MED-Amin Policy Brief n°2

Crop forecasting: An early-warning system for the Mediterranean region?

MED-Amin
Mediterranean Agricultural Market Information Network

1) Facing a complex cereal market, Mediterranean countries need an efficient crop forecasting system.

a. Crop conditions can be monitored remotely

Crop conditions monitoring at the regional and national scale using remote-sensing indicators is crucial to reinforce the information and transparency of agricultural markets. Such monitoring activities are currently organized around five main dimensions: the estimation of biomass and yields, the monitoring of droughts' impact, of phenological stages, of planted surfaces and of land use (changes in land use, fallowing, etc.). In a recent global environment that highlighted the importance of making available tools e to enhance market transparency, in particular to prevent speculation, it seems critical to have the relevant means to monitor planted surfaces and the development of crops in near real-time, in relation to the observed agrometeorological conditions. Such information allows decision-makers to fine-tune their imports/exports, marketing and internal-prices strategies with the final goal of ensuring the food security of the populations (Kogan et al., 2012).

b. Many initiatives already exist

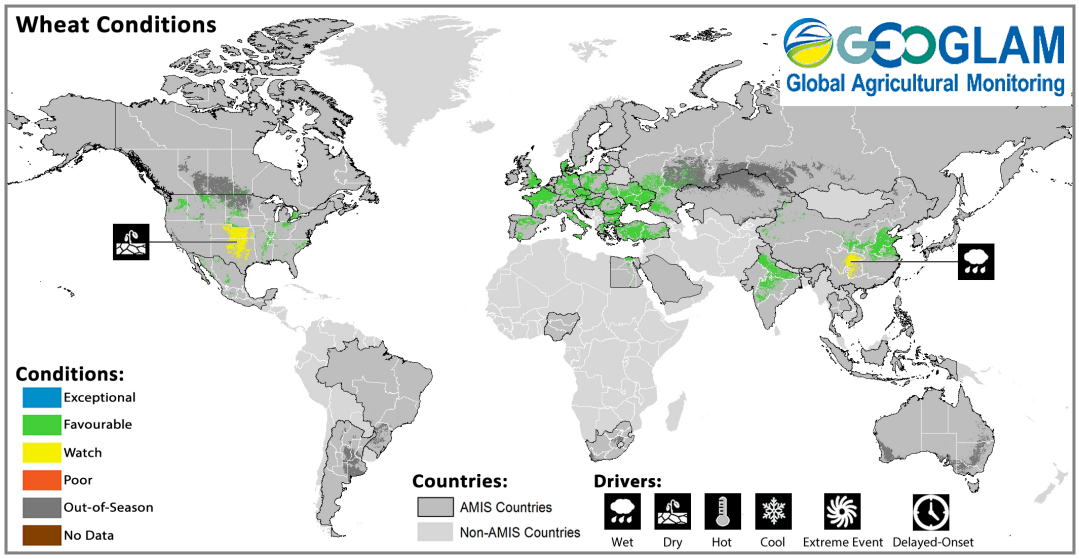
The US Department of Agriculture (USDA) has already established the GLAM System (Global Agriculture Monitoring Project) and benefits from easily accessible data based on tested remote-sensing indicators. As such, it is in a unique position as regards the global monitoring of crop conditions. In parallel, other initiatives have been developed at the regional (MARS in Europe, Asia-RiCE and AFSIS in Asia,…), national or international levels (FAO's Global Information and

The GEOGLAM initiative promoted by the G20 aims at federating those initiatives in order to organize information and methodology-sharing, and even harmonisation. GEOGLAM is also responsible for the production of crop conditions' analysis bulletins (integrated to the AMIS's Market Monitors).

c. Models can still be improved but ground-based expertise remains crucial

Early-warning systems correspond to a more advanced stage as compared to crop monitoring or forecasting systems, as they establish a link between "risks" and risk management requiring communication actions and the direct involvement of a wide community of actors (Pulwarty et al., 2014). Recent researches show that simple analyses based on remote-sensing indicators and on quality statistical data can provide a robust indication of the shocks (positive or negative) to be expected on future harvests (Becker-Reshef et al., 2010, Kogan et al. 2011, 2012).

The improvement of such analyses requires new methods to cover yields variability and the forecast of grains quality, based in particular on a fine analysis of the agro-climatic conditions observed between the emergence and the maturity of plants. While the effect of droughts is well-captured by current models, sp ecific methodologies covering the impact of excessive rainfalls are still being developed. In the future, the expected development of mid- and high-resolution satellites should allow the development of new applications, as technological progress will allow for a lowering of access costs.



