A Needs Assessment for Introducing Agricultural Insurance in Armenia in the Context of Climate Risk Mitigation

Attn: UNDP Armenia

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ACCRONYMS

Accronym	
ArmStat	Armenian Statistical Service of Republic of Armenia
AMD	Armenian Dram
ATP	Ability to Pay
CBA	Central Bank of Armenia
FAO	Food and Agriculture Organization
FSP	Financial Service Provider
GDP	Gross Domestic Product
Hydromet	Armenian State Hydrometeorological and Monitoring Service
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
KfW	Kreditanstalt für Wiederaufbau
MIN	Microinsurance Network
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organizations
UNDP	United Nations Development Program
WB	World Bank
WFP	World Food Programme
WII	Weather-based Index Insurance
WTP	Willingness to Pay
WWF	World Wildlife Fund for Nature

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Executive Summary

Armenian producers face several challenges to secure their household's income, food provision and an important economic contribution for Armenia. The impact of poor harvests may therefore be felt at different levels and is therefore important to address. Three of the main risks identified by Armenian producers are hail, frost and drought; they are common to many crops and regions. While these risks are not the only ones experienced, their financial impact may be partially addressed through risk transfer mechanisms, as part of a wider initiative to improve the resilience of farmers and sustainability of the agricultural activities.

An initial review of the information available in Armenia, of the stakeholders in both the agricultural, financial and public sectors and of the context of the agricultural production indicates that it may be possible to design insurance solutions for some of the risks faced by producers. The products' and programmes' designs may differ for each risk type in order to take into account the specificities of the risk, the data available and the financial sustainability of each potential model.

As a first step to offer insurance cover to Armenian producers, two products may be considered:

- An index-based product against frost using an extrapolation method for the temperatures at different elevations around the weather stations.
- A traditional cover for hail, pooling risks across areas and including innovative processes in order to reduce operational costs.

The index-based product as well as the hail cover may be offered through Public-Private Partnerships in order to optimize the public financial funds allocation required when offering agricultural insurance. Different levels of risk transfer may be envisioned and the financial structure may include communities, private insurers and reinsurers as well as national and local governments. Armenia should leverage the historical weather data and valuable knowledge available: Hydromet and agricultural experts should be closely involved in the design of the products. Availability of weather data and expertise should help Armenia start an agricultural insurance programme.

However, further analysis is required to determine the processes, insurance cover details and several challenges remain. The first one is to build capacity among private insurers and the public sector in order to ensure that all stakeholders contribute and take the best decisions toward the development of a national agricultural insurance programme. Currently-available weather and agricultural data constitutes a starting point and will have to be improved as it is incomplete: gathering data as the programme develops and refining assumptions will be crucial. Mountainous terrain and small landholding mean that substantial differences between regions and within regions will subsist, and that operational implementation has to be well thought: basis risk and operational expenses should remain limited to ensure attractiveness and sustainability of an agricultural insurance programme. It is well researched that climate change will significantly impact Armenia's climate thus farmers: expected rainfall and temperature trends have to be taken into account in the projections and insurance models. Furthermore, producers do not suffer only from weather-related risks but also from technical and market constraints. These last two points have to be addressed by a broader framework to support farmers through adaptation mechanisms, training and market development, which will be completed by an insurance protection. Finally, distribution challenges to reach a large number of farmers have to be overcome. Finding various channels to extend the insurance cover to the largest number of farmers will make the insurance programme more inclusive and more sustainable as it reaches scale. While initial covers may be limited in a first phase, the expansion to various products and regions can be considered in the in the long-term.

The government should take a leadership role in the design and implementation of agricultural insurance in Armenia. It already contributes to data collection and allocates some funds to relief but these contributions may be optimized and improved. In other countries, private players have struggled reaching small farmers without the support of governments. Therefore, the Armenian government has a significant role to play in endorsing agricultural insurance, contributing to infrastructure and data collection. But it may also support the development and provision of agricultural insurance in terms of distribution, linking risk carriers with intermediaries and communities. National and international agencies, public and private, should coordinate efforts and share knowledge during each step of the agricultural insurance development.

Introduction

With prospective climate change impacting the country considerably, the livelihood of a large proportion of Armenia's population—up to 75% in some marzes (provinces) work in the agricultural sector—is at risk. Any shock on agricultural production already has social and financial repercussions for both the population and the country as a whole; it impacts rural income levels, Gross Domestic Product (GDP), and, in the worst years, poverty rates. As part of the United Nations Development Program's (UNDP) work to support development and enhance climate resilience in Armenia, this study explores how agricultural (crop) insurance may contribute to climate risk management for the rural population.

The objectives of this assignment were to identify challenges for the introduction of agricultural insurance in Armenia and to propose a roadmap for the gradual implementation of the most adequate crop insurance programme in Armenia.

Based on national stakeholders' input and the review of available data and literature, this report details the challenges of implementing an agricultural (crop) insurance programme in the country due to the diversity of agricultural practices, the micro-climates, and the climate change context. However, assets are available in the country in terms of data and knowledge and may enable national stakeholders to overcome these challenges. After reviewing the existing insurance tools for crop insurance and the risk exposure of Armenian farmers, potential programmes, products, and risk transfer options are described. These solutions may be developed and implemented by the government and the financial sector, whose potential roles and activities are proposed as a roadmap for implementing crop insurance in Armenia. Finally, in order to test these concepts, a suggested UNDP pilot project is detailed, which would inform stakeholders and enable them to test the processes and impacts of such programme.

1. The Armenian context: challenges in delivering crop insurance and assets to be leveraged

Armenia combines geographic and economic specificities that will require a particularly tailored insurance solution for its agricultural producers and actors. On a relatively small territory, many small farmers produce mostly the following crops: cereals, horticulture[1] (including vegetables and orchards) and vineyards; half of he cultivated land is irrigated while the other half rain-fed thus relying on rainfall. Weather risks in this geography include frost, hail, and other meteorological phenomenon that are significantly impacted by climate change. Such a context represents a challenge for agricultural production and insurance delivery, but the long history of climatic data collection combined with local knowledge may support the development of a tailored insurance programme.

1.1 No comprehensive and affordable solution

Small farmers

Armenia is a developing economy with very little infrastructure. For historical and geographical reasons, it has a large number of small-scale low-income farmers, 339'300 as per official statistics.

An insurance programme's operational expenses for crop loss assessment have to remain limited in order to offer the client value and to ensure efficiency of an insurance programme. For risks that may impact a large number of farmers at once (risks that are not idiosyncratic), the costs of individual loss assessment would be too high and the assessment time too long for a programme to be sustainable.

The Armenian context therefore does not enable traditional insurance delivery for risks such as frost or drought; **an indemnity-based[2] insurance product would be too costly to deliver to the 339'300 Armenian farmers who only own 1.4 hectares (ha) of cultivated land on average[3]. Alternative designs should be explored to address this challenge.**

[1] Horticulture is the branch of agriculture that deals with the art, science, technology, and business of plant cultivation. It includes the cultivation of fruits, vegetables, nuts, seeds, herbs, sprouts, mushrooms, algae, flowers, seaweeds and non-food crops such as grass and ornamental trees and plants.

[2] See Section 2.1 for details on potential crop insurance products

[3] 1.1 Ha of arable land

Not all risks can be covered

The farmers are exposed to risks that go beyond weather and pests. They face challenges such as price variation, high input costs, financing costs, and lack of market access. Expensive and heavily subsidized programmes are offered to farmers in Western Europe, North America, and closer to Armenia in Cyprus and Israel for example. Even with high subsidies most insurance programmes do not provide comprehensive coverage. The table 1 shown in Annex 2 includes additional information that illustrates the costs and limitations of existing national agricultural insurance programmes.

Insurance coverage that remains affordable for the farmer (or other policyholder) and for the potential subsidy provider cannot include all risks. Some risks are therefore left out and born by the farmer depending on the product design (price, specific peril, pests, etc.). Coverage in low- and middle-income countries usually does not compensate for loss of income, but corresponds to a partial compensation (see Figure 1 below). **Consequently, a match between protection needs and perceived priorities is essential since not all risks can be covered when financial resources are limited.**

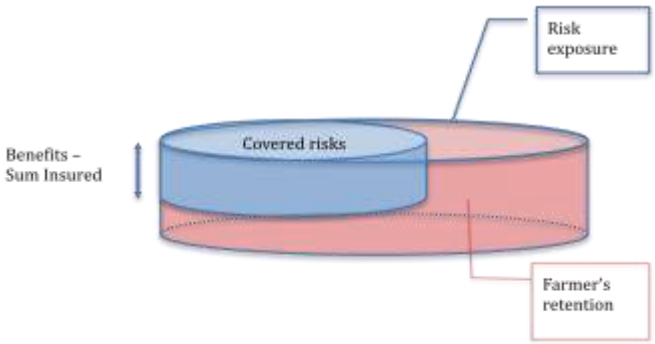


Figure 1. Illustration of the level of covered risk compared to the farmer's exposure [Source: *The emergence and development of agriculture microinsurance*, Sandmark and al.]

Furthermore, the yield and income may vary widely from one year to the other. The coverage for small but frequent yield variations would be too costly, as insurance coverage price is linked to frequency. **Initial coverage for Armenian farmers should thus be limited to large shocks, those that have a large impact on the farmer's livelihood.** In addition to the affordability criteria, this limited coverage may also help reduce adverse selection[4] and moral hazard[5] (see section 2.1, page 16). Other agricultural risks may be better addressed through other mechanisms than insurance (see section 3.1).

1.2 Implications of climate and crop diversity

Climate

While located in the northern part of the subtropical zone, Armenia's climate is classified as dry and continental. Since it is landlocked and surrounded by mountains, humid air does not reach the country. Its physical area is not very large (29 800km^2 with maximum distances of 300-350 km (north to south) and 200 km (east to west)), and its terrain is complex due to several mountain ranges. As a consequence, six climatic zones are encountered over a relatively small area[6], ranging from dry subtropical to dry continental. The variations are mostly linked to altitude, location, and the resulting changes in weather and seasons:

- Temperature and rainfall patterns vary greatly by elevation.
- Solar radiation and wind may be more important at higher altitude.
- Seasons start more or less early depending on altitude of location.
- Cold waves impact some regions more than others.

[4] Adverse selection refers to the tendency of higher risk individuals to seek out more insurance coverage on average in anticipation of a greater probability of experiencing the insured event(s). [Source: MicroInsurance Network Glossary]

[5] Moral Hazard is hazard arising from any non-physical, personal characteristic of a risk that increases the possibility of loss or may intensify the severity of loss for instance bad habits or low integrity. An example might include failing to properly care for an insured goat because it is insured, thereby increasing the chance it will die of disease.

[6] See maps in Annex n.1

Region and Marz	Altitude (meters above sea level)	Temperatures	Annual Rainfall
Mountainous region Marz: Shirak, Kotayq, Gegharkuniq, Aragatsotn, Vayots Dzor, Syuniq	1700m-2200m	16-18˚C (July) -8 to +9˚C (January)	500-700mm
Submountain region: Kotayq, Lori, Tavush, Aragatsotn, Vayots Dzor, Syuniq	1200m-1699m	22-24˚C (July) -4 to +5˚C (January)	300-400mm
Lowlands region: Ararat, Armavir, Tavush, Vayots Dzor, Syuniq	375m-1199m	26˚C (July) 1˚C (January) (-3˚C to 4˚C in the Ararat Valley)	250-300 mm (200-250 mm in the Ararat Valley)
Annual Armenian Average	1800 m	+5.5˚C average	592 mm

Table 1. Examples of weather patterns related to elevation

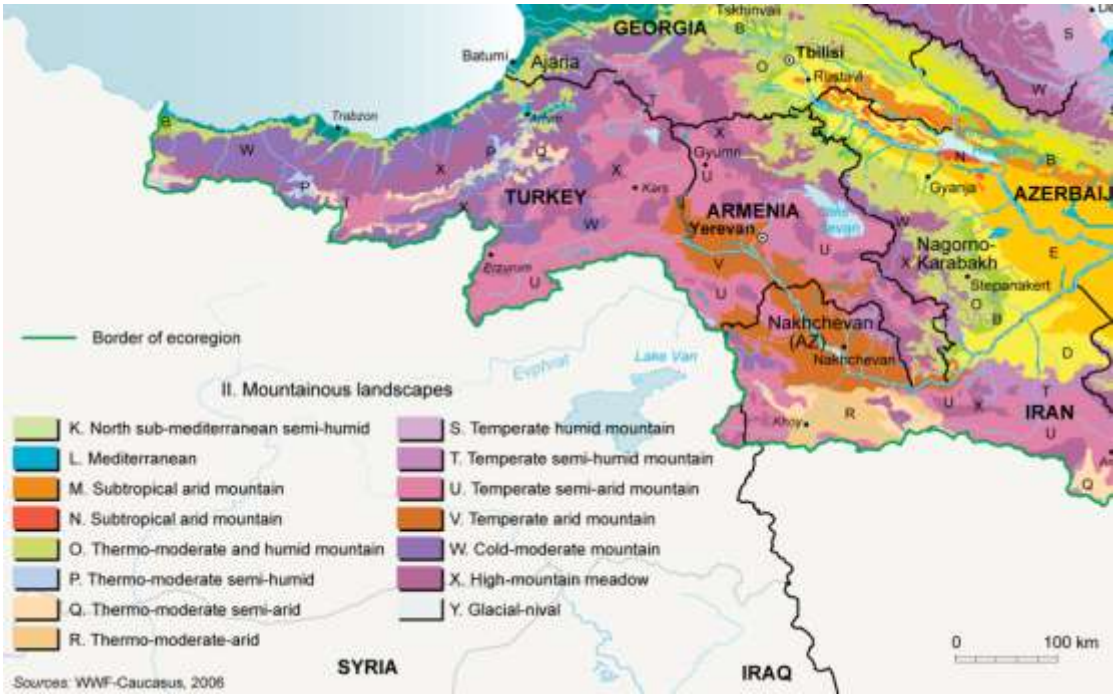


Figure 2. Climatic zones of Southern Caucasus [Source: WWF]

As illustrated by Table 1 and Figure 2 above, **the heterogeneous climates will require tailoring the insurance tool and its parameters to the climatic risk exposure by region since**, for example, temperature and precipitation levels vary greatly by altitude and location.

Agricultural Production

The heterogeneous climatic zones and the topography have led to an adaptation of agricultural production over centuries. The current main agricultural productions in Armenia are cereals, fruits, grapes, potatoes, and vegetables. Production is aimed at local consumption as well as the agro-industry; food transformation and exportation are an important economic sector in Armenia.

Crop	Main Production by Marz	National Production (1 000 tons)	Commercial Production Proportion	National Financial Value	Number of Farmers (Crop as Livelihood, 2012[7])
Fruit (excluding grapes)	**Aragatsotn, Ararat, Armavir,** Gegharkunik, **Kotayk**, **Tavush,** Syunik	332	63%	~100 M USD	11'000
Grapes	**Ararat, Armavir**, Tavush, Aragatsotn, **Vayots Dzor**	241	58%	88 M USD	6'000
Vegetables	**Ararat, Armavir,** Aragatsotn, Gegharkunik, Shirak	849	70%	N/A	60'000
Potatoes	**Gegharkunik, Shirak**, Lori, Aragatsotn, Armavir	647	26%	N/A	60'000
Grains and legumes	**Gegharkunik, Shirak**, Aragatsotn, Syunik, Lori	456	16%	Cereals: 123 M USD	60'000

Table 2. Production data [Source: ArmStat - Armenian National Agricultural University]

Fruit and vegetable production has further diversity that would have to be addressed in the insurance programme and product design. Armenian orchards and vegetable farms produce a wide range of products and varieties:

- Grapes (wine and table)
- Apples
- Plums
- Peaches
- Apricots
- Cherries
- Pears
- Strawberries
- Raspberries
- Watermelons, Melons
- Nuts/walnuts
- Eggplants
- Peppers
- Tomatoes
- Cabbage
- Cucumbers
- Carrots
- Onions
- Garlic

Each marz has primary crops on the list above. As each marz is at a different altitude and latitude, production cycles also differ amongst marzes.

