0.59
Vayots Dzor	0.7	0.7	0.7	1	1	0.35	0.7	0	0	0.7	0	0.53
Armavir	0.35	0.7	0.35	0.35	0.7	1	0.7	0.7	0.7	0	0	0.5
Ararat	0.7	0.35	0.35	0.7	0.7	0.7	0.35	0.35	0.35	0	0.35	0.44
Lori	0.7	1	0.7	0.7	0.35	0.35	0.7	0	0	0	0	0.4
Syunik	0.35	0.7	0.35	0.35	0.35	0.7	0.35	0	0	0	0.7	0.35
Aragatsotn	0.35	0.35	0.35	0	0	1	0.35	0.35	0	0	0.7	0.31
Gegharkunik	0.35	0.7	0.35	0.35	0.7	0	0	0.35	0	0.35	0.35	0.31
Tavush	0.35	0.7	0.35	0.35	0.35	0	0.35	0	0	0	0	0.22
<b>Average</b>	<b>0.6</b>	<b>0.6</b>	<b>0.53</b>	<b>0.5</b>	<b>0.5</b>	<b>0.49</b>	<b>0.47</b>	<b>0.31</b>	<b>0.28</b>	<b>0.25</b>	<b>0.19</b>	<b>--</b>

Each marz is assigned a rating: 0 indicates —no possibilityll; 1 indicates —dangerous to rate the potential for losses from each hazard (see Table 2).

Source: Developed by the Natural Hazards Assessment Network (NATHAN); GFDRR 2009

Regarding climate projection, recent studies reveal that Armenia's climate is changing. In general, an increase of 2.0 degree Celsius in temperature and a decrease of 10 percent in precipitations are

<sup>4</sup> The Concept of the Formation of Natural Disasters Forecasting and Preventive System in RA, Yerevan (2010)

<sup>5</sup> UNISDR (2005): National Report on Disaster Reduction in the Republic of Armenia for the World Conference on Disaster Risk Reduction, Kobe

<sup>6</sup> Armenian Red Cross Society, Contingency Planning Process, Final Document (Yerevan: Red Cross, 2007).

<sup>7</sup> Armenian Rescue Services, September 14, 2008 <<http://www.ema.am/En/ax.html>>.

expected in Armenia during this century. According to this scenario, the reserves of effective moist in soils will decrease by 15 to 20 percent, vaporization will increase by 7 to 8 percent, natural moist in plants will reduce by 15 to 20 percent, water resources will diminish by 15-20 percent<sup>8</sup>.

As a consequence of the changing climate, the frequency and intensity of natural hazards have undergone and will undergo particular changes. For example, the number of floods with lower quantities of sediments will decrease, and the number of floods with higher quantities of sediments will increase. Regarding droughts, since the quantity of precipitations tends to decrease and, as a result, effective moist in soils will be reduced, the probability of drought frequency and intensity will increase<sup>9</sup>.

### 3.2.2. Conclusion of workshop results

Through various participative workshops in all 13 villages/towns of Meghri, data about existing natural hazards that are likely to hamper the horticulture sector was collected for central/northern and Araks riverside areas. This information was cross-checked with secondary information available about Armenia.

The workshops included the following exercises: **hazard mapping** (defining the hazards according to their geographic occurrence); **hazard seasonal calendar** (defining the seasonal occurrence of hazards); **crop seasonal calendar** (defining the seasonality of crops); **an impact assessment of each hazard** (defining impact of each hazard on horticulture and incomes of producers) **and current coping strategies**.

The identified **natural hazards** for Meghri region – frost, hail storm, drought and flood (only in the case of the Araks riverside area) – are fully in line with the secondary information available about Armenia. As Meghri region occupies a rather small area, the **impacts** of some natural hazards like frosts or droughts affect almost all communities in Meghri region. The disastrous impact of frosts entirely corresponds to the information given at the national level (c.f. 3.2.1). Nevertheless, the level of damage caused by hazards is different depending on the specific local conditions.