GEOGLAM: A global initiative for crop conditions monitoring
(Synthesis of the situation "Wheat", April 2017, AMIS Crop Monitor)

However, human expertise and ground observations remain crucial. Obtaining data on precise development stage calendars and/or calibrating indicators require cooperation with ground-level personnel. Such active cooperation between ground experts and technical services specialized in the analysis of satellite indicators requires the production of reliable and easy-to-use indicators. The final goal is to allow real-time transmissions of alerts. The ASAP system (Anomaly hot Sport of Agricultural Production) currently being developed by the MARS Unit in Europe follows such a purpose.

MED-Amin

is a multilateral network established between the CIHEAM's 13 member countries, at their request, working at promoting quality information regarding the evolution of cereal markets and at fostering experience-sharing on the best practices in terms of cereal policies. The network brings together Algeria, Albania, Egypt, France, Greece, Italy, Lebanon, Malta, Moroco, Portugal, Tunisia and Turkey. Learn more at: www.med-amin.org or on Twitter: MEDAmin_network

CIHEAM
International Centre for Advanced Mediterranean Agronomic Studies

2) Implementing a cereal productions forecasting system

As a complement to the existing global information systems for the monitoring of international markets such as AMIS, and in addition to national systems, it may be useful to collect and make available real-time information in order to get the best possible estimate of the impact of agro-climatic events on cereal productions before harvests in order to estimate harvests at the regional level.

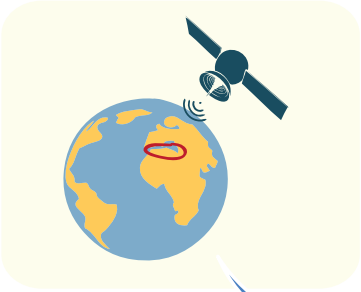
A MED-Amin system for crop monitoring and early-warning on harvests is presently under consideration. It would aim at accompanying countries in their forecasting effort and would participate to the objectives of capacity-reinforcement and relevant information-sharing to produce forecasted cereal balance sheets in the future.

Accordingly, MED-Amin launched an original initiative aiming at the construction of a cereal productions forecasting system within the Mediterranean area. Following the decisions taken in December 2016 during the MED-Amin network meeting in Tunis, MED-Amin has launched a pilot working group to analyse a set agro-meteorological indicators at the subnational level observed within the participating countries.

This working group uses satellite indicators relative to wheat growth conditions, thanks to the support of the MARS Unit. It endeavours to provide a qualitative estimation of the harvests in 2017. This pilot activity establishes both a regional dialogue between focal points and international experts (MARS and FAO) and a national dialogue between central analysts and services dedicated to crop and harvest monitoring on the ground. Indicators produced or collected by MARS will be communicated to the participating countries allowing the detection of significant agro-climatic events relative to the monitored crops. These indicators will also be cross-referenced with data collected on the ground by local experts. The activity will result in a qualitative analysis of production forecasts for the participating countries.

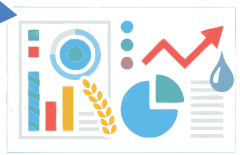
Such activities will lead also to an improvement of forecasted cereal balance sheets. Indeed, MED-Amin provides countries with guidance on the progressive realization of forecasted balance sheets that bring forward the main components of supply and demand (production, consumption, trade, stocks…) on the short-term. Such balance-sheets allow the early forecast of required imports and exports to be realized. This early information should allow enhanced positioning opportunities on international markets. On the long run, robust and regularly updated forecasted balance sheets are a necessary basis to the elaboration of response plans to ease frictions (logistical, etc.) and to build "win-win" international purchasing strategies with the aim of reducing purchasing costs for importing countries.

MED-Amin's crop monitoring system: Working principle



1) Satellite data produced by the European MARS initiative or by local authorities

The produced indicators (vegetative growth, meteorological data...) allow for interannual comparisons and subregional analysis



2) Compilation and transmission to MED-Amin focal points, through the Secretariat

After a selection realized by the countries of the subnational regions to be monitored in priority, the list of indicators for these regions is transmitted to the focal points through the intermediary of the MED-Amin Secretariat.