As illustrated by Figure 3 below, each crop has a different production cycle. They may be vulnerable to different weather events depending on the date and location of the event. For example, spring frost is a greater risk in areas where spring conditions happen earlier and fruit trees start early blooming. The earlier it is in the spring, the more likely frost could happen; buds and flowers could freeze and get damaged as a result. **The design of the insurance tools will have to take into account the different production cycles and regions, particularly the coverage period and weather risks.**

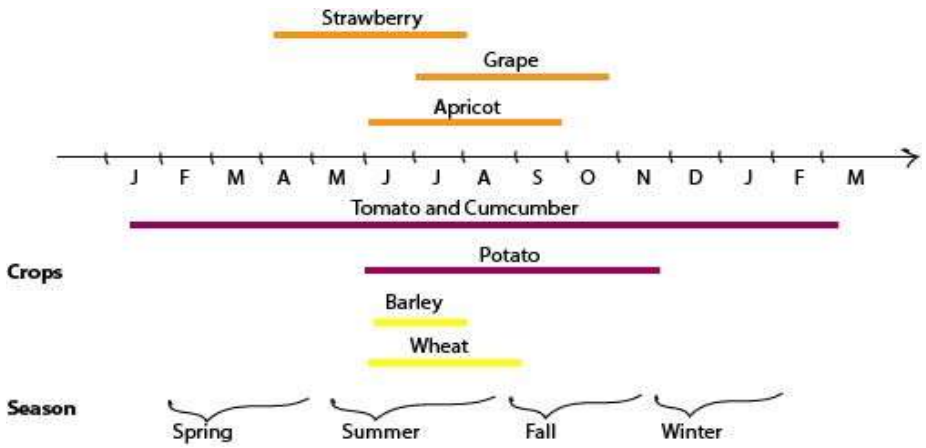


Figure 3. Armenian crop and production harvests [Source: Author based on input from experts and researchers of Armenian National Agricultural University]

[7] Experts' assessment, prior to national census.

Consequences of this diversity of geography, climate, and production

1) The adaptation of cultivation, production, and techniques to the climatic specificities implies that one insurance product will not fit all crops in one region not one crop in all regions. Risks and exposure are distinctive by crop and by season. Tailoring the insurance solution by region and by crop will be necessary due to the climate variation. Therefore, both the type of insurance product and its characteristics could be different by marz.

2) Another implication of the heterogeneity of weather patterns and subsequent risk exposure is that the risk pooling mechanisms may be challenging. Groups of producers exposed to similar risks may be small and, ultimately, appropriate financing mechanisms and products should be found for all producers.

3) The heterogeneous production, geography, and climate thus represent an important challenge in the design of an adequate insurance solution for Armenian producers. Several products will be needed to cover all regions, requiring time throughout for data analysis, product design, and a staged development of the programme (starting from the main production and risks then expanding).

1.3 Data and knowledge available

While the design and tailoring of a product may be challenging due to the diverse geography, climate, and agricultural production, Armenia can leverage a series of assets that are seldom encountered in countries trying to design national crop insurance programmes for the first time.

HYDROMET data

Armenia can rely on its current extensive network of hydrometeorological stations. It includes, as of July 2014, HYDROMET's **47 weather stations and three associated radars**. These weather stations capture the following data:

- Horizontal visibility
- Cloudiness (amount and type)
- Wind (speed and direction)
- Soil surface temperature
- Soil temperature at different depths
- Air temperature
- Atmospheric phenomena
- Humidity
- Air pressure
- Precipitation amount
- Land surface conditions
- Snow cover conditions
- Snow height and density
- Sunshine duration

Some areas have less coverage by weather stations, and distance between weather stations is important. Considering Armenia's topography, this may lead to a lack of accuracy in observation and data for whole areas. **The maximum distance between weather stations should be reviewed based on current models to extrapolate weather data; the government should then assess the need for additional weather stations**.

Figure 4. Location of Hydromet weather stations (as of 07.2014)

The historical weather data collected by the 47 stations is also important:

- 28 stations have more than 80 years of data collected.
- 40 stations have more than 50 years of data collected.
- Only three have discontinued data series[8].

[8] No detailed verification on weather data has been performed and the condition of less than 3% of missing data not validated in this study.

Compared to minimum statistical requirements, these datasets will be very valuable in the insurance product design. Historical data may be used to assess expected frequencies and trends in weather patterns. Moreover, this data has already been analyzed for the purpose of climate change observation and study. Data checks and information already exist to support the initial stages of insurance product design.

While coverage and automation of data collection may still be improved, this is a very good starting point for insurance product development, as both historical and ongoing weather data collection are available.

In addition, Hydromet also offers agro-meteorological services, and its staff has been trained on the computation of Normalized Difference Vegetation Index (NDVI). This may be used if further investigation shows that insurance product based on NDVI is applicable in Armenia. Hydromet considers that NDVI (subject to appropriate training and further investigation) would allow drought assessment in combination to other meteorological parameters.

Agro-climatic and climate change information

People in charge of developing the agricultural insurance product will be able to rely on extensive knowledge from local stakeholders, academics, and professionals working around climate and agriculture. The analysis will have to take into account climate change as a critical factor.

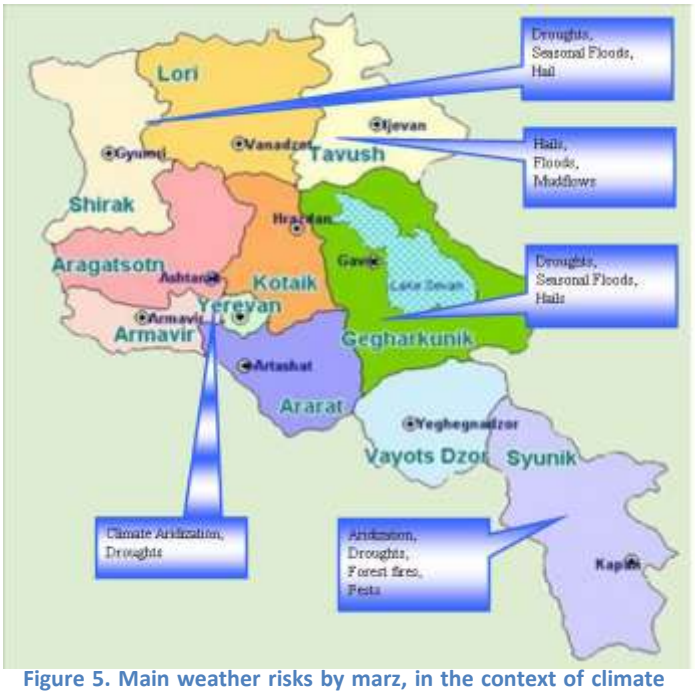


Figure 5. Main weather risks by marz, in the context of climate change

UNDP reports highlight that: "The analysis of trends for the period 1975 to 2006 shows that all these hazards (frost, hail, strong wind and heavy rainfall) have an increasing tendency. The record number of days with hydrometeorological hazards was recorded in 2003 and 2004. Over the last thirty years the total number of hydrometeorological hazards increased by 1.2 cases per year, and during last two decades, it has increased by 1.8 cases per year varying from region to region (ASHMMS, 2007). Research data from the meteorological observations show that the annual mean temperatures over Armenia between 1935 and 2012 reveal an increase by 1.03^{0}C (ASHMMS, 2012). On average, across Armenia, a decline in precipitation of six percent has been observed over the last 80 years.

The climate change impacts and scenarios seem well-documented and expected consequences on frequency and severity of climate event should be taken into account in the product design as well as assessment of cost of agricultural insurance cover. Indeed, it is anticipated that climatic zones will move upward by 200 to 400m in elevation that less water will be available for irrigation and that agricultural productivity will be reduced. All these consequences of Climate Change should be analyzed from an insurance perspective including adequacy and affordability of different cover and design options. In particular, historical data should be de-trended and zones defining insurance product cover, expected frequency and severity should reflect these trends and sensitivity to different scenarios should be tested in order to check potential sustainability.

Yield and other agricultural information

For the type of products that could match the exposure and needs in Armenia, the following agricultural information is required[9]:

- **Crop area (figures)**
- **Yield data and technique**
- **Official loss or damage data**
- **Cropping patterns**

Some of this information is scarce or patchy as of July 2014. Some data gaps may be addressed by the 2014 agricultural census that is taking place in Armenia. The census data should be leveraged to constitute a valuable input in future insurance product design. Land use and data from the State Committee of the Real Estate Cadastre

[9] Adapted from IFAD's technical guide on WII in Agriculture Development

should also be reviewed and used. However, accurate data illustrating historical losses may not be available at the granular level required for product design and should be addressed going forward. Indeed agricultural production information and data are required in order to:

- Link weather, vegetation period and yield data
- Assess historical losses
- Assess cover requirements and design cover
- Compare potential payouts with historical losses.

Availability of required data

1) Weather and agriculture-related data is a good starting point for agricultural insurance development purpose. Existing data should be leveraged to analyze exposure and explore product development options.

2) Armenia can count on knowledge from its agriculture and weather experts to support agricultural insurance development. Climate change trends have been analyzed and resources

3) Some data gaps remain (e.g. historical yield, weather severity and impact). Further analysis of available data should lead to detailed data gap identification and determine how these gaps can be filled going-forward.

2. The toolbox: agricultural insurance products and delivery models

Three main questions have to be answered to determine the features of an adequate agricultural insurance model:

- **Product type and design**: what should be covered and how?
- **Reaching farmers**: who should be covered; how to inform, collect premiums from, and pay benefits to farmers?
- **Risk transfer mechanisms**: which financial structure and risk transfers will make the programme sustainable?

2.1 Crop insurance products

In order to support the options available for Armenian crop insurance products, the current tools developed will be summarized briefly and examples provided. Each product type differs mainly by coverage and loss assessment.

Distinctive products: indemnity-based and index-based

It is possible to classify products into two categories: indemnity-based products and index-based products. Indemnity-based products assess the crop loss and insurance compensation on-site based on actual loss at the policyholder level. Index-based products' payouts are determined through an index payout scale. The index is a proxy for the loss incurred by the farmers.

Indemnity-based products can cover different types of events and losses incurred by farmers:

- **Named peril cover**: only covers perils that are listed in the policy and up to the sum insured determined at the policy term's inception. The compensation corresponds to the percentage of damage assessed once the risk has occurred, multiplied by the sum insured. The most commonly named peril in agriculture is hail; it is mainly written in European countries and can cover fruits and crops.
- **Multi-peril cover insurance (MPCI)**: covers all perils (unless excluded) that can impact the yield. The sum insured is an expected yield (chosen based on historical yields), and the risk covered corresponds to a percentage of this expected yield (e.g., 0-70%). It is more comprehensive (and thus more expensive) than named perils. It is written mainly in the US and Canada.
- **Revenue covers**: protects against both yield and price losses. The sum insured therefore is a guaranteed revenue, and the payout is the difference between the guaranteed and actual revenue. It is usually available when crops are traded on commodities markets.

Index-based products determine the benefits paid to the policyholder[10] by a pre-defined index that should be correlated to the crop yield. The compensation amounts are pre-agreed and, even if the actual loss and compensation do not match (this difference is called basis risk), payouts are made according to the pre-agreed payout scale. However, in order to best capture the correlation between yield and index, the index definition can vary based on the crop and location of production, as well as the data available to develop the product and other constraints. This product category has similarities with financial derivatives. There are a number of index-based products:

- **Weather-index**: a set of parameters representing the main weather risk is embedded in the index definition in order to capture the correlation between yield and weather. The parameters could measure rainfall, temperatures or wind, for example. The payout may be triggered when the index hits a value (also known as a *strike*), whether it's a low value (e.g., deficit of rain) or a high value (e.g., degree of high winds).
- **Area-yield**: the index is the average yield observed in an area for a specific crop. This average is measured via random sampling of crops for a homogenous and pre-defined area where the index is applicable. Payout compensates for lower-than-expected yield and therefore captures the multiple risks to which the crop is exposed.
- **Normalized Deviation Vegetation Index (NDVI)**: the index is based on the analysis of satellite data that captures the state of vegetation development. In this case, the payout also corresponds to suboptimal crop development that should be captured by the index.[11]

[10] A policyholder is a person or entity that pays a premium to an insurance company in exchange for the coverage provided by an insurance policy.

[11] *An upcoming study from IFAD compares adequacy of different indices.*

Advantages and disadvantages

While an indemnity MPCI product is more comprehensive and matches loss and compensation, it is more expensive. The index-based insurance products may not capture all risks to which the farmers are exposed. Each product type has several pros and cons, as summarized by the table below.

Product Type	Pros +	Cons -
Indemnity-based	• Indemnity = actual loss (no basis risk) • Good understanding and acceptance from clients • Multi-peril insurance	• High loss assessment costs • Slow claim settlement • Historical data often unavailable • Prone to moral hazard
Revenue	Covers all risks entailing financial losses, including price risk	• Complex to design, price, and understand • Linked to the financial markets
Weather-based index	• Indisputable and transparent • Faster claim settlement • Lower loss assessment costs (reduces administrative costs and thus the premium) • Objective (no moral hazard)	• Basis risk [12] • Requires a good network of weather stations • Complex to understand • Named-peril insurance (only perils captured by index are covered) • Requires studies and expensive expertise to design
Satellite-based index, NDVI	• Indisputable and transparent • Faster claim settlement • Lower loss assessment costs (reduces administrative costs and thus the premium) • Product available in large areas (whole countries) • Objective (no moral hazard)	• Basis risk • Complex to understand • Requires thorough studies to design • Satellite imagery expertise and information is costly to acquire
Area yield index	• No basis risk from modeling • Easy to understand • Multi-peril insurance	• Challenge of historical data which is needed for pricing • Slow claim settlement • High loss assessment costs • Spatial basis risk as areas may be vast

Table 3. Comparative overview of agriculture insurance product types
[Source: *The emergence and development of agriculture microinsurance* (MIN)]

Additional implications of model choice

In addition to the product type, other product and programme features have an impact on affordability and adequacy:

- **A compulsory or voluntary product**. A compulsory product reduces adverse selection for the risk carrier, increases the pool size, and therefore the pricing may lower. On the other hand, it may not match the farmer's perceived exposure and render another service more expensive if benefits to the farmer are not obvious (e.g., insurance bundled with credit).
- **The product's level of aggregation**. A product may be designed and offered to individual farmers or to an aggregator. The policy may be an individual cover or a portfolio cover for an intermediary (financial or from the agricultural supply chain). The micro-meso-macro options are described in the table below, along with their potential benefits. A meso or macro level may simplify some processes; however, it can also reduce client value if, for example, benefits, costs or other features are not transparent or clear to the small farmer.