The reduction of harvests and of the marketing potential of fruits have **direct impacts** on the livelihoods of fruit producing households, namely: reduction of income, savings on food (chose lower quality food), reduction of spending on health care and education, family members leaving the villages in order to substitute the loss of income, spending of household savings or borrowing money.

In general, the impacts of natural hazards on the horticulture in Meghri are similar to the impacts of those on horticulture in other regions of Armenia. The only difference is that the types of fruit growing in Meghri, such as pomegranate, persimmon and fig, are more sensitive to frost damage. However, it is important to emphasize that there has been a tendency to exaggerate about the impacts of hazards during the workshops and sometimes the answers given were very emotional and subjective which results that there is some controversy about qualitative and quantitative observations shared by the participants. For instance, based on the data provided by Armhydromet, the hail storm occurrence rate is 1.2, whereas according to the workshop participants from central and northern areas it was estimated to be about 2.0.

These controversies have the following roots: The secondary information available does not particularly focus on horticulture production. Further, the secondary data about Meghri region is rather scarce as there is only one hydrometeorological station operating in the town of Meghri<sup>10</sup>.

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<sup>8</sup> United Nations Development Programme in Armenia, GEF Armenia (2003): Country Study on Climate Change. Phase II.

<sup>9</sup> Global facility for disaster reduction and recovery Armenia (2009): Institutional arrangements for Disaster risk management and reduction.

<sup>10</sup> There used to be three stations in the region (Meghri, Lichq, Shvanidzor) in the 1990s.

Last but not least, **current coping strategies** applied by the population in order to minimize the consequences of natural hazards are traditional and based on people's experience. These are: intense irrigation (against frosts and droughts); deep pruning, fertilization (after frosts and hailstorms); heating through fuming/smoking and the use of meteorological forecasts (against frosts); hoeing, fruit thinning and mulching (against droughts); and construction of bank protecting layers and the planting of field and bank protecting trees (against floods). However, the communities can hardly afford to use modern methods or technologies to cope with the impacts of natural hazards due to financial and human constraints. In sum, the current coping mechanisms applied are often rather reactive instead of proactive measures.

## 4. Recommendations

Although Armenia was listed among the top 60 countries exposed to multiple hazards by the World Bank in 2005<sup>11</sup>, the conducted disaster risk assessment for Meghri region in the context of the „Rural Development Project“ has not particularly revealed a great exposure to natural hazards. The most frequent natural hazards, producers face in Meghri region are frost and hail, and to a lesser extent drought and flood (only in the Araks riverside areas). The impacts of these hazards were assessed from low to average, except for frost which rather needs to be ranked as high.

In case of **frosts and hails**, improved cultivation techniques and increased know-how among producers such as fruit trees varietal improvement, piloting of adequate anti frost machinery, establishing protective nets, etc. are crucial measures to be promoted to face these calamities. The project will in particular facilitate connections to appropriate and resistant varieties through collaboration with nurseries (e.g. technical advice, forecasting system). In addition, access to advisory service providers and input suppliers will be promoted. Access to advice will foster proper planning of the fruit season.

Against **droughts and floods** it will be important to introduce adequate varieties which can cope ideally with both drought and flood, not least to the fact that an increase (frequency and intensity) in more extreme events is to be expected in the upcoming years as clearly stated by secondary data (cf. 3.2.1). Further, there is already a tendency of decreasing precipitation which needs to be carefully considered for future horticulture activities.

Last but not least, the project will make sure that the communities are able to react to any other type of natural hazards occurring unexpectedly in Meghri region. In order to have certain awareness and capacities, adequate sensitization campaigns will be offered and thus contribute positively to the promotion of a preventive culture.

