Policy Brief

Agri-Environmental Indicators Monitoring System (AEIMS): A tool to support decision making on achieving agricultural sustainability

ECOserve Environmental Programme

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June, 2022

1. Summary

The AEIMS is designed to assess trends in the use and status of natural resources in agriculture and the quality of ecosystem services as well as to monitor the negative impact of agricultural production on the environment, thereby supporting agricultural sustainability and promoting environmental protection. The following six indicators have been selected for the establishment of AEIMS: i) Consumption of mineral fertilizers; ii) Consumption of pesticides; iii) Irrigated areas; iv) Water abstraction; v) Water pollution - Nitrogen (N) & Phosphate (P); and vi) Pasture degradation. AEIMS allows to track the complete process for each indicator, including physical data entry, processing and transmission to stakeholders, tracking reporting, as well as checking the accuracy of the tracking system for measurements, data quality, exchange, visualization and mapping using GIS tools. The monitored indicators should support the decision-making process by users based on the trends observed in its physical changes.

2. Introduction

AEIMS was developed within the framework of the program "Management of natural resources and protection of ecosystem services for sustainable development of rural areas in the South Caucasus" (ECOserve). ECOserve is implemented jointly by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and its partners in the South Caucasus. In Azerbaijan, the program focuses on the agricultural sector to promote biodiversity conservation and the sustainable use/management of natural resources. The political partner of ECOserve in Azerbaijan is the Ministry of Agriculture (MOA).
The initiative on the development of AEIMS is based on strategic documents of Azerbaijan such as the Strategic roadmap on agriculture, Joint action plan between MoA and the Ministry of Ecology and Natural Resources (MENR) on Green Agriculture, and a draft (unpublished) Strategic plan on reducing climate change impact on agriculture.
ECOserve, in cooperation with MoA, has initially identified the following 14 agri-environmental indicators for the development of sustainable agriculture: • Level of training of farmers, • Area under organic farming, • Consumption of mineral fertilizers, • Consumption of pesticides, • Irrigated/irrigable area, • Energy use, • Cropping pattern, • Livestock pattern, • Specialization, • Ammonia emissions, • Greenhouse Gas Emission, • Water taken for agriculture, • Water quality (pollution N, P), and • Permanent degradation of pastures.

3. Observed problems: Which problems do we have regarding the six selected indicators?

3.1 Fertilizer consumption

3.1.1 Problem

Since 2011 the use of fertilizers in cultivated lands has been stimulated in Azerbaijan, as noted in the Second Biennial Update Report of the Republic of Azerbaijan to UN Framework Convention on Climate Change1. Therefore, import and use of fertilizers has been increased in the country.
In the consumption of fertilisers, the following shortages are observed:

- Farmers apply mineral fertilizers without prior soil analysis to determine nutrient content and real demand for fertiliser application
- Before 2022, farmers were not legally obliged to conduct agrochemical soil analysis before the sowing activity
- Some farmers buy mineral fertilizers, but then sell some of them to another to cash out the subsidized money

- Despite the fact that Food Safety Agency (FSA) and State Agrarian Development Center (DAIMs) are the responsible authorities, there was no proper control over whether the farmer actually has applied the purchased fertilizer or sold out or did not use it at all within the fertilizer's expiry dates
- The current statistical reporting system collects the records of the volume of sales by rayon, rather than the volume of fertilizers applied to the land by the farmers
- Participation of MENR in monitoring fertilizer consumption in farming is unclear
- The knowledge of farmers about the fertilisers and their application with consideration of the crop requirement and soil nutrient content is low
- There is not yet established interaction between the involved organizations for full control of the fertilizers' circulation

3.1.2 Solution – Policy Options

Action Plan of the Republic of Azerbaijan on Conservation and Sustainable Use of Biodiversity3 defines policies to improve fertilizer application in the country. These measures include implementation of pilot projects on use of organic fertilizers in agricultural areas, development of organic farming and increasing the effectiveness of protection of environment and biodiversity. The risk of the land and water contaminations due to the fertilizers' application can be mitigated by the adoption of practices to partially replace chemicals with agronomic knowledge, organic inputs and other measures (i.e. right and timely application, soil analysis among others).