[12] *"Basis risk refers to the difference between the actual loss incurred by the farmer and the loss determined by the index, entailing claims for non-existent losses and no claims for effective losses.", Emergence and development of agriculture microinsurance (MIN)*

Policyholder	Sales or Distribution Model	Potential Benefit(s) of Model
Micro		
Farmers **Households** **Small businesses**	Farmers buy insurance as part of a package (e.g., credit and other financial services, technology, agricultural information) or occasionally as a stand-alone product. Note: Financial Service Providers (FSP), farmers' associations, processors, input suppliers or non-governmental organizations (NGOs) can also act as a distribution channel for micro products retailed to individual farmers.	WII payout can: 1. Allow farmer to avoid default and restart production 2. Compensate for additional livestock feed costs 3. Provide income support in lean periods 4. Supplement other sources of household income that may be disrupted 5. Facilitate access to credit 6. Encourage investment in higher quality inputs
Meso		
FSPs **Processors** **Input suppliers** **Farmers' associations** **NGOs**	Meso-level institutions buy WII policies (e.g., portfolio or group insurance) to protect their own exposure. They may create payout rules that directly or indirectly benefit farmers.	1. WII opens access to a new client base and helps manage mass defaults caused by weather shocks. 2. Meso-level actors can develop innovative linkages along the supply chain (e.g., contract farming, packaging of credit, and inputs) to help manage their risk and open market opportunities.
Macro		
Government (or relief agencies)	Government or relief agency is reinsured.	1. Government receives early liquidity following disasters; relief agency is able to fund operations.

Table 4. Micro, meso and macro levels of WII applications [Source: WFP-IFAD]

It has to be noted that index-based products are usually more complex for producers to understand and accept. The index may be more complex and accurate when the policyholder is an aggregator familiar with insurance and index-based concepts.

In order to illustrate further the different product types, a few examples of products currently offered are referenced in Annex n.2.

2.2 Distribution system

Once the most adequate insurance tool is chosen (and the detailed product features designed for the identified target population), it must reach its target population efficiently. Distribution and design are linked. The delivery of agricultural insurance implies a series of processes crucial to the programme's success:

1. **Enrollment** in the programme. The identification of farmers and their field locations, the crop/production, the land size, the sum insured, and other characteristics depending on the product retained (e.g., reference weather station).
2. **Premium** payment. Mode of payment, co-contributions, and timing are important.
3. Policy **renewal** and subsequent payments. Both of these factors must be convenient.
4. Payment of **benefit**. It should be quick, convenient, and cost-effective.
5. Delivery of **additional services.** If applicable, they can add value and tangibility to the financial service (as well as possibly minimize risks).
6. Management of **queries and complaints. This** should be efficient to ensure information availability and possible recourses.

In order to define and set up these required processes, the potential partners for offering and delivering a crop insurance programme have to be reviewed. In Armenia, considering the agricultural sector's operations, **the options include the involvement of the Government, the financial institutions, the extension workers, suppliers of input, and the traders and processors of agricultural outputs**. The retained entities will have to provide some of the services linked to the delivery of the insurance cover.

2.3 Risk transfer

In addition to intermediation in the insurance delivery, one or several entities will have to retain the financial risks of the agricultural insurance programme. The options may be determined by the covered risk(s), the financial capacity of the public and private stakeholders, and their know-how in terms of agricultural insurance. Indeed, agricultural insurance is a specific and complex line of business that requires adequate financial diversification and specific skills for the risk carrier considering the complexity of this Line of Business.

Some risks' occurrence may result in a large numbers of claims or catastrophic claims arising from the same event. **The financial risks are therefore amplified and claims have to be dealt with in a timely manner, which requires both institutional and financial capacity**. A range of stakeholders may be part of the programme, individually or jointly (co-insuring or retaining different layers of risk), as seen in Figure 6:

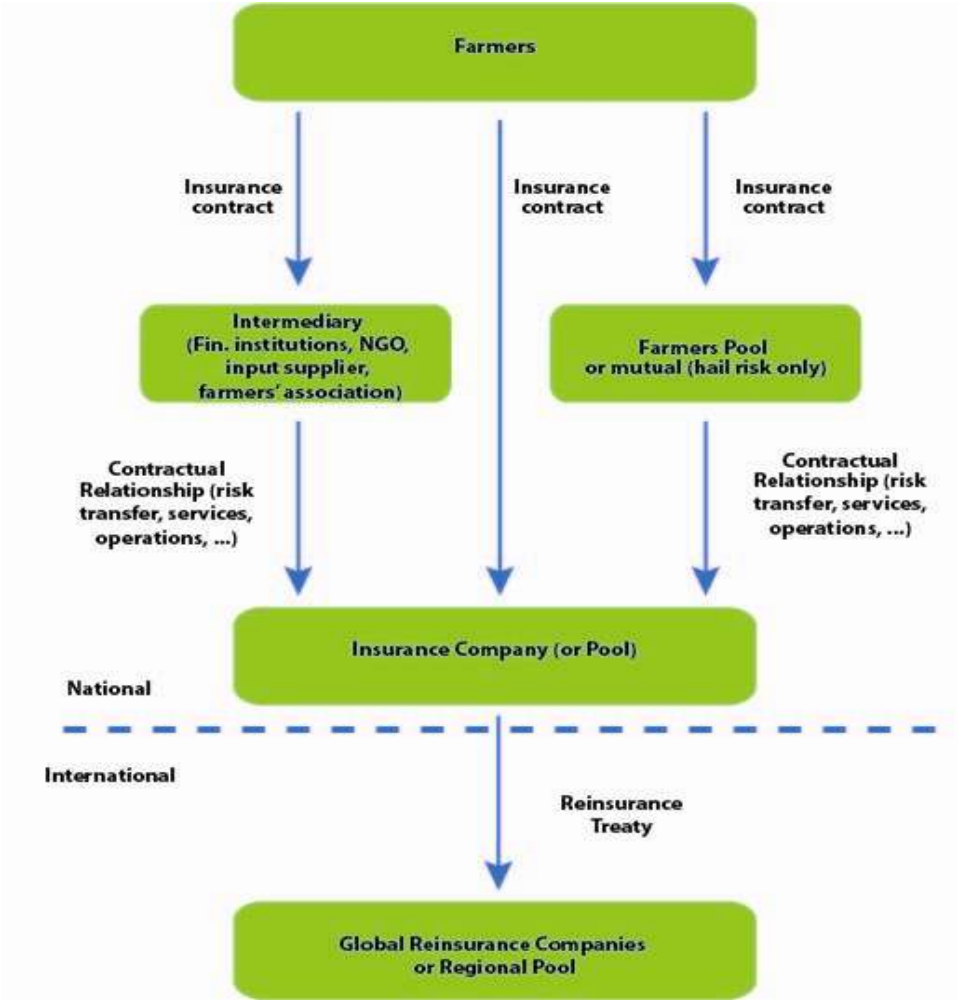


Figure 6. Potential risk transfer mechanisms distribution [Source: Adapted from WFP-IFAD]

Risk carriers will experience very low loss ratios[13] some years and very high loss ratios other years. Sufficient reserves will be required to face such variation, and an adequate financial structure should be retained to allocate funds optimally. The localized risks may be insured at a local level, but any covariant risks[14] have to be transferred outside the country through reinsurance to ensure **diversification of portfolio**. Quota-share[15] and catastrophic aggregate XS of loss[16] (stop-loss) treaties should be used to **cede the risk on the international market, considering the small size of Armenia and its resulting covariant exposure**.

Experience suggests that sustainable, scaled up agricultural insurance programs should be based on an equal partnership between the public and private sectors. The limited success of recent private sector agricultural insurance pilots can partly be explained by under-developed risk market infrastructure. This has arisen both from a lack of coordinated investments in key public goods, and the absence of institutions with sufficient capacity to ensure that the incentives of market participants are aligned with those of clients. The roles of the public and private sectors can vary from country to country, as premium volumes and policy objectives differ. However, if a country lacks an appropriate risk market infrastructure and associated public goods, agricultural insurance is unlikely to be sustainably scaled up for the benefit of farmers and herders. [World Bank AIDP Strategy Paper]

In addition to ensuring financial sustainability, a wider range of stakeholders will contribute to technical input on risk assessment, structuring, and modeling, as well as operational aspects (policy wording, loss assessment, etc.). **Both public and private sector players should therefore contribute to the structuring and provision of an agricultural insurance programme in Armenia**. The state may also play a role in the different layers and distribution mechanisms illustrated above in Figure 6.

3. Risk exposure in Armenia and potential agricultural insurance solutions

In order to assess which of the insurance tools mentioned previously are best suited for the Armenian context, this section first reviews the risks to which farmers are exposed in Armenia and the risks' characteristics. The retained product types are then described and illustrated, as well as their potential delivery mechanisms.

3.1 Exposure

Weather risks: frost, cold waves, hail, drought

According to initial input from producers, experts, and agronomists, the main perceived climatic risks in Armenia are hail, frost, cold waves and drought. Briefly reviewing these events will inform potential product design. It will illustrate how these events can be defined, how often they occur, how they impact crops, and how they might be prevented or mitigated.

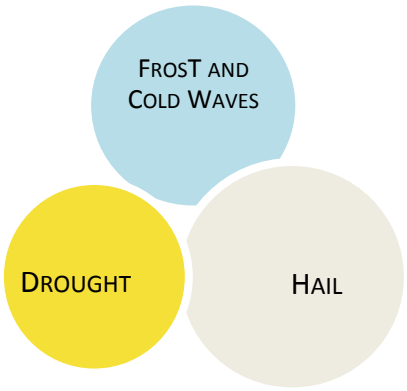


Figure 7. Main weather risks for the agricultural production in Armenia

a) Frost and cold waves

Definition and Impact

Frost is a condition that exists when the air's temperature near the earth or earthbound objects falls to freezing (0°C or lower) during the vegetation period. Frost may occur at different times and under different conditions. Hoar frost describes a deposition of ice crystals on objects by direct sublimation of water vapour from the air. Black frost, which happens under low humidity and low temperatures but without apparent ice formation, leads to visible necrosis of some organs and tissues. In spring frost damages gentle tissues; for perennial plants important winter frost damages all organs, including roots – "killing frost".

[13] Financial ratio: claim amounts paid divided by the earned premium over a period. Refer to vocabulary in Annex n.3.

[14] A risk, or combination of risks, that affects a large number of the insured items/people at the same time. http://www.microinsurancenetwork.org/glossary

[15] A form of pro rata reinsurance (proportional) in which the reinsurer assumes an agreed percentage of each insurance being reinsured and shares all premiums and losses accordingly with the reinsured. [Guy Carpenter Glossary]

[16] The reinsurer indemnifies an insurance company (the reinsured) for an aggregate (or cumulative) amount of losses in excess of a specified aggregate amount. [Guy Carpenter Glossary]

Frost or freezing can lead to plant damage as temperatures fall below those a plant can withstand. Except in tropical areas, this phenomenon happens when temperatures drop around 0˚C, either at night when the air cools down (radiative frost) or more sporadically when cooler air masses are conveyed (advective frost). When such weather events happen in a period when an area should be frost-free (in early and late winter and in early spring, early fall), the plants are not hardy, and plant tissues can incur damage from freezing. Plant cells freeze and are irreversibly impacted.

Critical temperatures for plants vary by crop, vegetable, fruit type and the time in the plant cycle at which frost occurs (cold wave may lead to winterkill). Different temperatures will also impact the plant differently; for example, only part of the plant may be impacted, the yield may be lower than expected or only the quality of the harvest will be affected, depending on the extent of the freeze. Fruit trees may have their bark, buds, flowers impacted depending on the date of the freeze, as noted in FAO's *Frost Protection: fundamentals, practice, and economics*, written by Snyder and de Melo-Abreu (2005): "Deciduous crop sensitivity to freezing temperature increases from first bloom to small-nut or fruit stages."

In the scientific literature, two temperatures capture the variability in frost impact: T_{10} and T_{90}, respectively the **critical temperatures** at which 10% and 90% of damage may be expected (temperatures indicated in the table below are the ranges for different developmental stages).

	T_{10}	T_{90}	**Frost Damage Symptoms [Source: FAO document]**
Vineyard	-2.2˚C to -10.6˚C	-2.8˚C to -19.4˚C	Damages to buds and flowers can be critical for yield loss. If only shoots are damaged, the yield may be partially (50-90%) restored by the auxiliary buds
Apricots	-6.2˚C to -2.3˚C	-3.3˚C to -14.1˚C	Damages to buds and flowers - loss of yield may be partial (20-90%) or complete. (No auxiliary bud)
Apples	-11.9˚C to -1.9˚C	-17.6˚C to -3˚C	Damages to buds, shoots and flowers (rare event as blossom is late), can lead to lower yield (10-60%).
Potatoes	-0.8˚C		Freezing injury may not be externally evident, but shows as grey or bluish-grey patches beneath the skin. Thawed tubers become soft.
Wheat	(at 3cm) -12 ˚C		Frost reduces the number of kernels per spike. A bleached and thinner band forms on the spikes for each frost event; awns become curly, and spikes are upright near maturity because the weight of grain is less. Long period of critical frost in winter, especially with insufficient snow cover, can completely kill the plants, thus leading to a complete loss of yield.

Table 5. Potential damage due to frost [Source: FAO and other documents]

The vulnerability to frost, and thus risk, varies by species due to changing critical temperatures based on physiological differences and due to varying plant cycles (e.g., the later a plant blooms, the lesser the risk). Cereals are one example of these variations:

- "During the winter, the critical temperatures change in relation to the degree of hardening. However, when hardening is complete, no plant destruction occurs with temperatures" that are very low; as noted in FAO's *Frost Protection: fundamentals, practice, and economics*, written by Snyder and de Melo-Abreu (2005).
- The following cereals can be classified from most to least resistant to frost: Rye > Bread wheat > Triticale > Barley > Oats and durum wheat.

For fruits, large fruits cool down more slowly after sunset, so large fruits may be less impacted than small ones for similar temperatures. Rainfall that transforms into frost or dew may impact the fruit as well, even if the measured temperature does not fall below the critical temperature (T_c). Deciduous trees and vines may still carry the impact of winter frost over more than one season. In Armenia, fruit trees can be damaged during the winter by cold waves for a given climatic zone of extreme low temperatures (-18 -30 ˚C for some period).

Frost conditions can impact a wide area, causing extensive damage. However, the microclimate in a given site can increase the likelihood of frost damage. Besides the risk variation by species, the risk of frost varies by several factors:

- Location. Within an orchard, temperature may fluctuate; within a village, an area may be exposed if at lower elevation or prone to fog or cold air drainage ("frost hollows").
- Height. Due to common inversion mechanisms, higher branches of a tree may be less impacted by frost than lower ones.
- Other weather factors. Humidity, a cloudy sky, and wind may decrease the intensity and likelihood of the frost phenomenon. Humidity leads to ice formation, clouds limit radiation and heat loss, and wind mixes the air.

The discriminating factor that best determines the plant's freezing seems to be the temperature; indeed, "…for short periods (2 to 24 h) the duration plant tissue is below a particular temperature is less important than how low the temperature goes (Levitt, 1980). Plant tissues cool at a rate dependent on the radiation balance and the temperature difference between the tissue and its environment. Therefore, if the air suddenly drops several degrees the tissue can rapidly cool below critical levels and result in freeze injury." (Frost Protection: fundamentals, practice, and economics (Vol. 1), R. Snyder and J. Paulo de Melo-Abreu, FAO 2005)

Based on the variety of potential frost weather events and impacts, defining frost for insurance purpose may be challenging.

Frost may be avoided or prevented through active and passive measures. While active measures (the use of heaters or sprinklers) require energy consumption and may be costly, passive methods can be more cost-effective in use and adaptation and could be considered in combination with insurance. Passive measures include species selection for timing of phenological, crop site selection, landscape and microclimate modification, nutritional status control, and promotion of soil management development for risk mitigation. Some frost events may be thus forecasted and anticipated.

Frequency and extent of freezing events in Armenia

Frosts are most often observed in the country's valley areas, particularly in the Ararat valley and its foothills, in Tavush and Syunik valleys, on average 3 times per year. In mountainous areas, frost episodes are not very common and cause practically no damage to agriculture due to the absence of fruits and vegetables.