An additional concern of the project is to reduce any potential risk that could inflict any additional new risks. Particular attention needs to be paid to overexploitation of natural resources due to a hopefully growing demand in the intensification of horticultural practices. The pressure, for instance, on water resources and land use will be high. Therefore, the project will develop a specific **“do no harm”** approach to avoid problems such as soils salination and pollution through extensive use of chemicals or risky specialised farming. The following three areas will be closely monitored by the project as horticultural practices intensify:

1. **Water resources, irrigation and threats on drinking water:** The water resource is scarce in Meghri and the intensification of horticulture should not put the access to drinking water at risk. E.g. extension of orchards should not threaten the use and rehabilitation of the traditional water adduction systems (chahrezes) that have been refurbished with SDC investments.
2. **Intensive use of chemicals and management of residues in the soils:** Intensification of the production relies to some extent to an increased usage of chemical inputs (fertilizers, pesticides, insecticides, fungicides, etc.). The project will develop specific actions to ensure that these products are used appropriately without putting the environment and human health at risk, namely: development of a list of authorized chemicals in collaboration with the relevant authorities, development of specific trainings to be disseminated by service providers such as the Agricultural Service Centre and other private providers, facilitating linkages between the companies producing the accredited chemicals and the producers so that they would embed technical advice in the distribution of the product.

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<sup>11</sup> World Bank (2005): Natural Disasters Hotspot – A Global Risk Analysis



3. **Soil salinisation:** With frequent irrigation necessary in dry conditions such as those in Meghri, irrigation can cause salinisation. The project will analyse the water content in close collaboration with ASC and the local authorities and develop appropriate recommendations on irrigation in coordination with the local authorities responsible. In addition, a careful monitoring of the soils will be established.

Although no **gender-specific** characteristics in relation to natural hazard in the horticulture production have particularly been highlighted, the project will ensure that any planned intervention is gender responsive and sensitive to local knowledge.

## 5. ANNEX 1: Workshop exercises for the disaster risk analysis

### Part I. Hazard Analysis

#### 1. Exercise: Identification of natural hazards – impacts – current coping strategies

**Objective:** To identify the current natural hazards, impacts and coping strategies applied by the community members.

**Time:** 2 hours

**Material:** Paper, colour cards and markers

**Expected result:** table summarizing **all the hazards** occurring in the project region, their impacts and their current coping strategies

#### Main questions

1. What are the **natural hazards** currently affecting local communities and its horticulture production?
2. What are the **impacts** of these hazards?
3. What are the current **coping strategies** used to deal with the impacts (by the community members)?

#### Procedure

In this exercise, it is important to collect and record all the answers by the community members. Each answer will be written on a colour card. After having collected all the answers regarding the first question (natural hazard), the participants need to rate the hazards according to its intensity in the region, on the top the most severe hazard etc..

The same stepwise approach needs to be done for the second (impacts) and the third question (coping strategies). Do first collect all the answers regarding impacts for each hazard and then choose the three most severe impacts (based on a discussion among community members). After having selected three impacts for each hazard, do the same procedure for the coping strategies. Please use for the answers of each question different colour cards (see photo).



It is important that the facilitator does take in a passive role; only the answers by the community members should be considered and documented. In this exercises it is not the idea to present the information collected in official CC documents; it should reflect the community's perspective.

**Table:** Hazards, impacts and coping strategies (to be filled in after the exercise by the SHEN team)

Hazards	Impacts	Current coping strategies


## 2. Exercise: Hazard Mapping

**Objective:** To locate the affected areas by specific hazards within the project region.

**Time:** 1 hour

**Material:** Large size map of the location with general physical features – needs to be prepared by the SHEN team beforehand), scale, colour markers

**Expected result:** the hazards are clearly identified and located in the village and thus the most vulnerable regions highlighted in the map.

## 3. Exercise: Hazard seasonal calendar

**Objective:** To identify the periods of hazards/disasters occurring throughout the year (January to December)

**Time:** 1 hour

**Material:** Paper, scale, colour markers

**Expected result:** a table which identifies **all the hazards** occurring in the project region throughout the 12 months (identified in exercise 1).