3) Cross-comparison of remote-sensing indicators and ground-observation based indicators

Using these indicators, the focal points, supported if necessary by local experts, are responsible for the detection of the specific agroclimatic events that may impact future harvests.
This analysis must be cross-compared with data extracted from ground observations.

4) During MED-Amin working group's virutal meetings, an evaluation of impact is realized

For each of the analyzed subnational regions, an evaluation of the potential impacts of the observed conditions is produced on a 5-levels scale (Crop failure, Poor, Watch, Good, Exceptionnal) so as to realize a MED-Amin regional synthesis of the crop forecasts.

5) Production of a Bulletin

The synthesis produced during the meeting will be transcripted under the form of a bulletin featuring a qualitative evaluation of upcoming harvests aggregated at the MED-Amin regional level.

The above-mentioned working group builds upon existing ground-monitoring and remote-sensing systems. These systems are briefly presented hereafter using a survey realized by MED-Amin.

b. Ground-based crop monitoring mechanisms within MED-Amin countries

MED-Amin countries rely on a diversity of crop conditions monitoring systems that is often a result of their specific agricultural ministries' development history, of the organisation of agricultural policies, or of their administrative divisions.

- **Albania** Monitoring activities are implemented in the 13 most agricultural regions of the country. In each municipality, a local expert proceeds twice a month to the monitoring of a selection of farms (covering about 70% of the agricultural production). Data collection is organized in collaboration with the Regional Agricultural Registry. The presence of experts on the ground is also an opportunity for extension and direct consulting to farmers, as well as continuous monitoring of crop conditions.
- **Algeria** The authorities have implemented a two-phases yields survey: the first phase (April-May) occurs at an early maturation stage and does not allow for a direct measurement of yields. The second phase is realized in June: cuttings and weightings are realized directly.
- **Egypt** Egypt relies on a system of ground-based monitoring declined over three levels (villages, districts and governorates), and on a compilation and results-evaluation process starting at the district level.
- **France** The crop monitoring system is organized around two modalities: from a quantitative point of view, outlook estimates are based on the assessment of a network of experts mobilised in each French region. Additionally, the "Terres Labourables" survey is based on the interrogation of 13000 farmers in three waves per year and covers planting intentions, as well as the observed post-harvest yields. A weekly monitoring of crop conditions development stages is also realized. This programme, called "Céré'Obs" provides a representation of crop conditions all along the campaign.
- **Greece** The country relies on a survey system covering land monitoring, planted and harvested areas and crop conditions. An early-warning system also exists in Greece, mainly focused on parasites, pests and diseases detection.
- **Italie** ISTAT is the official source of information for areas, yields and production estimates. A computer-assisted telephone interview is realized between November and December covering a sampling of farms with the aim of collecting data on planted areas for each crop. The results of this survey are published in February. The validation of these results, as well as the collection of further data on yields and crop conditions, is provided by regional agricultural offices during the month of July, by successive waves until total consolidation is reached, usually by the end of the year.
- **Lebanon** Data collection is organized in Lebanon on agricultural areas and meteorological conditions. It is organized on the one hand as a random-evaluation whose purpose is to estimate planted and subsidised areas for durum wheat and barley, and on the other hand as a calibration of a satellite system currently being developed for the monitoring of vegetative covers and meteorological conditions for durum wheat.
- **Malta** Malta does not produce cereal for human consumption, the local production being limited to fodder. The country is however affected by meteorological conditions and climate change.
- **Morocco** The cereal crops monitoring mechanism in Morocco is based on areas and yields estimates. The evaluation of cereal areas is realized annually from an areal sampling distributed on 3.000 segments (covering about 19 million hectares). Ground-based monitoring missions are realized between February 10th and March 30th for each campaign and the publication of provisional productions are released around mid-April.
- **Portugal** The data collection system relies on a mixed system based on surveys (national and sampling-based) realized on farms (through interviews) and on other operators (cooperatives, companies, etc.), administrative registries, and other sources. The system covers cultivated areas, crop conditions and yields, on a monthly basis. The monitoring of harvests conditions is externalised to correspondents of the agricultural ministry's regional offices, as they have developed networks of contacts, within their area of influence, who are visited systematically: local producers and cooperatives, ground-based local experts and private entities.
- **Spain** The statistical monitoring of harvests is organized around two components: on the one hand, a system "AVANCES" for the early estimate of planted areas and production is implemented by technicians from territorial administrations (autonomous communities). It is based on mixed methods of data cross-matching (surveys realized with operators and cooperatives, administrative registries, technical measurements of production). On the other hand, the "ESYRCE" program is a survey based on direct ground observation and sampling, covering planted areas and yields for the different crops.
- **Tunisia** The country introduced in the beginning of the 1970s a system aimed at estimating production and cereal yields based on sampling and material measurement of production (selection of sampled plots, harvesting and weighting). The estimation of the cereal production is realized during the June-July period for each agricultural campaign. This activity is realized by regional services annually, in two successive waves per cereal region. The results are centralized afterwards.
- **Turkey** Data collection is organized in three sessions each year (May, October, December) and covers areas and yields. Data are sourced from province and district registers and from surveys realized within farms, agricultural chambers or through field tours, etc. Additionally, Turkstat has organised two pilot surveys aiming at the production of agricultural statistics in line with European Union norms.