Further data and mapping of frost risks by marz, crop type is required to assess needs for insurance cover, potential costs and product type.

b) Hail

Definition and Impact

Hail is precipitation of either transparent, partly or completely opaque particles of ice (hailstones), usually spheroidal, conical or irregular in form, and of diameter very generally between 5 and 50 millimetres, which falls from a cloud either separately or agglomerated into irregular lumps. [WMO definition]

Hail is a type of precipitation encountered in the presence of cumulonimbus clouds during thunderstorms and atmospheric instability. When the air is humid and unstable with updrafts (upward air movements), water drops freeze when they hit cold layers and form hailstones. These hailstones can measure a couple of millimeters (mm) to several centimeters (cm), usually between five and 50 mm. The stronger the updraft in the storm, the bigger the hailstones are. When they fall from the clouds, they may reach speeds from nine meters per second (m/s) (one cm stones) to 48 m/s (eight cm stones).

Hailstorms are localized events; when hail strikes it is usually very confined. Hail falls in paths or "hail swaths"; the damage zone may be only a few square metres (m^2), a few hundred m^2, or, more seldomly, a few square kilometres (km^2). Hailstorms last a few minutes and can be captured and monitored via radar. Hailstorms are known to be more common in some areas than others, based on observation and historical data (as shown in the map beside). Some areas are thus called "hail alleys".

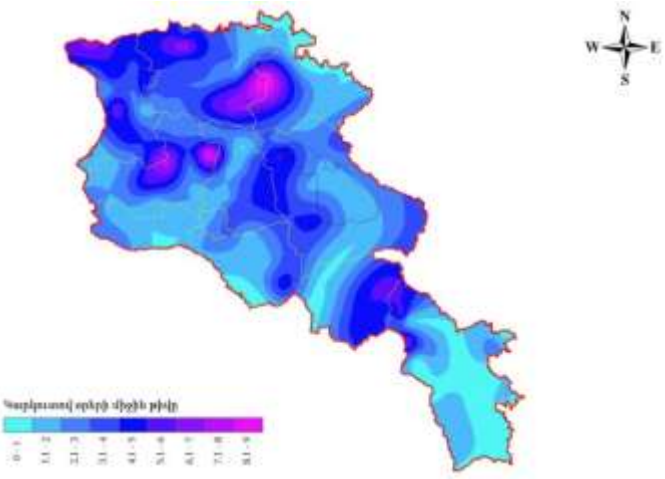


Figure 8. Average number of hail days [Source: Hydromet]

The impact of hail on crops can be devastating. Crops may be completely (100%) damaged. The degree of damage depends on the intensity of the hailstorm and when in the production cycles the storm occurs:

- Early in the season, some fruits may fall or be hit; however, even if some fruits are impacted, some buds may still be able to produce other fruits (compensatory growth). Yield may be lower than expected.
- When vegetables and fruits are out in early summer, the whole harvest may be lost.
- During late summer storms, vineyards are also very vulnerable.

If fruits and vegetables are impacted by hail, their quality and therefore their price may be lower, reducing the producer's income. Furthermore, trees impacted from hail may be more prone to pest and diseases, as hail points may be entry points for diseases. The impact of hail can be assessed visually if the impact factors are documented by agronomists.

Frequency of hail in Armenia

Hailstorms happen in Armenia during the hot season between the months of May and August. Hail is most frequently seen during the May-June period, while the large grains observed in July-August. Hails is more frequent in Shirak, Lori, Tavush, Aragatsotn hills, Gegharkuniq and Kotayk mountainous areas, with an average of 4-5 cases per year. In valley areas, the frequency of hail is lower: 1-2 times per year.

Since hail is a local phenomenon and Hydromet could not capture all historical events (through radar detection and reports), the above-mentioned frequency may be incorrect. Indeed, further detailed data and mapping may be required to assess needs and hail events' frequency; and develop an adequate insurance cover.

Cloud seeding and anti-hail cannons have no proven track record of efficiency in preventing hail phenomena. However, producers in areas with high hail exposure and expensive crops may resort to hail nets if investing in protection measures results in more cost-efficiency than transferring the risk for modern orchards and vineyards.

c) Drought

Definition and Impact

Drought is a complex phenomenon that results in a deficit of precipitation and several types of drought exist. It is difficult for scientist and policymakers to define this phenomenon: "Drought is a progressive phenomenon, in terms of an accumulating soil moisture deficit for plant growth, and its impact on crop production and yields is often extremely difficult to predict, then measure and isolate from other non insured causes."[17]. For agriculture drought is the result of different of meteorological (or hydrological) situations: precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels and its effects are not immediate. In WMO report, an expert underlines that: "Drought should be considered relative to some long-term average conditions of the balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) **in a particular area**. It is also related to the **timing** (principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the **effectiveness** (i.e., rainfall intensity, number of rainfall events) of the rains."[18] And this definition is conceptual but not operational.

Drought's impact on plants corresponds to damage on their main organs: shoots and fruits. Drought can reduce yield and when severe the plants may be killed. On a varied terrain (elevation, sun exposure, water access), the impact of lack of rainfall and its intensity can vary greatly. Therefore the characteristics of lack of rainfall and drought episodes (as defined conceptually by the WMO expert) that lead to negative impact on crops are difficult to define: several factors may play a role, the impact differs by crop and location, the timing of the event etc. Using an index that summarizes some of the factors such as rainfall amount, onset, soil moisture, temperature enables to identify severe events but localized or less acute events may be more difficult to capture. Furthermore, farmers may not consider drought or lack of rainfall as their main concern unless the drought phenomenon is stark and the impact on yield is drastic and obvious.

[17] Insurance of crops in developing countries, FAO, Roberts (2005)
[18] Drought assessment and forecasting, Monacelli, WMO (2005)

Weather experts have defined numerous indexes to quantify droughts (e.g. deciles, Palmer-Drought Severity Index, Surface Water Supply Index, Standardized Precipitation Index). Some of these indexes are very complex and could not be easily conveyed to producers. An index-based product may be considered as an option. However, in order to develop the right index for a production and area, further investigation to determine vulnerability to this peril would be required. Lessons from other projects and impact of climate change would have to be taken into account. Drought may be covered at a later stage of the development of agriculture insurance in Armenia based on reported priorities from producers and the complexity of drought.

Frequency of drought in Armenia

In Armenia, drought is usually recorded during the July-September period, but it may also occur in spring and fall. It generally occurs in the Ararat valley and sometimes in the Ararat submountainous region, Tavush and Syunik valleys. However, in 2000 and 2006, droughts occurred all over Armenia, reaching elevations of up to the 3000m. The frequency of droughts roughly can be once in 2-4 years; more details on its severity would be required. Defining drought for insurance purpose may thus be challenging and information and studies appears scarcer in Armenia for this risk type than for others.

Risks by crop

The exposure to the risks described in the previous sections varies by crop. Producers for each crop may therefore have different cover priorities based on their crop type, location, access to irrigation and other mitigation mechanisms. This table summarizes the risks and yields by crop type:

Crop	Actual yield per Ha	Expected yield per Ha (range, agro data)	Yield variability factors (weather risks, pest and diseases, other)
All cereals	2.7	1.5-5.0	Frost, drought
Wheat	2.6	1.5-6	Frost, drought
Barley	2.6	1.5-3.5	Drought
Potatoes	20.1	20-60	Drought, hail, phytophtora, coleopterous worms
Grape	13.8	8-30	Frost, hail, excess of air humidity, cryptogamic disease
Watermelon & melon	40.2	20-100	Drought, hail, worms, mites
All vegetables	33.5		Hail, dry wind & drought/for all
Tomatoes	43.7	25-80	Coleopterous worms
Cucumber	35.6	25-60	Air humidity
Cabbage	28.6	20-50	Worms
Carrot	18	10-30	Mites
Onion	30	25-50	Mites
Eggplant	20	15-35	Excess of air humidity
Pepper	15	10-25	Mites
All fruits and berries	9.7		Winter frost & hail /for all/
Apricot	8.2	8-30	Early blossom frost, excess air humidity, cryptogamic diseases, worms
Apple	11	10-50	Dry air, worms
Peach	11.6	10-35	Air humidity, worms, early blossom frost
Pear	7	8-25	Drought, dry air, bacterial fire, worms
Plum	8.2	6-20	Drought, worms
Strawberry	7.6	5-12	Drought, dry air, mites

Table 6. Yield and risks by crop type (Source: agronomist)

Beyond weather

Farmers are exposed to risks beyond weather. With generally low and fluctuating income levels for small-scale farmers and additional non-climatic exposure, some of these risks need to be addressed to support farmers in a more sustainable and comprehensive way. Farmers mention a range of risks:

- Pest and diseases
- Price risks
- Market access challenges
- Limited choice of intermediaries
- Lack of quality input
- Gap in techniques and knowledge
- Limited or expensive access to financing tools

These risks and constraints cannot be addressed through an insurance cover per se, but could be as important as weather risks for farmers. Further information on producers' cover priorities may be available with the demand research conducted in KfW's autumn 2014 study. The study results will inform the package of services and opportunities that farmers should have access to in order to improve their livelihood, including the interventions mentioned in the Figure below.

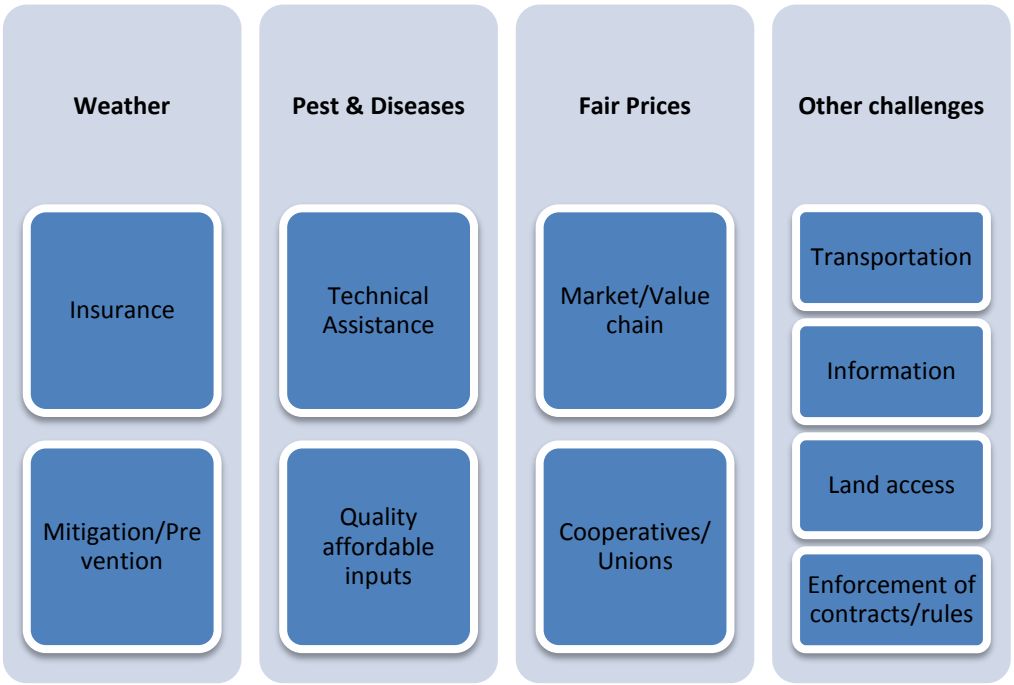


Figure 9. Range of risks and challenges faced by farmers

The challenges encountered by small farmers will impact their interest in the coverage offered as well as their ability to pay. Addressing more than one of these challenges will improve potential take-up of the coverage if the product is voluntary:

1) The farmers will see a match between their priorities and the coverage offered.
2) Their income level may increase and thus their ability to pay (ATP) for insurance.

The insurance's impact and likelihood of success will increase if these risks are considered in the overall rural safety net strategy (that should include risk transfer and other risk mitigation strategies).

3.2 Risk classification

As seen in Section 3.1, three main weather risks may impact farmers' harvest in Armenia[19]. From a financial perspective, these risks have inherent characteristics that should be taken into consideration for the product and risk transfer design:

- Two risks may impact a large number of farmers at once; drought and frost may damage partially or destroy completely the crops of all farmers in a region.
- Hail, on the other hand, is a much more localized risk occurrence, impacting some farmers in a village and some villages in a region at once.

One event is **localized and quasi-idiosyncratic** on the one hand (hail), while the others are **regional and covariant** (drought and frost). This is one of the key elements in determining the type of risk transfer required. A contingency fund or reserve will be completely drawn (and would be an expensive funds allocation option) and most likely insufficient if a large number of farmers experience the same risk at the same time. It is therefore critical to ensure that sufficient funds are available and to define an adequate, quick claims process for the covariant risks.

For idiosyncratic risks, pools or risk transfers at the local and national level could be envisioned; for the covariant risks, risk transfers must enable diversification of exposure and thus necessitate the involvement of international risk carriers.

3.3 Potential solutions: products, distribution, and underwriters

Types of Products

Based on the events in Section 3.1 and the potential tools described in Section 2, we can define the potential products for covering the main risks. For covariant risks, risks transfers are required at the national and international level. For events that could be "captured" in the definition of an adequate index, an index-based insurance product could be more cost-efficient. The suggested products and risk transfers are summarized in Table 7:

Risk	Type of Risk	Potential Type of Insurance Product	Potential Risk Pooling and Transfer	Challenge(s) in Delivery
Hail	Idiosyncratic - relatively localized	Traditional/ hybrid	Farmers' funds pool (marz/national) + insurance layer	Event definition; Cost-efficient loss assessment and management
Early and late frost	Regional, national or localized – covariant	Index-based (temperature + extrapolation) at meso-level	(Re)insurance	Complex event definition by marz/location/crop; Impact of climate change; Basis risk[20]
Cold spell/ harsh winter	Regional, national - covariant	Index-based (temperature) at meso-level	(Re)insurance	Event definition by marz/location/crop; Impact of climate change; Basis risk
Drought	Regional, national - covariant	Index-based (rainfall and/or yield)	(Re)insurance	Weather stations and agro-climatic data; Impact of irrigation; Impact of climate change; Basis risk
Other (pest, diseases)	Localized or regional - covariant	Traditional or area yield-based index	(Re)insurance	Not possible to include except with area yield-based index

Table 7. Potential Crop Insurance Products and Models

[19] This should be confirmed by demand research and is based on agronomists' input.

[20] For index-based insurance, it is the risk that some affected insureds will be compensated too little or not at all while others with a only small loss or no loss will be overly compensated. This happens because compensation is not based on the each insured's actual loss but on an index formula which is a proxy for estimating the average losses of all insureds.

Examples of design

(These examples are provided as illustration only; further research is required to define the products.

1) Frost–Early Spring

If we can define and identify frost conditions as temperatures very close[21] or below 0° C, an **index based on temperature** could be the input for an insurance product design. The index must capture the frost phenomenon adequately; sometimes a combination of risks increases the impact of low temperatures (e.g., impact of wind). As noted in section 3.1, one important factor is the speed at which the temperature decreases.

The index may therefore capture this temperature gradient every day and be conditional to the growing degree-days required for a specific crop. Additionally, the temperature would have to be measured at a specific weather station (WS) pre-determined for a specific coverage. The trigger may be a temperature of 0° C or slightly above zero depending on the WS location. Indexes are usually not suitable in mountainous areas due to the complexity of micro-climates, but the measurement could be combined with Hydromet's temperature extrapolation software output (which would have to be tested).