### Procedure

The facilitator presents the lists of hazards identified earlier (exercise 1). (i) The participants are then requested to identify the months of occurrences of each of the hazards. (ii) Afterwards, the participants also visualize the intensity of the hazards in the respective months (use of a line/curve).

Hazard	J	F	M	A	M	J	J	A	S	O	N	D

## Part II. Impact analysis on horticulture production

### 1. Exercise: Crop seasonal calendar (to be done in male/female focus groups)

**Objective:** Local livelihood options and their seasonality dimensions

**Time:** 1 hour

**Material:** Paper, colour markers

**Expected result:** a table which identifies the different types of crops and their cycle throughout the 12 months (identified in exercise 1).

Type of crop (mark period of seeding, harvesting)	J	F	M	A	M	J	J	A	S	O	N	D

S= seed; H= harvest etc.

## 2. Exercise: Impact assessment by each hazard (to be done in male/female focus groups)

**Objective:** To get a first idea on the severity of the impacts by the hazards identified in the project region

**Time:** 1 hour

**Material:** Paper, colour markers

**Expected result:** a table highlighting **all the hazards** occurring in the project region according to its **intensity** and **frequency**

Hazard (to be taken from exercise 1)	Impact ( to be taken from exercise 1)	Severity of incidence (High, Medium, Low) (based on exercise 3 and 4)	Time of occurrence and frequency (based on exercise 3 and 4)	Which and how many households affected?	Other relevant information

*Notes: Level of intensity in column 3 can be determined considering criteria like type of impact and degree of losses, number of households affected, damage of physical facilities, damage by geographical coverage, social impact due to disaster/hazards etc.*

### 3. Exercise: Semi-open questions to be discussed in the male/female focus groups

**Objective:** To evaluate the information gathered in the previous exercises per male/female group to see whether women are more exposed than men to some risks.

**Time:** 1.5

**Person:** one facilitator in each focus group which writes down the most important elements

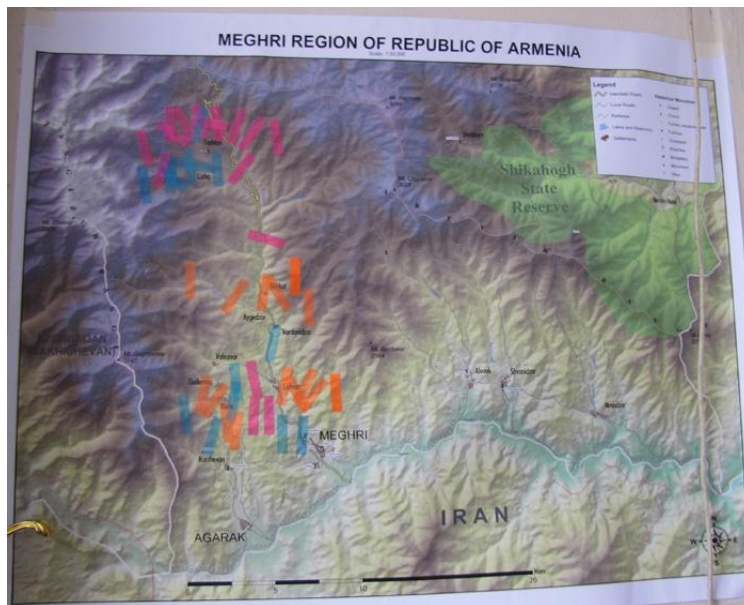
**Expected result:** To summarize the most important information and messages in the previous exercises and highlight the different impacts on women and men.