ECOserve has made a contribution to develop administrative measures to make soil analysis obligatory for farmers to be entitled to get a subsidy which came into effect from 2022 onwards. The need for the fertilizer should refer to the crop type and results of the agrochemical analyses. The fertilizer should be applied with the consideration of the available soil nutrients, crop needs and yield expectation.

Reduction of fertilizer usage can also be achieved by application of precision agriculture. This practice makes it possible for farmers to regulate the rate of fertilizer application across the field, according to the actual need. Modern technologies for the precise agriculture include GPS (Global Positioning System), GIS (Geographic Information Systems), FMIS (Farm Management Information Systems), and VRT (Variable Rate Technology) allows producers to manage soils with more precise solutions. Establishment of the proper controlling mechanisms, including measurement, verification and monitoring system over the consumption of the fertilizers allows to reduce adverse ecological impacts to the crop yields, yield quality, soil, ground waters, surface water contamination and biodiversity.

3.2 Irrigation Area

3.2.1 Problems

Recent climatic change has significantly influenced the formation of water sources, and therefore irrigation management for better use of the land and water resources is becoming a critical issue in Azerbaijan. In addition, most of the irrigated areas are located in the territories with high mineralization/ salination of the groundwater, where the water table is close to the soil surface. Therefore, irrigation is executed with the application of the drainage system. The existing irrigation infrastructure of primary and secondary canals contribute to losses considerably as many of them are not concrete, iron or plastic tube pipes, but open trenches only.

The following shortages can be noted:

- Data accuracy problem. For example: according to the official data of the State Statistical Committee (SSC), a comparison of the areas of irrigated land shows that the difference in data between 2015 (1434.5 thousand ha) and 2019 (1450.2 thousand ha) is

only 15.7 thousand ha. However, according to the annual Cadastral Report of Land Reclamation and Water Management Facilities in the Republic of Azerbaijan, the area of irrigated land was 1974.8 thousand hectares in 2019. In addition, taking into account the fact that since 2015 new agricultural parks have been developing and the new irrigated lands transferred into the agricultural use, the discrepancy between official statistics and actual data is obviously observed; The State Service for Property Issues (SSPI) receives information from the relevant executive authorities of each village or settlement, and are not able to check if this information is precise; The relevant executive authorities themselves do not proof the data for validity;

- In some regions, especially in the arid zones, repeated (second) sowing in one season is applied, however data may be not reflecting the real situation;
- There is not tracked difference between irrigated and irrigable areas and information systems for them are not interconnected;
- The EAIS contains information about the sown structure and irrigated lands for the private or leased lands only;
- Due to climate change, in some areas rainfed agriculture is being replaced with partial irrigation by the local farmers' initiative to keep economically viable yields, however, statistics do not take this into account;
- The statistics do not indicate the area of rainfed agriculture and do not keep regular separate records.
- Water losses during the irrigation is quite high due to the application of the traditional surface irrigation methods
- Irrigation water prices are significantly low that may cause a waste of water

3.2.2 Solution - Policy Options

In order to ensure irrigation application, the territory must have reliable water resources, irrigation infrastructure and hydraulic facilities for uniform distribution of the irrigation water between canals and fields. Irrigation technology provides for the distribution of water across the field. Higher irrigation technology allows to achieve the uniform distribution of moisture along the soil surface and reduce insufficient water losses.

To measure the impact of agriculture on the environment, irrigation has been identified as one of the important agro-ecological indicators. Trends in the dynamics of the irrigated area give a clear picture of the intensity of irrigation application, agriculture development investments, implemented policies, the efficiency of farming, soil quality changes, salinity, water use, and losses in irrigation and ground water quality changes.

These trends provide the basis to elaborate amended policy arrangements, including the planning of the environmental, social, and economic regulations. The changes in irrigation area are directly influencing the environment and biodiversity, therefore it is considered as one of the important indicators for the evaluation of the agriculture-environmental interactions.

It is highly important to promote innovations in irrigation technologies to use the scarce and decreasing water resources in an efficient way.

Water prices shall be regulated in a balanced way and based on real consumption - reasonable enough so that all farmers can pay and quite high so that the water is not wasted.

3.3 Water Abstraction

3.3.1 Problems

In Azerbaijan, water abstraction is of particular importance, as approximately 90% of the water taken in the country is used for the needs of the agricultural sector.