The **cover period or policy term** could be for the critical months of March to April, (and potentially the first decade of May, as phenomenon is more rare) when temperatures are susceptible to decreasing quickly after warmer daylight hours. This period is also when the plants start growing and may be impacted in their development. The cover period could vary by location in order to reflect the usual local dates of spring. This product could be offered to farmers that sustain crop losses due to frost and for which the correlation between frost and damage is high. A **frost-free-days map** would help assess needs, cover period, and contribute to design adaptation and pricing.

The index may be designed based on exposure, including parameters that would differ by crop and area. Similarly, the **sum insured and limits** will vary based on crop and region. The sum insured and limits may depend on the insured area, that is, the cultivated area for a certain crop that will be insured. The sum insured may correspond to the cost of production. For example, farmers mentioned amounts up to 1.2 million AMD per hectare for vineyards. Alternatively, the sum insured per hectare could be the total loan amount received from a financial institution divided by the number of hectares cultivated.

The **Premiums** for the coverage would be determined by the risk carrier based on historical values of the index and the trends observed (plus the administrative costs and risk loadings). The cost of the coverage would be expressed per acre insured; the premium would be proportional to this amount.

The **payout structure,** thus index-values, should reflect the extent of the crop damage for different temperature scenarios. As mentioned in section 3.1, the damage may vary greatly; based on input from an agronomist for a specific crop, this relation may be assessed.

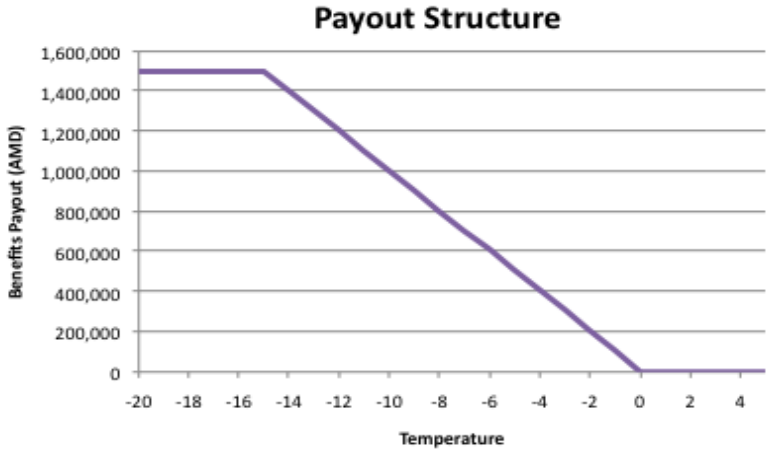


Figure 10. Example of payout structure

[21]Soils tend to be colder than the air at the height of weather stations; measured temperatures of up to 1° C- 3° C may coincide with frost conditions for agriculture.

Based on the product characteristics above, a potential index for spring frost could have the following definition:

$$Index_{t,\theta} = \begin{cases} \text{if } t \notin [01/03;30/04],\ 0 \\ \text{else } Index_{t,\theta} = \text{Min}(15,\text{Max}(0,0-\theta)) \end{cases}$$

This index may be multiplied by the benefit of the cover; for example (as in the graph), 100'000 AMD.

Finally, there is potential for adverse selection since some sites and crops are more prone to frost and thus damage. Compulsory or meso-products should be considered to avoid anti-selection and to provide potentially more affordable products to a larger number of producers. Additionally, since there is temperature variation spatially, basis risk should be assessed. Hydromet's temperature extrapolation models may help in assessing the validity of an index-based product.

A different index type would capture frost in fall and harsh winter, since trigger values, index definitions, and so on will differ. For each period, a different frost index would have to be determined based on the critical scenarios for the insurable crops.

2) Hail

Hail cover insures the producer against crop damage resulting from hailstorms; this includes four components:

- Crop damage from hailstones
- Fire resulting from hailstorm lightning
- Risk of frost resulting from the crop's delayed maturity
- Diseases to which the damaged crop may be more prone after the hailstorm

The simplest coverage that seems to correspond to Armenian producers' priorities is for **damage due to hailstones**. This product term may cover the period during which severe thunderstorm risk exists, from April to June, (or August as hail is rare during the summer time but stones may be large), and may vary by region). The hail coverage could provide options in term of sum insured levels (which could also be conditional on crops).

As hail is a localized phenomenon, more traditional product coverage (in the form of named peril as described above) is required. Based on observations from a third party and the extent of damage incurred, an **assessment of the loss incurred** may be determined. The sum insured in the case of hail may also be limited in order to ensure affordability. While being a relatively simple product, the **process** set up should help ensure its affordability and value-for-money.

The verification of the event occurrence and damage assessment will be key to containing these administrative costs. In order to perform the steps described in Figure 10, the hail program should leverage tools and processes that will speed up the claims assessment while also lower its cost and potential fraud or undue claiming.

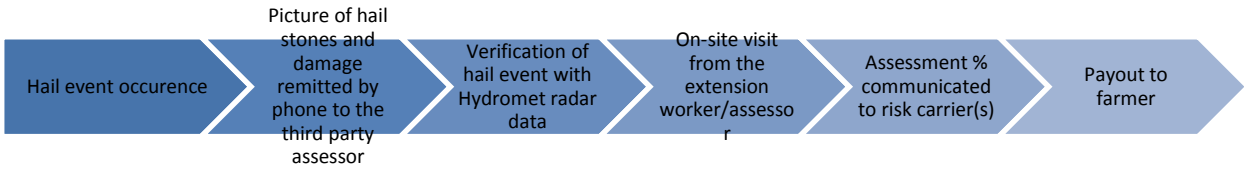


Figure 11. Potential mobile-enabled claims process for hail coverage

We could envision the following claims process, including the use of mobile technology, recourse with local extension workers, and Hydromet's data:

1) Once a hailstorm hits a farmer's field, the farmer must contact a village resource person who uses a Global-Positioning-System-enabled (GPS-enabled) smart phone to take and send a picture of the hailstones and the damage observed in the field to the insurance contact person. A simple phone application (app) could remind the user of each step, provide references, and facilitate the process.
2) The insurance program representative would then contact Hydromet and verify that the radar data for the photos' GPS location also shows the occurrence of a hailstorm. This step avoids unnecessary field travel and prevents fraud; this process should be explained to farmers.

3) If the hailstorm is confirmed, the assessor (or team) should travel to the village(s) where the storm has occurred within a short time, in order to assess the percentage of crop damage and provide impacted farmers with the next steps.
4) This assessment would then be reported to the risk carrier(s) (insurer and/or fund based on model retained).
5) The benefits payout should be convenient for the farmer (who also should incur minimum expenses to cash in his benefits).

For a hail product, a premium computation would take in several factors:

	Factor
Crop type, Rate factor	1
Risk area 1, Rate factor	2
Basic Premium Rate	2%
Coverage Selected	180$
Area Insured (acres)	1.5
Premium =	1x2x2%x180x1.5 = **10.8$**

A benefits computation would include the coverage selected, damage observed, and the area impacted:

If the deductible is 30%	**Scenario 1**	**Scenario 2**
Coverage selected	180$	180$
Damage observed	10%	60%
Area impacted (acre)	0.5	1.2
Payout =	**0$**	180 x 60% x1.2 = **129.6$**

If the damage observed is low, the potential payout may be lower than the administrative expenses. This may support the rationale behind a deductible[22].

In addition to the coverage and benefits, the following processes and conditions should also be clearly defined for all crop product types:

- Eligibility (minimum area insured, leased land eligibility, etc.)
- Restrictions, if any (certain crops, for example)
- Deadlines for enrollment and premium payment
- Sum insured level options
- Deductible, if applicable (minimum hail damage, for example)
- Conditions for changes and cancellation (if those are possible; for example, if the crop is destroyed by another peril early in the season, or the land is sold)
- Complaints and recourse processes
- Detailed process for appraisal (an insurance programme staff's manual)

Definition of these elements should take into account both the costs of these processes and the farmers' ability to understand the processes, conditions, and the cost-benefits of the potential controls of **adverse selection[23] and moral hazard[24]**. Like frost coverage, there is potential for adverse selection since some areas are more prone to hail than others. Compulsory or meso-products should be considered to avoid anti-selection and to provide potentially more affordable products to a larger number of producers.

[22] Also known as excess in some countries, it is the amount that must be deducted from a claim (or from a cumulative claim amount) before the insurer will step in and pay a portion of the remaining amount. - http://www.microinsurancenetwork.org/glossary
[23] Tendency of persons with a higher-than-average chance of loss to seek insurance at standard (average) rates, which, if not controlled by underwriting, results in higher-than-expected loss levels – Microinsurance Centre, Glossary
[24] Hazard arising from any non-physical, personal characteristic of a risk that increases the possibility of loss or may intensify the severity of loss for instance bad habits or low integrity. An example might include failing to properly care for an insured goat because it is insured, thereby increasing the chance it will die of disease – Microinsurance Centre, Glossary

Risk Transfer

As described in Figure 5 and in Table 5, the risks should be retained as different layers by various stakeholders based on the covariance and required funds to face liabilities of these risks. **For drought, frost (both in spring, fall), and winter cold spells, national and international insurers should be involved to ensure financial sustainability and cost-efficient funds-allocation for the government and farmers. For hail, local funds could avail reinsurance from the national insurers if regulation was authorizing such financial risk transfer structuring.**

Some national insurers interested in agricultural insurance may also decide to work together and share the risks of an agricultural programme. In any case, they will need to avail reinsurance from the international market as covariance and exposure are high for the above-mentioned perils.

As of 2013/12[25], Armenian national insurers are all non-life insurance companies. 563'000 policies were issued in 2013, mostly motor (58%) and health (20%) insurance policies. These companies reported 35.8 billion AMD of earned premiums in 2013 (45% motor, 32% health) and an overall loss ratio of 62% and a low ROE of 3%. Insurance companies transferred 9% of their premiums to the reinsurance market.

As reported by the IMF[26] and the World Bank[27] financial system reports, the insurance market in Armenia is: nascent, limited but developing and well-supervised by the Central Bank of Armenia (CBA). Indeed no life insurance is available and penetration is limited. 9 insurance companies are registered and the market is concentrated.

The IMF report also indicates that regulation follows ICP principles, and that supervision is comprehensive and thorough. CBA reports claims ratios[28] for the sector at 137%. It is interesting to note that the number of insurance agents has greatly increased since the introduction of compulsory motor insurance. More than 5'500 agents are the companies' relays throughout the country.

While the product types currently offered in Armenia are not diversified and no agriculture insurance has yet been developed and offered by the private sector, some private sector actors may be able to underwrite agriculture risks provided they receive training and adequately reinsure the agricultural portfolio.

Distribution channels

The risk carrier and government need to find the most efficient and practical way to reach Armenia's farmers. With the implementation of compulsory motor insurance, insurers have opened branches in each marz, and people have become familiar with their brands. This network of insurance branches will help build awareness of a programme developed as a Public-Private Partnership (PPP) as well as the crop insurance process for farmers.

However, in order to reduce administrative costs as much as possible, the programme should identify large groups of farmers that can be insured as a group and for which transactions and processes will be easier than for individual farmers. In addition to administrative costs, insuring groups will bring down the risk premium since adverse selection wouldn't happen as all farmers would have to enroll. This may be considered as a first feasible step in the national effort to set up agricultural insurance.

Based on the agricultural value chain, we could identify four main options for distribution:

- Financial institutions
- Aggregators and the transformation industry
- Input suppliers
- Farmers' associations and communities (when created and strengthened)

[25] All figures in this paragraph refer to data from: *2013 Armenian Financial System Report, Development, Regulation, Supervision*, Central Bank of the Republic of Armenia.
[26] *Republic of Armenia: Financial System Stability Assessment*, IMF, 01/2013
[27] *Republic of Armenia, Financial Sector Assessment*, World Bank, 08/2012
[28] Claims ratios may be defined in simplified terms as: claims incurred/earned premiums

For each region and/or crop a combination of these channels may be necessary to cover the largest number of farmers possible. Both the government and the private sector should maximize the number of enrolled farmers in order to ensure actual social impact of a rural safety net and its sustainability in the long term.

Several factors should be considered as these distribution channels present advantages and disadvantages:

	Pros +	Cons -
Financial Institutions (banks and microfinance institutions (MFIs))	- Existing financial transaction with farmers. - Risks are born by financial institution and farmer (two levels of interest in coverage). - Currently, the crop failure risk's cost is embedded in the financial rate.	- Farmers without loan or not renewing loan may not have access to insurance coverage. - May increase the cost of lending.
Aggregators (output market) and agro-industry	- Existing financial transaction with farmers. - The industry bears the costs of bad weather or bad yield years, which impacts operations, business financial results, and employment.	- A majority of farmers do not have a link to a formal market or the industry. Thus is different by region and crop production. - Agro-industry in Armenia is reluctant to try such innovation.
Input suppliers	- Existing financial transaction with farmers.	- Neither all crop production nor farmers require purchase of input.
Farmers' associations	- Close to farmers, may have farmers' trust. - May address farmers' other difficulties and help deliver other benefits.	- Very limited outreach in Armenia; would have to be set up or strengthened to take part in the delivery process.
Communities	- Close to farmers, may have farmers' trust. - Potential outreach. - Strengthen community self-reliance.	- Potential difficulties in governance and oversight.

Table 9. Distribution channel options for a crop insurance programme in Armenia

The agro-industry and financial institutions already bear some costs of the harvest failure risks and may be willing to insure themselves). They however have a limited outreach. Only a small portion of Armenian farmers avail loans to finance their agriculture production, and most Armenian farmers remain outside formal value chains.

In order to avail insurance coverage, a farmer should not have to be dependent on an institution that offers a service or purchase price that could potentially reduce the farmer's income or sales decision options. From the farmer's perspective, insurance availability should not come at the expense of income opportunities, such as creating additional costs from financing which is already high or reducing the choice of crop buyer. Moreover, from the financial institution's perspective, the introduction of insurance should not create an uneven field. In addition to banks, credit unions and MFIs should also be able to offer agricultural insurance to their clients and members, thereby ensuring fairer and greater access to crop insurance coverage for farmers. The introduction of crop insurance may actually help the extension of financial services to farmers. New institutions may develop these activities, bringing in competition; interest rates could decrease slightly if crop failure risk is not borne entirely by financial institutions.

As mentioned in Table 4, some risk-bearing organizations (MFI, agro-industry) do not reach out to every farmer but do already have financial transactions set with farmers, while the community-based channels would take more

time to develop based on their current status in Armenia. This may influence the agricultural insurance road map design, so that a staged or concomitant extension of distribution channels offering insurance coverage to farmers could be envisioned.

Whichever the channels retained in the first and later stages of agricultural insurance development, the transaction platform may be unlinked from other processes; the provision of different services, payment, and other processes could include different stakeholders. For example, the renewal process, the payment of renewal premiums, and the payout of benefits could involve different partners than the initial enrollment. This approach would ensure ease of access to service and payments for farmers, lower transaction costs, and therefore a better value-for-money and sustainability of the programme. The public sector could also be involved in this aspect of the programme.

4. Prerequisites to product design: technical activities

Prior to designing crop insurance products and in order to further assess feasibility and inform the government's roadmap toward agricultural insurance in Armenia, additional preliminary activities should be conducted.

Detailed data review
While an overview of the Hydromet and agricultural data appears to support the potential for agricultural insurance development in Armenia, a more detailed review of the data should be undertaken. The data review and analysis should have three main objectives:

- It should assess the **expected frequency** of weather events as described in section 3, which would help determine if it is possible and sustainable to cover these events through an insurance mechanism. An insurance product may not be a viable solution in some areas or for some risks. Only a closer look at data (including data mining and descriptive analysis) will answer this essential question for insurance development.
- It should identify **any gap** in data and information at a detailed level (weather station, marz, etc.). The data review should include weather data, as well as yield, soil, census, cadastre, geospatial data, crop production, and other economic data available. All data should be assessed for quality, consistency, and continuity.
- It should enable a **preliminary assessment of costs** and potential public contribution to crop insurance coverage. It will also be the input for creating risk maps that will inform the programme roadmap and budget decisions.