#### Some main questions

1. Do the answers/results of the exercises reflect the current situation in the project region? Please highlight the most important issues.
2. Is there any risk missing which has a particular impact on the horticulture production and/or on activities especially carried out by women?
3. What are the major challenges for you? Is there any social group who suffers most from these risks?
4. How can these challenges be overcome?
5. Questions coming up during the workshop

## 6. ANNEX 2: Disaster risk analysis Group 1 (Central and northern area)

### Hazard mapping



#### Legend

 Hail-storm

 Drought

 Frost-bite

#### Natural hazard seasonal calendar

Hazard	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Frost-bite		x	x	x								x
Hail-storm					x	x						
Drought					x	x	x	x				

#### Crop seasonal calendar

Type of crop, horticultural activities	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Cleaning of ditches				x	x							
Branch cutting				x	x							
Orchard dyking			x	x	x							

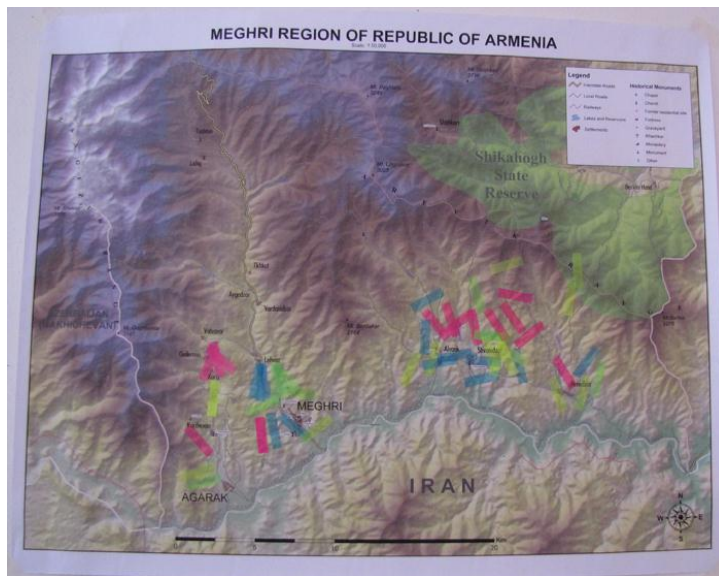
Blossom of trees			x	x	x							
Crop ripening						x	x	x	x			
Harvest						x	x	x	x	x		

### Impact assessment of each hazard

Hazard	Impact	Severity	Occurrence and frequency	Households affected (types and percentage)	Other information
Frost-bite	<ul style="list-style-type: none"> <li>- Loss of the harvest</li> <li>- Loss of next years harvest</li> <li>- Complete destruction of several trees (subtropical)</li> </ul>	Fierce	IV month  Once for 2 years	55 % of agriculturists and cultivators	
Hail-storm	<ul style="list-style-type: none"> <li>- Loss of the harvest</li> <li>- Loss of next year's harvest</li> <li>- Loss of the fruit's commercial look</li> </ul>	Average	V, VI months  Twice a year	40 % of agriculturists and cultivators	
Drought	<ul style="list-style-type: none"> <li>- Loss of the harvest</li> <li>- Reduction of next year's harvest</li> <li>- Loss of the fruit's commercial look</li> </ul>	Low	V, VI, VII, VIII months  Once for 2-3 years	30 % of agriculturists and cultivators	

## 7. ANNEX 3: Disaster risk analysis Group 2 (Araks riverside area)

### Hazard mapping



**Legend**

- Flood
- Drought
- Hail-storm
- Frost-bite

**Natural hazard seasonal calendar**

Hazard	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Frost-bite	x		x	x								x
Hail-storm					x	x	x	x				
Drought							x	x	x			
Flood					x	x						

**Crop seasonal calendar**

Type of crop, horticultural activities	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Preparatory activities for												



spring		x	x	x								
Blossom of trees			x	x								
Crop ripening					x	x	x	x	x	x		
Harvest					x	x	x	x	x	x		
Autumn activities										x	x	
Chemical struggle			x	x	x	x						