The following shortages are observed in the current statistical reporting system:

- Due to the malfunction, most of the water measuring devices in the canals cannot keep accurate records of irrigation water taken from the sources and discharged to the outlet of the Water Users Union (WUU) on-farm systems;
- There is no installed or absence of appropriate water distribution and metering equipment for even supply of the water between the plots in the service areas of WUUs;
- The known total water abstraction from natural sources in 2019 was 13,227 mln m^3. Official data suggests water losses during transportation from source to field amounting to 3,755 mln m^3 in 2019, equal to 28% of water abstraction.
- There is no organized metering and statistical reporting system of the irrigation water used on-farm level, including in the plots;
- Current statistical reporting system considers volumes of the water consumed for irrigation and livestock together;
- Data verification system has not yet been developed to check the accuracy of the delivered statistical data;
- Due to frequent power cuts in pumping stations during water abstraction, inefficiencies and/or disruption of water supply occur. Both, electricity waste as well as yield losses because of lack of irrigation cause economic losses.
- In some cases, water meters and pressure gauges are not installed in sub-artesian and artesian wells, or there is external interference in the operation of water meters in order to hide the metering of the real water consumption;
- The role of MENR in monitoring of the water consumption in agriculture is not yet clear in the practice;
- Regulations on "Electronic water management Information System" was adopted by the Presidential Decree on 13.02.2021, but there is future need to develop working instructions (agreements between organizations at various working levels) regulating mechanisms of the information circulation and exchange between the related organizations.

3.3.2 Solution – Policy Options

A strategy for monitoring agricultural water use must answer three basic questions: i) where and how is water used in agriculture; ii) how much water is used in agriculture, and when is it needed; iii) how well is water used in agriculture? An information system on agricultural water use should cover three areas of data: i) data on the current and historical areas equipped for irrigation in the country; ii) data on the actual net and gross water use in irrigation; iii) data on the performance of irrigation schemes to assess the functionality of the schemes and provide recommendation for their improvement; information system on agriculture -who is responsible for the collection, analysis and dissemination of data and the maintenance of the information system.

The indicator on water abstraction directly supports the development of the water policy in Azerbaijan and guides the process of sector reforms, as well as elaboration of the short- and long-term investments.

3.4 Water Contamination (N, P)

3.4.1 Problems

The quality of irrigation water tends to deteriorate. The Kura River is primarily polluted due to the industrial wastes and the impact of irrigation water emerging from the countries lying upstream of "Lower Kura". Water inflow into the country is expected to decline more because of the predicted climate changes and an increase in water use in other countries of the Kura–Aras Basin. Water contamination in the country occurs due to the agriculture development and increasing of the water abstraction in agriculture. Changes in the chemistry and an increase in

the mineralization of the irrigation water over the recent half century take place both before water enters the country, in the upper reach of the Kura, and, partly, within the country, because of the poor irrigation management at all levels and pollution arisen from the untreated sewage waters. The runoff of return water (containing fertilizers) from irrigated areas and collector-drainage water into the Kura River and its tributaries affected river water quality.
The following shortages are observed in the current statistic reporting system:

- The current monitoring organized only for a limited number of the rivers and lakes;
- The monitoring is conducted in certain points, which may not allow to define the exact reasons of the pollution by the trend;
- Currently there is not yet organized regular statistic reporting system about the quality of the underground water, although MENR has regular data on the quality of the underground water from the National Geology Service;
- The monitoring fixes the rate of pollution in the respective section; however, this monitoring does not capture pollution caused by agricultural activity in the region;
- The actual applied standards on the permissible concentration limits (PCL) for surface waters adopted in 1994 and since then used widely, although there are international standards, as mentioned above;
- In the statistical form shown that the data shall be checked and approved by the local supervisory engineer of Azerbaijan AWM OJSC, but not clear how this engineer will be able to check the results of the water quality analyses conducted by MENR, as most of the laboratories in the structure of the company local bodies are out of date;
- Statistical Reporting System does not consider any verification mechanism to be certain on the data quality.