Risk maps
The weather data and the agro-climatic knowledge should be translated into visual representations that illustrate the regional exposure to each risk. These tools will support decision-making even before designing products by supporting several key aspects:

- Informing pilot characteristics (e.g., coverage term, coverage area);
- Identifying priority areas and risks for the roadmap development;
- Assessing insurance costs and viability by region;
- Visualizing variation in frequency and thus potential coverage costs within Armenia;
- Preparing in-depth analysis and product design.

The risk maps may be used to analyze and include trends in models and could be built using current agro-climate zonal mapping tools probably available from Climate Change studies. This is another prerequisite in the product design process. For example, frost-free days for each region could be mapped; such maps plus dataset analyses could illustrate the last occurrence of frost in spring and the first occurrence of frost in autumn, thereby showing which areas are more prone to late frost and which period, regionally, would require coverage for farmers to hedge frost risk.

Public goods assessment
Thanks to the data review and input from national stakeholders (e.g., Statarm, Hydromet), the public sector can assess the current infrastructure and address the gaps (current and future) to developing agricultural insurance in Armenia. This public goods assessment will inform product design decisions and the crop insurance roadmap as

some areas may not be ready yet for the development of insurance tools. These public goods may be infrastructure as well as data and services.

Crop damage expertise
Some damage may be assessed through yield loss evaluation, but in-depth information should be collected from agricultural experts and compiled in a manual, so that verifications can be made during the developmental phases. Learnings and comparison between actual and foreseen losses will be essential, so that loss assessment is refined over time and based on the experience gathered during the initial phases. Insurance and agricultural experts should work jointly to develop this expertise as well as the methods to train local resource people in the field.

5. Roadmap for public and private stakeholders

The complexity of setting up national insurance schemes, whether health-based or agricultural, requires thorough planning and phased development. In the case of agriculture and with the idea of a public-private partnership (PPP) model, the roadmap to crop insurance will involve the coordination of activities between complementary stakeholders. Establishing crop insurance in Armenia will happen through phases and the involvement of various stakeholders from the Ministry of Agriculture to international reinsurers. Improvement of each insurance product, extension of coverage available, and increased access to farmers will require iterations. While keeping in mind the long-term objective of offering the best safety net possible to producers, both the public and private sector will have to gain experience and improve capacity and products over time.

The following table summarizes the different actions each stakeholder may undertake to take the crop insurance programme forward:

	Stakeholder	Potential Role	Tasks
PUBLIC SECTOR	**Ministry of Agriculture**	Initiator, data provider, decision-maker	1. Include a more detailed vision and operational strategy on national agricultural insurance in its framework 2. Set up and coordinate a working group + a specific unit for implementation 3. Build capacity on agricultural insurance (inform donors and help in communication/coordination) 4. Decide on definitions of roles beyond risk carriers and beyond direct financial contribution 5. Improve data collection mechanisms (e.g., yield, land use)
	Ministry of Finance	Data provider, decision-maker	1. Assess current ad hoc expenses on relief (loan subsidy, seeds/seedlings handing, tax cuts, etc.) 2. Secure budget for 2015-2016 pilot
	Hydromet	Data and technical provider	1. Provide summarized and detailed weather data for the two main risks (temperature and hail) 2. Assess needs for additional infrastructure and pilot models for pilots then scale-ups (weather stations (WS) and radar).
	Central Bank	Regulator	1. Review current law and regulation to ensure index-based insurance is possible 2. Assess insurers' and other financial institutions' capacity (both technically and financially) for potential PPP 3. Build internal capacity on agricultural insurance

PRIVATE SECTOR	**Intl Agencies**	Supporter	1. Coordinate support efforts to the Government of Armenia (GOA) 2. Provide capacity building and technical assistance on agricultural insurance 3. Conduct study on financial allocation of funds based on Ministry of Finance (MoF) data, on aggregators, and on demand 4. Support during pilot testing with scale-up objective
	Insurers	Risk carrier, technical provider	1. Build internal capacity on agricultural insurance 2. Seek support from reinsurer
	Financial Institutions	Channel	1. Build internal capacity on agricultural insurance 2. Assess financial losses and potential exposure to agricultural losses 3. Improve client value of services (lower costs, flexibility)
	Communities	Beneficiaries and facilitators	1. Provide feedback and data 2. Engage in mitigation solution development

Table 10. Suggested activities for public and private stakeholders during the initial phase

Public sector: initiating the process

As outlined previously, the pre-conditions for crop insurance development in Armenia are met[29] if the following factors are in place:

- Existing weather risk and potential demand
- Available agricultural data and information
- Available weather data and infrastructure
- Government policies and interest
- Regulatory environment
- Available partners, interested parties, and champions

However, the public stakeholders need to formalize their **vision** and coordinate their actions, while all parties should build their capacity in order to make the development of an insurance programme possible. Indeed, while there is public interest, the Ministry of Agriculture (MoAg) and the Ministry of Finance (MoF) should develop a joint vision and plan toward a national crop insurance programme. This framework would signal to all stakeholders (international donors and the private sector) that the GOA has a system approach to developing crop insurance in Armenia. The vision may define how the GOA will explore and then coordinate the offer of insurance coverage, for which crops, and how this offer may later expand, as illustrates Figure 12 below.

[29] Check list (WFP-IFAD – page 25 Weather IBI in Agricultural Development, a technical guide)

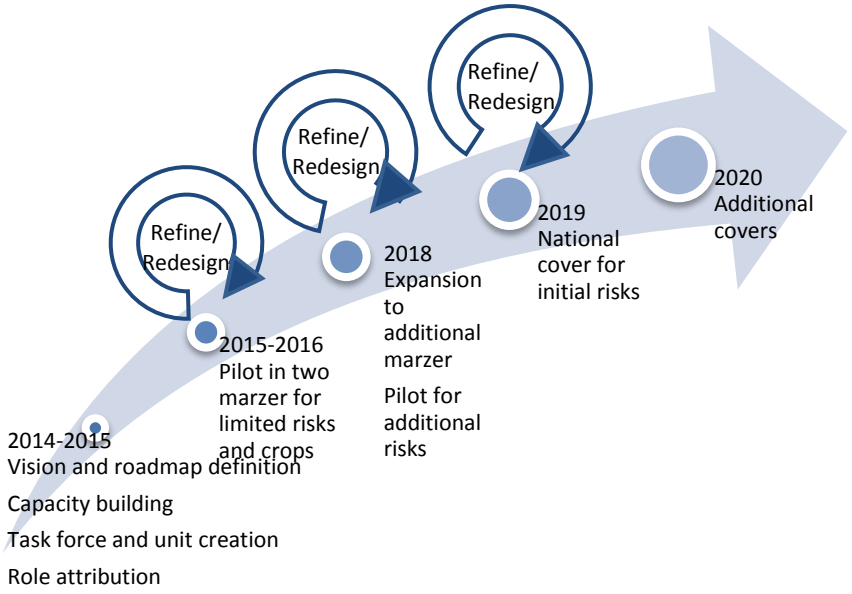


Figure 6. Example of potential steps toward a national insurance programme

The Ministry of Agriculture (MoAg) may start by **setting up a task force** in charge of leading this interdisciplinary effort, so that realistic medium- and long-term objectives are set based on the knowledge and competencies of agricultural, meteorological, and financial resource people. The task force should therefore involve key stakeholders (in particular, public sector ones from different ministries and agencies such as MoF, CBA, etc.) and, based on the Ministry of Agriculture's vision, should define clear roles for each task force participant. In addition, **a technical unit** would be responsible for moving the project forward. Specialized staff would coordinate the tasks of the public and private entities, such as the assessment of insurers, the review of the regulation by CBA[30], the stock-taking on data and infrastructure, the weather data provision by Hydromet, and other activities described in Table 7.

Once the roles and activities are defined, two tasks are essential prior to any product development:

1. All stakeholders, public and private, **must build their internal capacity** in agricultural insurance. Capacity building is crucial to ensuring the best decision-making process from the public sector and the best implementation and technical ability from the private players involved. It is therefore a major component of the first phase and a prerequisite to developing the policy vision and the implementation plan.
2. The GOA **must conduct a financial assessment** of all funds currently allocated and previously spent on crop failure relief for rural communities. This assessment will help the government to budget and reallocate support to target vulnerable producers. If some of these funds are budgeted and allocated to the insurance programme (in addition to the indirect government contributions of data collection, Hydromet services, infrastructure, etc.), the support to the rural communities would be targeted and optimal.

Donors and support

The main support donors can provide to the GOA is capacity building and exposure to relevant agricultural insurance solutions, that is, cost-efficient and targeted at small farmers. The initial costs linked to planning and setting up the insurance programme as well as to increasing infrastructure (if required) could be considered as potential interventions from international agencies.

In addition, several agencies seem to be involved in interventions around agricultural insurance; therefore coordination between donors and interventions is essential to provide the best support to the GOA.

[30] See Annex AA

Conclusion

Armenia has the opportunity to design agriculture insurance solutions for its producers. The country can rely on the data gathered by its agencies and the knowledge of its local experts. Further analysis is needed to design the insurance products and processes. Iterative processes will be required to design successful programmes but the initial information and partners are available for the development of agriculture insurance in the country. It may be envisioned that a mix of traditional and index-based insurance products could be designed in a staged process, for hail, frost and drought risks and for an initially limited cover.

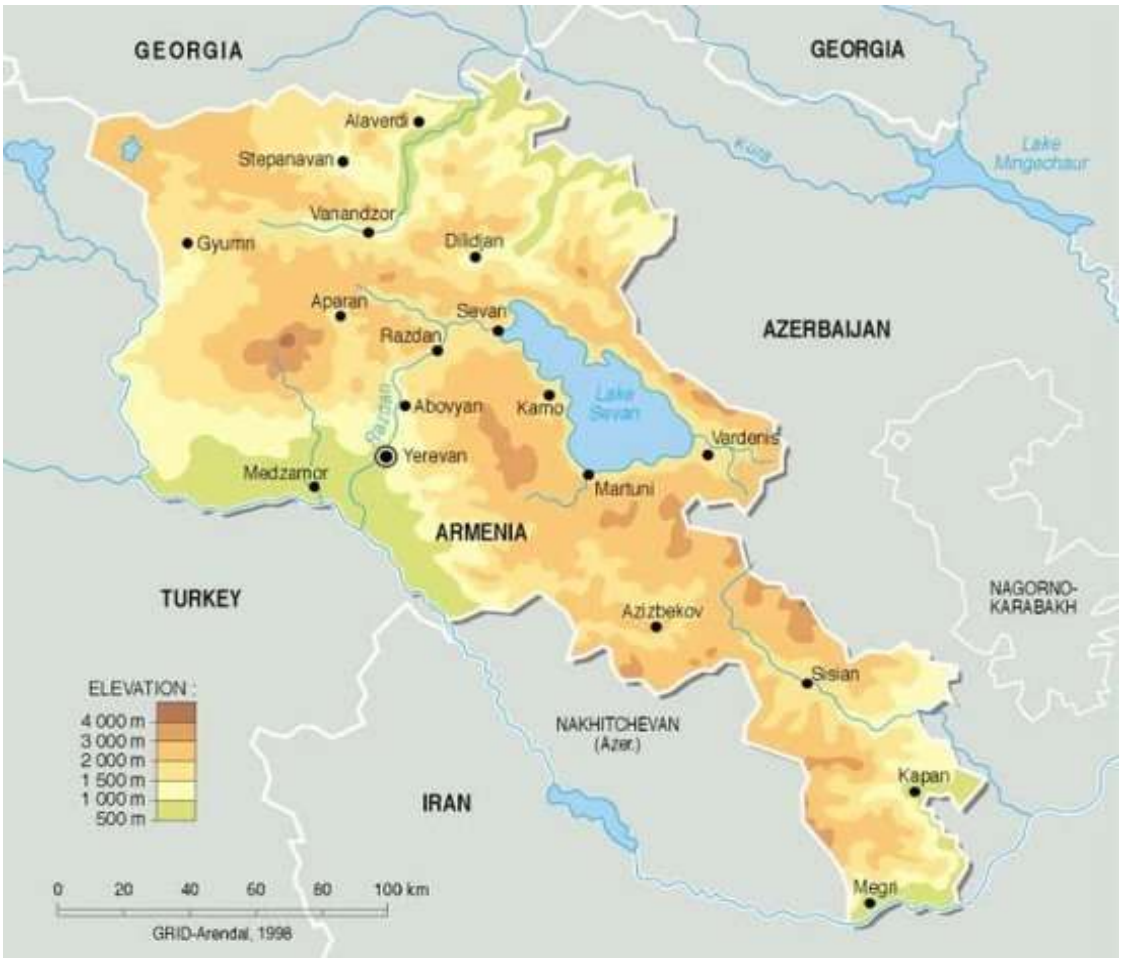
Developing a national insurance programme will require coordination among stakeholders from both the public and private sector and different stages in the expansion of the insurance programme. Distribution and risk retention, under a sound allocation of public support, will require the cooperation of the Government of Armenia, the potential distribution channels, private insurers and reinsurers as well as other national and international agencies.

Finally, while insurance is one tool to address the risks faced by the producers, its development should be framed in a broader national policy and initiatives to address the challenges faced by Armenian farmers, including climate change.