### Impact assessment of each hazard

Hazard	Impact	Severity	Occurrence and frequency	Households affected (types and percentage)	Other information
Frost-bite	<ul style="list-style-type: none"> <li>- Loss of the harvest</li> <li>- Withering of trees</li> <li>- Loss of next's years harvest</li> </ul>	Fierce	I, III, IV months  Once for 2 years	60-70% of agriculturists and cultivators	
Hail-storm	<ul style="list-style-type: none"> <li>- Loss of the harvest</li> <li>- Partial loss of next year's harvest</li> <li>- Loss of the fruit's commercial look</li> <li>- Destruction of new planted trees</li> </ul>	Average	V, VI, VII, VIII months  Once a year	40% of agriculturists and cultivators	
Drought	<ul style="list-style-type: none"> <li>- Partial loss of harvest</li> <li>- Partial withering of several types of trees</li> <li>- Loss of the fruit's commercial look</li> </ul>	Low	VII, VIII, IX months  Once for two years	40-50% of agriculturists and cultivators	
Flood	<ul style="list-style-type: none"> <li>- Demolition of water canals and field tracks</li> <li>- Washing away and destruction of humus layer of soil</li> <li>- Loss of harvest and demolition of garden trees</li> </ul>	Low	V, VI months  Once for two years	30% of agriculturists and cultivators	

## 8. ANNEX 4: Female focus group

### The impact of natural hazards (female focus group)

		Frost-bite	Hail-storm	Drought	Floods	Winds
Group 1	Meghri	average	average	-	-	-
	Agarak	fierce	average	-	-	average
	Karchevan	fierce	average	-	-	
	Nrnadzor	fierce	-	low	-	-
	Shvanidzor	fierce	average	low	average	-
	Alvanq	fierce	low	low	-	
Group 2	Lehvaz	average	average	low	-	-
	Kouris	fierce	average	low	-	low
	Goudemnis	fierce	average	low	-	-
	Vahravar	fierce	average	low	-	-
	Vardanidzor	average	average	low	-	-
	Litchq	low	low	low		
	Tashtun	low	average	low		

### What kinds of fruits suffer from natural hazards (female focus group)

	pomegranate	persimmon	fig	grapes	walnut	apricot and peaches	cherries and cornel	apples and pears
Meghri	+	+	+	+		+		
Agarak	+	+	+			+	+	
Karchevan	+		+			+		
Nrnadzor	+		+	+		+		
Shvanidzor	+	+	+			+		
Alvanq	+	+	+	+		+		
Lehvaz	+	+	+	+		+		
Kouris					+	+	+	+

Goudemnis				+	+		+	+
Vahravar					+	+	+	
Vardanidzor						+	+	+
Litchq								+
Tashtun								+

### What percent and which social groups suffer from natural hazards (female focus group)

	Communities	Social groups that suffer	Household affected (percentage)
G r o u p 1	Meghri	pensioners, those without additional jobs	30% (414 hh)
	Agarak	those who have orchards	65% (1008 hh)
	Karchevan	the families who don't have at least 1 member working at Agarak factory	40% (37 hh)
	Nrnadzor	refugees, elderly pensioners	50% (22 hh)
	Shvanidzor	poor families	40% (40 hh)
	Alvanq	all orchard owners	85% (95 hh)
G r o u p 2	Lehvaz	families with many children and single-parent families	50% (85 hh)
	Kouris	pensioners, families with many children	50% (20 hh)
	Goudemnis	single pensioners	20% (2 hh)
	Vahravar	pensioners	90% (22 hh)
	Vardanidzor	single mothers, families with many children, pensioners	80% (105 hh)
	Litchq	pensioners	5% (4 hh)
	Tashtun	pensioners	10% (3 hh)