3.4.2 Solutions - Policy Options

In order to protect future sustainability of the water resources it is necessary to:

- construct irrigation systems of a new generation
- develop agricultural cooperative associations with the application of the smart solutions,
- improve the operation of the existing irrigation systems, agro-technical measures for crop cultivation, especially the application of fertilizers and chemicals in the field
- provide trainings to qualified personnel

In order to strengthen the quality and reliability of data, the monitoring sites in rivers and lakes shall be increased. Necessary data shall be provided for AEIMS to capture the pollution caused by agricultural activity. All above proposals for maintaining water quality require to make appropriate monitoring, especially for controlling the dangerous contents and pollutants in the water. A verification mechanism proposed by AEIMS is of high importance to achieve the data quality.

3.5 Pasture Degradation

3.5.1 Problems

In Azerbaijan, pastures are the main resource for maintaining natural livestock breeding and the production of quality meat and milk. Permanent pastures make a significant contribution to the stability of the size of the soil aggregates and the preservation of the soil living organisms and biology. They also promote the circulation of nutrients (organic carbon, nitrogen, phosphorus, potassium) in the soil.
However, excessive livestock maintenance and increased overgrazing pressure on pastures cause unfavourable conditions for the restoration of their natural biodiversity. Climate change and an observed increase in temperature and a decrease in rainfall, especially during the summer period, accelerate the loss of vegetation cover of pastures, which leads to the process of

desertification, erosion and degradation on the soil surface.
The following shortages in the country pasture management practices are observed:

- No authority is controlling the actual use of pastures; According to the existing legislation, the control over the use and compliance with the contractual obligations shall be executed by the local Executive bodies, but in fact there is not proper control
- Lack of maps and databases reflecting the current state of pastures
- There is not special restoration program for pastureland improvements
- There are no provisions in the regulations of MENR regarding the monitoring and use of pastures, and their role in this area is unknown
- SSPI is responsible for the documentation of the pasture usage by farmers, but maps and databases reflecting the current state of pastures (topsoil quality, grazing rate by the animals, watering status etc.) have not yet been properly compiled

3.5.2 Solutions - Policy Options

Generally, in pasture management, the methodology approach includes the following structure in order to understand and evaluate ongoing processes: 1. Mechanisms for pasture degradation; 2. Function of grassland ecosystem; 3. Restoration and improvement of grasslands.
The proper organization of grazing livestock – a balance between the carrying capacity and stocking rate – (their moderate number and correct distribution along the pasture plots) creates favourable conditions for the development of a stable and strong vegetation cover, which reduces the risk of erosion caused also by water and wind and reliably protects pasture ecosystems.
The prevention of degradation of pastures is urgently needed for rehabilitation of the natural ecosystem and its resistance against climate changes and thus, reliable and up to date monitoring and reporting system is necessary to be developed for the elaboration of the future policy measures.
A key state body shall be designated in legislation for pasture management. This body shall be authorized to design and implement policies for efficient use and protection of pastures.
Therefore, the implementation of AEIMS as a reliable monitoring and reporting system, which will enable the control over the pastures' condition, becomes an urgent task. Please see also the Policy brief on pastures.

4. Conclusion: The Relevance of AEIMS System for Change Management

AEIMS shall make it possible to see the whole picture of the on-going processes in agriculture, both negative and/or positive, that will help to make adjustments in the policy of natural resources use and protection, ecological services, agriculture planning and environmental protection.
AEIMS will improve the situation by precise tracking of the given indicators. It will strengthen inter-ministerial interactions and intensify active participation of farming communities, environmental protection specialists and other stakeholders. It will contribute to the data availability, data quality, rapid data exchange, and organization of monitoring processes. Thus, a sound basis for interpretation and decision-making on policies with regards to sustainable agricultural practises is available.
For effective implementation of AEIMS the following state bodies as key actors shall maintain fruitful cooperation: Ministry of Agriculture (MoA), Ministry of Environment and Natural Resources (MENR), State Customs Committee (SCC), State Statistics Committee (SSC), Food Safety Agency (FSA), Amelioration and Water Management Joint Stock Company (AWM JSC), State Service for Property Issues (SSPI). A special Operation Unit shall be established under MoA, consisting of representatives of the above-mentioned state bodies by the support of the Cabinet of Ministers. The operational unit shall make available all the reliable data needed

for monitoring.
In the long run, AEIMS could support the adoption of certain environment-friendly procedures in the technical implementation of agriculture and the improvement of the policy and legal framework towards a sustainable agriculture. The functions of the digital web-based system of AEIMS have the potential to be extended and upgraded once more indicators and tools are integrated.

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