Annexes

Annex n. 1 - Maps and data

Relief



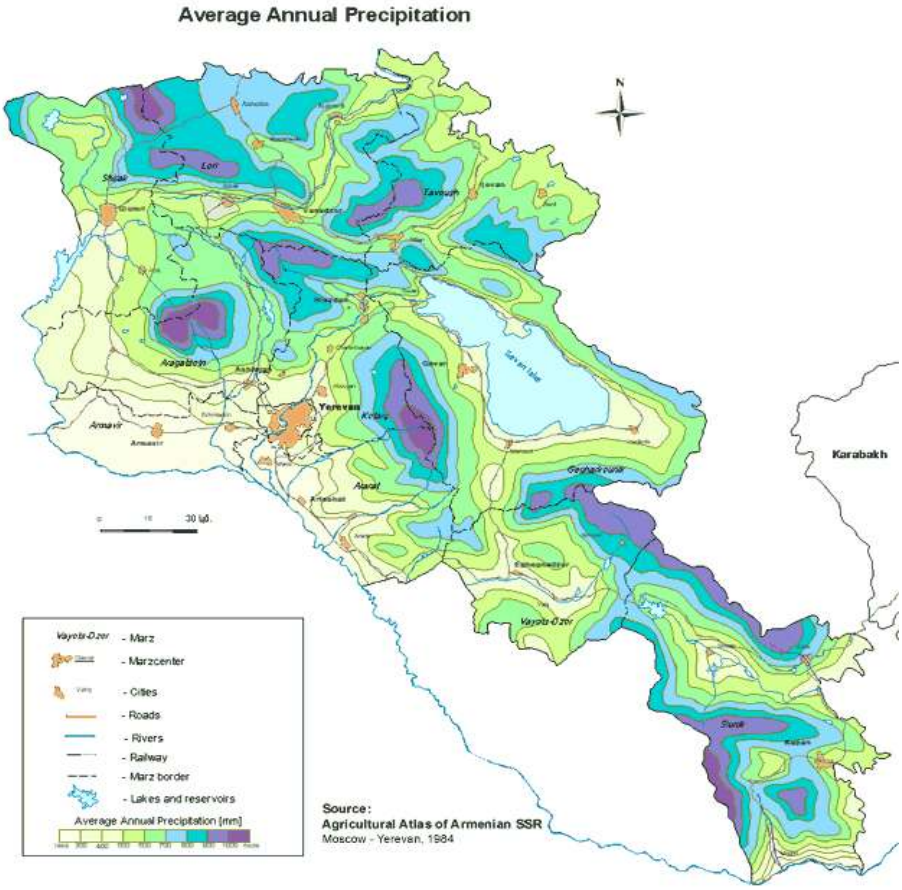
Above sea level, m	Area, in square metres	
	000’ square metres	%
400-500	0.02	0.1
500-800	0.53	1.18
800-1000	2.37	8.0
1000-1500	5.43	18.3
1500-2000	9.30	31.3
2000-2500	7.29	24.5
2500-3000	3.80	12.6
3000-3500	0.97	3.3
> 3500	0.03	0.1

Climatic zones

Agriculture production [Source ArmStat 2012 – *units not indicated*]

Annual Average Precipitation [Source: http://www.grida.no/graphicslib/]

	Sown/Planted areas						Gross Harvest					
Marz	Grains/ Leguminous	Potatoes	Vegetables	Watermelons	Fruits/ Berries	Grape	Grains/ Leguminous	Potatoes	Vegetables	Watermelons	Fruits/ Berries	Grape
Yerevan City	167	93	319	32	1,327	612	1	2	4	0	6	4
Aragatsotn Marz	23,621	1,569	978	158	6,486	1,694	65	38	31	6	67	14
Ararat Marz	5,516	896	6,406	1,380	7,299	5,120	20	28	305	65	86	100
Armavir Marz	6,569	1,567	8,790	3,438	7,729	7,033	19	52	332	131	82	103
Gegharkunik Marz	44,538	14,524	2,074	#	1,488	1	122	295	62	#	25	-
Lori Marz	9,690	3,712	1,359	10	2,571	64	21	55	18	-	6	0
Kotayk Marz	10,936	843	1,356	#	4,690	403	19	18	23	#	19	1
Shirak Marz	39,717	4,148	1,486	#	494	#	102	103	41	#	6	#
Syunik Marz	20,415	1,703	978	#	2,586	185	54	30	17	#	13	1
Vayots Dzor Marz	2,634	187	454	19	2,143	928	6	3	7	0	5	4
Tavush Marz	8,403	2,001	1,011	91	2,472	1,375	28	24	10	2	17	13
Republic of Armenia	172,206	31,243	25,211	5,128	39,285	17,415	456	647	849	205	332	241



Annex n. 2 - Examples from other countries

Table 7 - Examples of products offered [Sources: online and Annex E WB document]

Country	Type of Product and Coverage	Specificities	Premium levels and subsidy %
Cyprus (OGA)	1) Named perils covered (which vary by crop): Hail, frost, drought, rain, floods, water logging, windstorm, strong dry wind, heat wave, and warm dry air. 2) Series of exclusions; ex. Unfavorable weather conditions during the flowering of apples and stone fruits that do not exceed 60% at the community level or complex communities. In tree crops before full bloom and vines before bud. 3) Revenue insurance 4) Deductible (15-30%)	1) Compulsory insurance 2) Public insurer, no reinsurance, 3) Info on financial results (incl. admin. costs)??? 4) Distributed through farmers cooperatives and associations	50% subsidy; Vines: 5% premium (Hail , frost , hurricanes , heatwave , strong winds , XS rain, drought) Potatoes: 8% premium (Hail , frost , floods)
Israel (KANAT)	1) Example for Fruits: Basic Insurance – Compulsory, purchased by the Plant Production and Marketing Board. KANAT offers Full Coverage Insurance (optional) for MPCI & National Disaster Insurance (NDI). The optional insurance offers the farmers a higher yield and higher levels of the sum insured per hectare 2) Covers vary by crop	1) Public insurer 2) 85% penetration (as of 2008) 3) Reinsurance on the international market 4) 8M USD in subsidies in 2007 5) Combined Loss Ratio > 100% on 2003-2007 period	Subsidy: 35% for MPCI and 80% for NDI
Morocco	1) Hail cover for vineyards, arboriculture (citrus, olive and fruit trees) 2) MPCI cover for 4 cereals and 5 leguminous plants	1) Subsidy depends on farm size 2) Agricultural Mutual retaining risk (MAMDA) 3) MPCI reinsured by international reinsurer 4) Exploring WII options	Subsidy: Hail 20-40% of the premium (1.6%-4.5%) MPCI 53%-90% 260M euros in 2011-2012
Mexico	1) Indemnity-based products offered by private sector, mutuals and 'fondos', eligible for government subsidy. e.g. MPCI area-yield insurance (50-70%) 2) Catastrophic covers, index-based insurance purchased by the states' governments through private and public insurers.	1) Mix of risk carriers and schemes: Agroasemex (public), commercial companies, mutuals, and mutual funds 2) Multiple layers and role of Agroasemex beyond risk carrier (insurer/reinsurer) with technical assistance. 3) Mix of models 4) Some of the covers specifically target small-scale farmer	1) 35-60% 2) 100% subsidy
Colombia	1) MPCI cover – mostly covering banana, corn, rice, tobacco. 2) Attempt to insure small coffee producers	1) Do not reach small farmers 2) Very limited penetration	1) 30-60%
Ghana	1) Drought index insurance for maize and soya 2) Area-yield index based insurance for rubber and banana 3) Covers offered through MFIs, rural banks.	1) 19-insurers-pool and a private-public management board 2) Technical unit administrating and developing business and products 3) International reinsurer	Operational expenses shared among commercial insurers and supported (phasing out) by GIZ.

Sources:

http://www.oga.org.cy/ ;

http://www.kanat.co.il/

Emergence of Agriculture Microinsurance (MIN)

http://www.gaip-info.com/

Annex n.3 – Risks by Crop

Crop	Actual yield per Ha	Expected yield per Ha (range, agro data)	Yield variability factors (weather risks, pest and diseases, other)	Common Financing mechanism (intermediary, bank/MFI, self-financing)	Other info on production (production costs, varieties, techniques…)
All cereals	2.7	1.5-5.0	Frozen, drought	20 % banks, 80 % self-financing,	Uncomplicated crop
Wheat	2.6	1.5-6	Frozen, drought		In favorable lowlend regions
Barley	2.6	1.5-3.5	Drought		In mountain regions
Potatoes	20.1	20-60	Drought, hail, phytophtora, coleopterous worms		80% late and 20% early varieties
Grape	13.8	8-30	Frozen, hail, humidity of air /cryptogamic/		75% for wine and 25% for table grape
Watermelon & melon	40.2	20-100	Drought, hail, worms, acariens		90% watermelon, 10% melon
All vegetables	33.5		Hail, dry wind & drought /for all/		
Tomatoes	43.7	25-80	coleopterous worms		80% late and 20% early varieties
Cucumber	35.6	25-60	Air humidity		60% late and 40% early varieties
Cabbage	28.6	20-50	Worms		90% late and 10% early varieties
Carrot	18	10-30	Acariens		90% late and 10% early varieties
Onion	30	25-50	Acariens		100% late varieties
Eggplant	20	15-35	Air humidity		90% late and 10% early varieties
Pepper	15	10-25	Acariens		90% late and 10% early varieties
All fruits and berries	9.7		Winter freezing & hail /for all/		
Apricot	8.2	8-30	Early blossom frost, humidity of air /cryptogamic diseases/, worms		Only endemic varieties
Apple	11	10-50	Drayed air, worms		90% late and 10% early varieties
Peach	11.6	10-35	Air humidity, worms, early blossom frost		70% late and 30% early varieties
Pear	7	8-25	Drought, drayed air, bactérien fire, worms		90% late and 10% early varieties
Plum	8.2	6-20	Drought, worms		50% late and 50% early varieties
Strawberry	7.6	5-12	Drought, drayed air, /acariens/		20% late and 80% early varieties

Annex n. 4

United Nations Development Program (UNDP) potential pilot – Concept note

1. Concept

Considering the novelty of agricultural insurance solutions in Armenia, UNDP may consider setting up a couple of pilot projects with the following objectives:

1. To inform government decisions (impact of program, testing processes, further assessing farmers' challenges, Willingness To Pay (WTP), etc.);
2. To test a community-based insurance approach for hail or for addressing basis risk for index-based products;
3. To showcase and improve linkages between risk reduction and risk mitigation initiatives in agriculture;
4. To prove that it is possible to set up crop insurance and that it may then be scaled up.

As explained in the roadmap report, two of the main risks against which producers could protect themselves through an insurance programme are hail and frost. Both of these risks impact large parts of Armenia; products and processes may be tested in 2 locations that have different but representative characteristics.

2. Potential Product Pilot

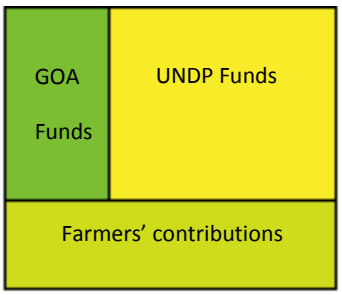
2.1 Hail

Hail cover could be offered through a **guarantee fund** approach with direct contribution of farmers and financial reserve built with donor and government support (and private sector involvement if the government prefers that option and as a 2nd layer once the programme is scaled up). Such a pilot could test community's **willingness to pay** and enrollment rate, test processes to offer such a cover to producers as well as showcase how risk and probabilities of hail occurrence and damage can be assessed.

In order to test a guarantee-fund at a small scale, the following steps may be considered by UNDP:

1. Choose **3-4 villages in the same marz**, with exposure that is neither nil nor high (i.e. based on prior analysis from Hydromet data and this in order to avoid lack of exposure thus interest from farmers in an insurance cover and to avoid high-frequency areas where insurance is not the right tool, as it would be too expensive)
2. Assess the **number of farmers** active in the selected villages and the cultivated areas – this may inform of the potential take-up and scale of pilot programme. It will be crucial to discuss with local authorities how to efficiently inform and mobilize the population. This preparation will also prepare the **communication** to producers on how the programme will be structured, and managed so that expectations are adequately set and producers understand how the programme will work. Depending on initial funding available, a maximum number of participating producers may be set based on the maximum potential loss computed based on data and farmers' participation in the pilot.
3. Define which **crops** are eligible for the hail cover (starting with the 2-3 main crops in the retained area), i.e. the crops that are at-risk and prevalent in the area. Participating farmers should be identified and information on the **area and crops cultivated** should be available for each insured and each crop cycle. This will enable defining **exposure** of the scheme and required funds to ensure payment to producers if the risk occurs. It will also enable efficient premium collection at the beginning of the crop cycle and claims payment at the end.
4. Define the insurance product **cover** (i.e. benefits of the cover and contribution, term of policy, based on agronomist input and analysis of meteorological data and cost), **processes** to report and assess impact of hail events. As discussed in the roadmap report, an individual could be in charge for each village on reporting and documenting hail events; a third party may be trained and in charge of verifying extent of damage on-site.

5. The **financial structure** of the fund may be simplified for the pilot project. However, financial contributions to the programme could include:
    a. UNDP
    b. GOA
    c. Producers
    d. Intermediary (if identified and interested in the pilot)



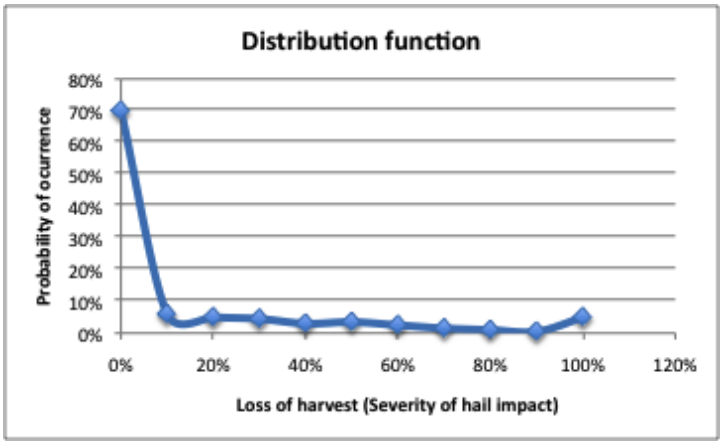
Assessing required funds and frequency of events will be challenging and prone to errors, especially on a small scale and if granular data is scarce; thorough consultation of agronomists, Hydromet and local farmers may provide a first set of assumptions to be refined in a second phase.

6. These funds may be managed by UNDP and the public authorities for the duration of the pilot. UNDP may document and share learned lessons with the GOA and private stakeholders. The funds may cover the administrative costs to set-up the pilot.

Premium and required initial funds' assessment

In order to assess the contributions and funds required, historical data and events will have to be analyzed. Ideally, the analysis should lead to summary information similar as illustrated below. This analysis along with the processes' definition and communication to farmers are crucial steps in the pilot set-up.

Severity if event - % loss of production		Frequency of event		Number of years observed (historical data)
0%	No loss	70%	14 in 20 years	14
10%		6%	1.2 in 20 years	1.2
20%		5%	1 in 20 years	1
30%		5%	0.9 in 20 years	0.9
40%		3%	0.6 in 20 years	0.6
50%		4%	0.7 in 20 years	0.7
60%		3%	0.5 in 20 years	0.5
70%		2%	0.3 in 20 years	0.3
80%		1%	0.2 in 20 years	0.2
90%		1%	0.1 in 20 years	0.1
100%	Total loss	5%	0.5 in 20 years	0.5
Risk premium rate		14.7%		20



⇨ **Premium Computation**

From the historical data and taking into account potential trends in frequency and severity of hail events, the contributions of producers may be computed. Since the benefits of the cover will differ by crop type (as potential losses differ by crop type for the same event), the premium may be set based on the following criteria:

+ Location (if exposure is perceived as significantly different from one village to another)
+ Crop type
+ Area cultivated

Benefit of hail cover	1,000,000
Premium to be paid	147,000

For example, if the insurance cover for grapes is 500'000 AMD per Ha, and for the 3-4 retained villages considered, the premium rate calculated is 14.7%; then the premium to be paid by a 1-Ha vineyard owner is 147'000AMD.

⇨ **Initial funds required**

In order to ensure the liabilities of the funds toward the enrolled producers are met, a sufficient provision fund should be established. This reserve should be able to pay the maximum loss possible in a year. Determining the funds required will depend on the enrollment numbers (producers and sum insured). These funds should be sufficient to cover claims and operational expenses for the duration of the pilot.

2.2 Frost

Unlike hail, hedging against frost will require risk transfer to a private insurer as all producers in the area selected will be impacted at once by a frost event. It would therefore deplete the funds from public players under a guarantee fund programme or require very large amounts to face the liabilities of offering a frost cover in a limited area. A suggestion, as described in section 2 of the report, would be to use an index-based product for frost risk. Piloting such a cover may be an opportunity to test: if temperatures can be modeled in a mountainous area of Armenia thanks to a software, to which extent producers are willing to bear the basis risk, what type of events they consider crucial to protect themselves against and if a PPP for an agricultural insurance cover is feasible.