### What new impacts of natural hazards may be mentioned (female focus group)

Communities	Natural hazard impacts
-------------	------------------------

G r o u p 1	Meghri	reduction of family income start to save on food by buying cheaper, thus, worse quality food
	Agarak	reduction of family income the living standard of the family drops not enough money for health care and recovery
	Karchevan	family savings are being spent seeking for alternativ sources of income husbands sometimes work far from the family
	Nrnadzor	reduction of family income youth outflow
	Shvanidzor	reduction of family income start to save on food the young leave the village
	Alvanq	reduction of family income children are deprived of the opportunity of getting education jewelry is being pawned the remainders of family savings are being spent
G r o u p 2	Lehvaz	reduction of family income children drop out of universities since can't afford to pay the tuition look for other sources of income
	Kouris	the elderly move to Agarak the village is being deserted
	Goudemnis	the income received from fruit sales decreases the elderly move to Agarak to join their children and the village is deserted (in wintertime, only 5 families( 9 people) out of 36 stay in the village)
	Vahravar	reduction of family income families can't afford to pay for their children's tuition the level of education drops
	Vardanidzor	reduction of family income less money is left to be used for children's education women try to find other jobs (to milk their neighbor's cows, work in their fields) do not rely on horticulture only; engage in      and look for other sources of income

	Litchq	reduction of family income not enough money to pay for heating in winter are obliged to sell the cattle
	Tashtun	reduction of family income not enough money to pay for heating in winter are obliged to sell their cattle

## 9. ANNEX 5: Male focus group

### The impact of natural hazards (male focus group)

		Frost-bite	Hail-storm	Drought	Floods	Winds	Land slides
G r o u p 1	Meghri	fierce	low	low	low	-	-
	Agarak	fierce	low	average	-	average	-
	Karchevan	fierce	average	-	-		-
	Nrnadzor	fierce	-	low	low	-	-
	Shvanidzor	fierce	fierce	low	average	-	-
	Alvanq	fierce	low	low	low	-	-
G r o u p 2	Lehvaz	average	average	low	-	-	-
	Kouris	fierce	average	low	-	-	-
	Goudemnis	fierce	average	low	-	-	low
	Vahravar	fierce	fierce	low	-	-	-
	Vardanidzor	average	average	low	-	-	-
	Litchq	low	average	low	-	-	-
	Tashtun	low	average	low	-	-	-

### What kinds of fruits suffer from natural hazards (male focus group)

	pomegrate	persimmon	fig	grapes	walnut	apricot and peaches	cherries and cornel	apples and pears
Meghri	+	+	+	+	+	+		
Agarak	+	+	+	+		+	+	+
Karchevan	+	+	+	+		+		
Nrnadzor	+		+	+		+		
Shvanidzor	+	+	+	+	+	+		
Alvanq	+	+	+	+		+		
Lehvaz	+	+	+	+	+	+		
Kouris					+	+	+	+

Goudemnis	+				+		+	+
Vahravar					+	+	+	
Vardanidzor						+	+	+
Litchq								+
Tashtun								+

### What percent and which social groups suffer from natural hazards (male focus group)

	Communities	Social groups that suffer	Household affected (Percentage)
1 g r o u p	Meghri	pensioners, those without side/additional jobs	40% (550hh)
	Agarak	orchard owners families with many children	60% (930 hh)
	Karchevan	the families who don't have at least one member working at Agarak factory	45% (40 hh)
	Nrnadzor	refugees, elderly pensioners	60% (26 hh)
	Shvanidzor	poor families	40% (40 hh)
	Alvanq	all orchard owners	90% (100 hh)
2 g r o u p	Lehvaz	single-parent families and families with many children	60% (102 hh)
	Kouris	pensioners,	60% (24 hh)
	Goudemnis	elderly pensioners, single pensioners	30% (3 hh)
	Vahravar	pensioners, the families whose only source of income is horticulture	85% (22 hh)
	Vardanidzor	refugees, single mothers, families with many children, pensioners	65% (85 hh)
	Litchq	pensioners	5% (4 hh)
	Tashtun	elderly pensioners	15% (6 hh)