c. Distance-based monitoring systems within MED-Amin countries

EU EU member countries benefit from a crop conditions monitoring and forecasting for harvests realized by the Joint Research Centre (JRC) MARS team to support the European Commission's market monitoring. Countries may also have implemented independent projects for the satellite monitoring of cereal production. For example, Italy is reactivating the AGRIT project that had been left in stand-by for the last few years, under the form of a project combining remote-sensing data (aerial snapshots and satellite data) with ground-based data. As another example, Spain benefits from a satellite system focused on grasslands and rainfed arable lands, allowing for an early detection of hydric stress. The system also monitors areas affected by negative meteorological events (drought) and should soon allow central services to estimate yields.

Algeria A satellite-based system has been set-up to follow the progress of agricultural campaigns and provides snapshots of areas meeting difficulties. A quantitative system also allows the calculation of harvest forecasts based on statistical models. This system, covering durum wheat, soft wheat and barley, is currently being developed in partnership between JRC, INRAA and the Direction of Agricultural Statistics and Information Systems within the Ministry of Agriculture, Rural Development and Fisheries.

Egypt Egypt relies on remote-sensing capabilities applied to agriculture through its National Authority for Remote Sensing & Space Sciences (NARSS) funded in 1971. In the framework of its programme called "Agriculture applications, Soils and Marine" (AASMD), a national integrated information system on agricultural resources is used with the main purpose of monitoring the different crops, and is coupled with ground-based data. This program also promotes regional and international cooperation in the agricultural and marine fields for the reinforcement of national capabilities.

Lebanon The calibration of a satellite-based system is currently underway to monitor vegetative covers and meteorological conditions for durum wheat.

Morocco The monitoring of cereal harvests through satellite images is realized by CGMS-Morocco (Crop Growth Monitoring system), a system developed through international cooperation (with VITO, JRC, Wageningen and the Milano University). At the national level, CGMS-Morocco is managed by INRA and supervised in a consortium bringing together the National Direction of Meteorology (DMN) and Direction of Strategy and Statistics (DSS/MAPM). The system is coupled with data collected from meteorological stations and with data originated from statistical surveys realized by the Ministry of Agriculture. The integration of satellite and ground-based data results in the publication of a bulletin.

Turkey Turkey benefits from a system for the satellite monitoring of vegetative covers (NDVI, Modis) coupled with different meteorological systems (rainfall, evapotranspiration, crop water requirements) to monitor durum and soft wheat. The country has implemented an integrated system for agricultural monitoring (TARBIL) based on ground-based, remote-sensing, meteorological information as well as on market monitoring and on data collected directly from farmers using mobile applications.

Recommendations for decision-makers

Depending on the available human resources, countries may choose between deploying a public system or relying on a network of experts and private local contacts to monitor data on the ground.

In any case, they need to make sure:

- That sufficient local capabilities exist to realize ground-based monitoring or that such a network could be implemented for this purpose;
- That the country can rely on sufficient capabilities for the analysis of remote-sensing data and of the relevant agro-climatic indicators at the central level;
- That the coordination between the staffs of the different institutions and services involved is robust and responsive;
- That information arising from the local levels are brought up to the national level without delay and that it is freely made available to the actors involved in the implementation of early responses to identified risks (farmers' protection, substitution imports, etc.);
- That the country has possibly implemented, updated and activated contingency plans including triggering conditions;
- That action plans are tested and evaluated, in particular thanks to the experience feedbacks from professionals involved at the different stages of the value-chain;
- That actors involved in the implementation of action plans have been sufficiently trained and mobilised, and that they are ready to work in an adequate environment also featuring feedbacks.

Going further

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