In order to test a an index-base product at a small scale, the following steps may be considered by UNDP:

1. Identify one Hydromet weather station for which reliable long-term temperature data is available. Choose 3-4 villages in the same marz, close enough from this weather station, with frost exposure that is neither nil nor high (i.e. based on prior analysis from Hydromet data and this in order to avoid lack of exposure thus interest from farmers in an insurance cover and to avoid high-frequency areas where insurance is not the right tool, as it would be too expensive).
2. Assess the number of farmers active in the selected villages, whose crops are exposed to frost (e.g. orchards). Discuss with local authorities how to efficiently inform and mobilize the population. Carefully prepare the communication to producers on how the programme will be structured, and managed so that expectations are adequately set and producers understand how the programme will work.
3. Design a product cover based on the crops in the area and the risk for harvest loss (i.e. eligible crops, cover period, trigger of index, sum insured/benefits, costs of cover based on historical frequency of frost events and trends observed and anticipated etc.). This technical phase will required a joint work between an insurer, Hydromet experts, agronomists and UNDP. [See report for details]
4. The financial structure (from the public sector perspective) may be simpler than for hail as premiums may be transferred to the private insurer (ceding part of the risk to a reinsurer may not be required if the pilot has limited scale and time required and costs of setting reinsurance outweigh the financial risk for the private insurer). Funds may be allocated though, to cover both administrative expenses and frost-related risk premium.
5. An option for testing the cover design would be to split the contributions between the insurance product and a side-fund that would partially compensate for the losses that are not captured by the index. This may require more community involvement and be challenging but would assess how basis risk can potentially be addressed.
6. The management of the pilot may be jointly undertaken by UNDP and a private insurer to test the PPP concept and promote experience sharing.

⇨ **Premium assessment**

The risk premium will be assessed thanks to the weather station historical data (Burn Analysis) and taking into account trends detected (increasing or decreasing severity and frequencies of low temperatures observed). The expenses linked to the pilot programme will have to be accounted for. (The premium calculation may be done by a statistics expert with input from Hydromet staff and supervision of an insurance specialist)

⇨ **Funding and risk transfer**

Since risk will be borne by a private insurer, funding from the public stakeholders may be limited to the operational expenses as well as some human resources to set up the programme, unless the public stakeholders decide to contribute to the premium payment.

3. Potential location(s)

The pilot could be developed for 2 locations in order to test the concepts:

- in a location that has less basis risk for the frost product vs. a mountainous location
- among producers with different ability to pay, access to markets and community ties.

3.1 Ararat Valley (fruits/vineyards)

Covers: hail and frost through products described in Section 2.

Advantages	Challenges
Uniformity of exposure	Trust and communities ties may be low
Better connection with value chain and presence and penetration of financial institutions as a distribution channel	Wealthier producers may not be interested
Greater ability to Pay (ATP)	
Easy access for implementation and monitoring.	
Impact in terms of number of farmers covered could be important, considering production in the region. Could be a pilot for scaling up.	

3. 2 More complex location (fruits/vineyards), less densely populated, more remote/mountainous area

Covers: hail and frost hail and frost through products described in Section 2.

Advantages	Challenges
Tighter community ties (thus willingness to pool risk)	Basis risk for index-based product if weather station cannot cover area
May not have alternative financial tools to protect themselves: greater need and interest in insurance	Potential requirement for extrapolation of temperature data
	Less credit access so other channels would have to be found to reach farmers
Impact	

⇨ **Timeline: 2015-2016; about four to eight months may be required to design and offer the cover to producers on a pilot basis.**

Annex n. 5 - Glossary

Term	Definition
Adverse Selection	Tendency of persons with a higher-than-average chance of loss to seek insurance at standard (average) rates, which, if not controlled by underwriting, results in higher-than-expected loss levels.
Agent	An insurance company representative who solicits, negotiates or effects contracts of insurance, and provides service to the policyholder for the insurer, usually for a commission on the premium payments.
Basis Risks	For index-based insurance, it is the risk that some affected insureds will be compensated too little or not at all while others with a only small loss or no loss will be overly compensated. This happens because compensation is not based on the each insured's actual loss but on an index formula which is a proxy for estimating the average losses of all insured's.
Benefits	The amount payable by the insurance company to a claimant, assignee or beneficiary under each coverage.
Beneficiary	The person or financial instrument (for example, a trust fund), named in the policy as the recipient of insurance money in the event of the occurrence of an insured event.
Broker	A sales and service representative who handles insurance for clients, generally selling insurance of various kinds and for several companies. Brokers resemble agents, except for the fact that, in a legal sense, brokers represent the party seeking insurance rather than the insurance company.
Claim	A request for payment of a loss that may come under the terms of an insurance contract.
Claims incidence	For a sample of insureds for a particular period, it is the number of claims or claimants divided by the number of insureds. This is a statistic often used by actuaries as an estimate for the true underlying probability that an insured from the sample will make a claim.
Coinsurance	In the most general sense, coinsurance refers to the insured retaining a portion of the insured risk. It can take many forms, but usually it means that the insured will have to pay a portion of the incurred expense.
Covariant risk	A risk, or combination of risks, that effects a large number of the insured items/people at the same, for example an earthquake, or a major flood.
Coverage	The scope of protection provided under a contract of insurance, and any of several risks covered by a policy. Credibility theory A branch of actuarial science that tests the validity of data.
Coverage term	The length of time coverage is in effect before it must be renewed. This applies mainly to term products. Some types of insurances need not be renewed; these are generically called permanent insurance.
Earned premium	The premium income in a period minus change in unearned premium reserve for the same period. A premium payment is made to purchase insurance cover for a defined period. Accrual accounting principles require that the premium is earned over the duration of that period, and in a pattern that reflects the expected incurred expenses and claims over the period. Thus, at any point during that period, the portion of the premium that has been earned to that point is called the earned premium.
Exclusions	Specific conditions or circumstances listed in the policy for which the policy will not provide benefit payments.
Exposure	The possibility of financial loss based on the probability of an event occurring.
Group Insurance	Insurance written on a number of people under a single master policy, issued to their employer or to an association or other organization with which they are affiliated.
Incurred claims	Incurred claims are those where the insured event has happened, and for which the insurer may be liable if a claim is made. An insurer is usually not aware of all incurred claims at a particular point in time or for a current accounting period. To estimate incurred claims for a current accounting period, the following estimate is made: benefits paid during the period plus the change in reserves set aside for benefits to be paid after the period. Reserves typically include incurred but not reported claims, claims in course of

	settlement, and accrued liabilities reserve.
Insurable interest	A party is said to have an insurable interest in X (a person, object, or something else) if a loss of X or damage to X would result in an emotional, financial, or other type of significant loss to that party.
Insured	The policyholder - the individual(s), businesses, other organizations or entities protected by an insurance policy in case of a loss or claim.
Loss Ratio	For insurance, the loss ratio is the ratio of total losses incurred (paid and reserved) in claims plus adjustment expenses divided by the total premiums earned.
Moral Hazard	Hazard arising from any non-physical, personal characteristic of a risk that increases the possibility of loss or may intensify the severity of loss for instance bad habits or low integrity. An example might include failing to properly care for an insured goat because it is insured, thereby increasing the chance it will die of disease.
Mutual scheme	An insurance scheme where the insured persons are also the owners of the scheme.
Policy	The printed document issued to the policyholder by the company stating the terms and conditions of the insurance contract.
Policyholder	A person or entity that pays a premium to an insurance company in exchange for the coverage provided by an insurance policy.
Portfolio insurance	A method for lenders used to manage the mortality risk of borrowers affecting their loans portfolio, it is insurance coverage that reimburses the lender for a portion of a deceased borrower's outstanding loan balance.
Premium	The sum paid by a policyholder to keep an insurance policy in force.
Reinsurance	A form of insurance that insurance companies buy for their own protection. One or more insurance companies assumes all or part of a risk undertaken by another insurance company.
Risk carrier	Entity that bears the financial risk resulting of the insurance provision.
Risk pooling	Spreading of losses incurred by a few over a larger group, so that in the process, each individual group members losses are limited to the average loss (premium payments) rather than the potentially larger actual loss that might be sustained by an individual. Risk pooling effectively disperses losses incurred by a few over a larger group.
Sum Insured	This is the sum of all individual benefits.
To cede risk	To transfer all or part of a risk written by an insurer to a reinsurer.
Underwriting	Process of selecting risks for insurance and determining in what amounts and on what terms the insurance company will accept the risk.
Written premium	When an insurer assumes a term contract, premiums expected to be received over the life of the contract are called gross written premium. After reinsurance premium is deducted from this it is called net written premium.

Source: Microinsurance network glossary http://www.microinsurancenetwork.org/glossary
and Microinsurance Centre glossary http://www.microinsurancecentre.org/resources/glossary.html .

Annex n. 6 – Meeting Schedule in Armenia

9 July 2014 (Wednesday)			
09:45-11:30	Project Office	• Meeting with the CRM Project Team; • Discussion and finalization of the Mission Agenda;	• Ms. Diana Harutyunyan, Climate Change Related Programme Coordinator • Mr. Aram Gabrielyan, UNFCCC National Focal Point • Ms. Rubina Stepanyan, Climate Change Related Projects Associate • Ms. Gohar Hovhannisyan, Project Task Leader • Mr. Vardan Melikyan, Project Expert • Mr. Ara Hovhannisyan, Project Expert • Ms. Tatevik Vahradyan, Expert Team Assistant
12:00-13:00	State Univ. of Economy, 10th floor, Amberd research center	• Meeting with the Expert	• Mr. Samvel Avetisyan Director of "Amberd" Research Center
13:30-14:15	Bio resources management agency	• Meeting with the head of agency	• Mr.Artashes Ziroyan Ministry of Nature Protection
14:30-15:30	UN House in Yerevan	• Meeting with Environmental Governance Portfolio	• Mr. Armen Martirossyan, EG Portfolio Analyst • Mr. Georgi Arzumanyan, Programme Policy Adviser
10 July 2014 (Thursday)			
11:00-12:00	Ministry office	• Ministry of Agriculture	• Mr. Armen Harutyunyan (Deputy Minister) • Mr. Hrachya Tspnetsyan, Head of Rural development Department
12:15-13:45	Project Office	• Insurance Association, head	• Mr. Andranik Ohanjanyan
14:15-16:00	Hydromet 2nd floor, conference hall	• National Hydromet Service	• Mr. Hamlet Melkonyan, Deputy Director • Ms. Zara Petrosyan, Head of Operational Hydrometeorological Centre • Kamo Hayrapetyan, Head of Hydrology and Ecolody Center • Levon Azizyan, Head of Hydrology Center
16:00-16:30	• Ministry of Territorial Administration	• Ministry of Territorial Administration	• Mr. Ashot Giloyan
11 July 2014 (Friday)			
11:00-12:00	Ministry of Finance	Ministry of Finance	Armen Melkikyan Head of international relations department
13:30-14:30	GIZ office	GIZ, KFW	• Bella Andreasyan
14:45-15:45	FAO office	FAO	• Ms. Gayane Nasoyan,
16:00-17:00	Project office	• Armenian National Agrarian University	• Ms. Gohar Voskanyan, Lecturer
14 July 2014 (Monday)			
10:00-11:00	Central Bank office	Central Bank of Armenia	• Mr. Andranik Grigoryan, Head of Methodology Department
14:30-15:30	IFAD office	IFAD	• Mr. Alexandr Kalantaryan, Head of Development Division
16:00-17:00	CARD office	CARD	• Mr. Karen Petrosyan, Executive Director • Ms. Hasmik Altunyan, Project Manager • Mr. Gagik Sardaryan (out of city) • Mr. Manuk Petrosyan (out of city)
15 July 2014 (Tuesday)			
11:00-12:00	FREDA office	FREDA	• Mr. Tigran Khanikyan, Director
15:00-16:00	INGO office	• Insurance Companies: INGO ARMENIA	• Mr. Artak Martirosyan, Head of Special Projects Unit • Mr. Harutyun Gevorgyan, senior Underwriter

16 July 2014 (Wednesday)			
11:00-12:00	Rosgosstrakh office	• ROSGOSSTRAKH-ARMENIA	• Ms.Gohar Hakobyan, Head of New Product Development Division
12:30-13:30	Hydromet office	• Meeting with the Project Expert	• Ms. Zara Petrosyan
14:00-15:00	Farm Credit office	Farm Credit	• Hrant Yeghiazaryan, Deputy Director
16:00-17:00	ICARE office	ICARE	• Mr. Vardan Urutyan, General Director
17 July 2014 (Thursday)			
9:30 -10:30	ACBA office	Head of Credit department	• Nazaryan Norik (noriknazaryan@acba.am)
11:00-12:00	World Bank office	World Bank	• Ms. Arusyak Alaverdyan, Operations Officer
15:30-17:30	"Huso tun"	Round table discussion with different organizations:	ARNAP (Disaster Risk Reduction Platform), OXFAM, Insurance company, UNDP DRR Project…
18-19 July 2014 (Friday-Saturday)			
All days	Tavush region	Meetings with the farmers (Tavush marz):	• Noyemberyan region • Berd region
21 July 2014 (Monday)			
First half of day	Project office UNDP office	Meeting/discussion/finalization	• Armen Martirosyan, UNDP DRR Program Coordinator • Diana Harutyunyan, UNDP Climare Change Program Coordinator
22 July 2014			
14:00-15:50	Aviatrans hotel	Presentation during the workshop.	All interested parties.
16:00-16:30	UNDP office	• De-briefing with UNDP CO Senior Management	• Ms. Claire Medina, DRR

References

Weather

http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisRegion=Asia&ThisCCode=ARM#

http://www.britannica.com/EBchecked/topic/35178/Armenia/44249/Climate

http://en.wikipedia.org/wiki/Geography_of_Armenia

Agriculture Maps and Data

http://www.fao.org/countryprofiles/maps/en/?iso3=ARM

http://www.fao.org/ag/agp/AGPC/doc/Counprof/Armenia/Armenia.htm

http://www.fao.org/docrep/007/ad878e/ad878e03.htm

http://armstatbank.am/

http://www.fao.org/fileadmin/user_upload/eufao-fsi4dm/docs/Armenia_highlights_Oct-Dec_2012.pdf

Rural Credit and Finance Overview in Armenia, Vardan Urutyan

Risks

http://www.preventionweb.net/files/12368_ReportArmeniaDisasterRiskReductiona.pdf (see table 2 p8)

http://www.worldbank.org/projects/P117069/swiss-seco-south-east-central-europe-catastrophe-risk-insurance-facility?lang=en

http://country.eiu.com/armenia

http://go.worldbank.org/696KRWGRD0

http://card.am/wp-content/uploads/2013/01/Armenia_highlights_April_June_2012_ENG_PDF.pdf

http://arka.am/en/news/economy/ingo_armenia_may_become_a_pioneer_in_offering_agricultural_insurance_in_republic/

Frost protection: fundamentals, practice, and economics, Richard L Snyder and J. Paulo de Melo-Abreu, FAO Environment and Natural Resources Service Series, No. 10 - FAO, Rome, 2005
ftp://ftp.fao.org/docrep/fao/008/y7223e/y7223e00.pdf

Agriculture Insurance

The Emergence of Agriculture Microinsurance, Sandmark and al., MiN (2013)

Agriculture, Microinsurance, and Rural Development, A thematic paper by Silvia Müller, Gaby Ramm, and Roland Steinmann

Agricultural Insurance, Ramiro Iturrioz, Primer series on insurance, Issue 12, November 2009, World Bank, http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/Primer12_Agricultural_Insurance.pdf

Weather Index-Based Insurance in Agricultural Development, A Technical Guide, W. Dick and A. Soppa, WFP-IFAD publication

WEATHER INDEX INSURANCE FOR AGRICULTURE: Guidance for Development Practitioners, Agriculture Risk Management Team (ARMT) of The World Bank, World Bank publication https://www.agriskmanagementforum.org/doc/weather-index-insurance-agriculture-guidance-development-practitioners

https://www.vito.be/EN/HomepageAdmin/Home/Nieuws/Nieuwsberichten/Pages/news_remote-sensing_insurances_Africa.aspx

http://www.lnt.ma/finance/la-mamda-20-ans-dexperience-dans-la-couverture-de-lalea-climatique-96229.html