### What new impacts of natural hazards may be mentioned (male focus group)

	Communities	Impacts of natural hazards
1 g r o u p	Meghri	family income drops borrow money start to save on food by buying cheaper and less qualified food put off house repair work
	Agarak	reduction of family income continuing education becomes harder not enough money for health care
	Karchevan	family savings are being spent In search for other sources of income, husbands often have to work far from their families
	Nrnadzor	reduction of family income youth outflow
	Shvanidzor	reduction of family income have to save on food the young are leaving the village
	Alvanq	reduction of family income children are deprived of education jewelry is pawned or sold the family savings are being used
2 g r o	Lehvaz	reduction of family income dropping out of universities because of unaffordable tuition look for other sources of income
	Kouris	the elderly are moving to Agarak the young are leaving the village the village is being deserted
	Goudemnis	the income received from fruit sales drops the elderly move to Agarak; in winter, there are only 9 people staying in the village
	Vahravar	reduction of family income families can't afford to pay tuition fees the level of education decreases
	Vardanidzor	reduction of family income less money is left to pay for children's education



u p		<p>not enough money for health care</p> <p>women are hired to work for wages</p> <p>do not rely on horticulture only; engage in cattle-raising and look for other sources of income</p>
	Litchq	<p>reduction of family income</p> <p>not enough money to pay for normal heating in the winter</p> <p>are obliged to sell their cattle</p>
	Tashtun	<p>reduction of family income</p> <p>the young are not able to marry and leave the village</p> <p>not enough money to pay for normal heating in the winter</p> <p>are obliged to sell their cattle</p>

## 10. ANNEX 6: Dates for tree blooming

### Approximate dates for tree blooming in Meghri region

Communities	pomegranate	fig	persimmon	apricot	peaches	apples	pears	walnut	grapes
Meghri	IV 20 – VII 7	IV 10– VI 20	V 10 – VI 10	III 20 – IV 5	IV 10– IV 25	IV 25 - V 5	IV 25- V 5	IV 15 - IV 30	V 25- VI 10
Agarak	IV 20 – VII 7	IV 10– VI 20	V 10 – VI 10	III 20 – IV 5	IV 10– IV 25	IV 25 - V 5	IV 25- V 5	IV 15 - IV 30	V 25- VI 10
Litchq	-	-	-	-	-	V 20- V 30	V 20- V 30	V 20- VI 5	-
Tashtun	-	-	-	-	-	V 20- V 30	V 20- V 30	V 20- VI 5	-
Vardanidzor	-	-	VI 10- VI 20	IV 10- IV 30	IV 10- IV 30	V 1- V 10	IV 25- V 10	IV 25- V 10	VI 10- VI 20
Lehvaz	V 1-VII 15	VI 15- VI 30	VI 15- VI 25	IV 10- IV 25	IV 10- IV 25	V 10- VI 20	V 10- VI 20	IV 25- V 10	VI 10- VI 20
Vahravar	-	-	VI 20- VII 5	IV 15- V 5	IV 15- V 5	V 10- V 20	V 15- V 25	V 15- V 20	VI 10- VI 20
Goudemnis	-	-	-	IV 20- V 10	V 5- V 15	V 15- VI 25	V 20- VI 1	V 1 – V 20	VI 10- VI 20
Kouris	-	-	-	IV 20- V 10	V 5- V 15	V 15- VI 25	V 20- VI 1	V 1 – V 20	VI 10- VI 20
Kartchevan	V 1- VII 15	VI 15- VI 30	VI 15- VI 25	IV 10- IV 25	IV 10- IV 25	V 10- VI 20	V 10- VI 20	IV 25- V 10	VI 10- VI 20
Shvanidzor	IV 20 – VII 7	IV 10– VI 20	V 10 – VI 10	III 20 – IV 5	IV 10– IV 25	IV 25 - V 5	IV 25- V 5	IV 15 - IV 30	V 25- VI 10
Nrnadzor	IV 20 – VII 7	IV 10– VI 20	V 10 – VI 10	III 20 – IV 5	IV 10– IV 25	IV 25 - V 5	IV 25- V 5	IV 15 - IV 30	V 25- VI 10
Alvanq	IV 20 – VII 7	IV 10– VI 20	V 10 – VI 10	III 20 – IV 5	IV 10– IV 25	IV 25 - V 5	IV 25- V 5	IV 15 - IV 30	V 25- VI 10