# ENVIRONMENT MONITORING FOR AGRICULTURE GOOD PRACTICES

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**ABSTRACT:** Water is an essential resource for agriculture. Its management goes through good practices to determine the available amount for several users, such as industry and human consumption. The water content used for irrigation should go through an optimization process, evaluating the necessary variables to maximize productivity and expenses control. The environment monitoring and climate conditions enable to forecast the hydrological period and the irrigation water consumption according to crop needs and available water inventory. In 2010 was installed by Hydraulic and Irrigation Area at UNESP Ilha Solteira the São Paulo Northwestern Weather Network and the UNESP CLIMA Channel (http://clima.feis.unesp.br), where is provided the real time historical data bank and the internet user can follow weather changes and estimated evapotranspiration with a five minutes refresh delay. The suitable monitoring of soil water content becomes an irrigation good practice, which enables crops high productivity and collaborates to conscious water application, apart from affording positive financial yield, in productivity growth as well as in sparing energy on water pumps, besides conservation of the environment and water resources. The irrigated agriculture expansion is an important social and economic growth vector, and could be called the driver for a region and therefore, the aim of this paper is to demonstrate how UNESP operates its Sao Paulo Northwest Irrigant Support Service, optimization of data bank handling, supporting and encouraging rational and sustainable application on irrigated agriculture, as well as the results achieved on this paper.

**KEY-WORDS:** Irrigated agriculture, weather station, water use

## MONITORAMENTO AMBIENTAL PARA BOAS PRÁTICAS AGRÍCOLAS

**RESUMO:** A água é um recurso essencial para a agricultura. Sua gestão passa por práticas que definem a quantidade disponível para diversos usuários comuns, como indústria e consumo

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humano. O volume de água utilizado para a irrigação deve passar por um processo de otimização em seu uso, avaliando as variáveis necessárias para a maximização da produtividade e controle dos custos. O monitoramento ambiental e das condições climáticas possibilitam prever o comportamento do ciclo hidrológico e planejar o uso da água na irrigação conforme a necessidade das culturas e o estoque disponível. Em 2010 foi implantada pela Área de Hidráulica e Irrigação da UNESP Ilha Solteira a Rede Agrometeorológica do Noroeste Paulista e o Canal CLIMA da UNESP (http://clima.feis.unesp.br), onde é disponibilizada a base de dados climáticos em tempo real, o Internauta pode acompanhar as variações do tempo e a estimativa da evapotranspiração com atualização a cada cinco minutos. O adequado monitoramento do armazenamento de água no solo se constitui em uma boa prática na irrigação que garante alta produtividade das lavouras e colabora com o uso consciente da água, além de proporcionar resultados financeiros positivos, tanto no aumento da produtividade, como na economia de energia usada no bombeamento da água, além da preservação ambiental e dos recursos hídricos. A expansão da agricultura irrigada é um importante vetor de crescimento social e econômico, podendo ser a locomotiva para um futuro sustentável de uma região e assim, o objetivo deste trabalho é mostrar como a UNESP opera seu Serviço de Apoio ao Irrigante na região Noroeste Paulista, otimizando o tratamento de sua de sua base de dados e apoiando e incentivando o uso racional e sustentável da irrigação na agricultura, bem como os resultados aferidos com este trabalho.

**PALAVRAS-CHAVE:** agricultura irrigada, monitoramento climático, uso da água

## INTRODUCTION

Making agriculture more and more productive and sustainable is one of the most important principles for the Food and Agriculture Organization of the United Nations. Improving efficiency in the use of resources is crucial to sustainable agriculture. Enhancing current practices improve the productivity on agricultural business. The productivity gains will be always a market request due to the risk of future supply shortness. Limiting the expansion of agriculture and not damaging on natural ecosystems are good practices for improving efficiency in the use of resources.

Future productivity gains will have other variables on the game than kilograms per hectare of production. Energy efficient and water production systems gain a lot of confidence on planning water scarcity and reducing greenhouse gas emissions. Agricultural production demands natural resources. The sustainable use of natural resources will sustain agricultural as a wealthy business.

The worldwide model of agriculture expansion involves high use of land, water, fertilizers and pesticides. The further coming water pollution endangering freshwater springs and lose of soil properties are a threat to a sustainable future.

Agricultural is among the riskiest types of businesses. Extreme weather events and market volatility affects the business stability on producing food. The development of good policies, technologies and practices will strength producer´s resilience to environment and market threats.

It is important to apply tools for quantifying water use, water demands represented by crop evapotranspiration to make available the correct amount of water to crops and to evaluate crop development related to water resources, the so called water productivity. It means how many food kilograms were produced for each water cubic meter (m3) applied or evapotranspirated. In this context, the Area of Hydraulics and Irrigation at UNESP built the São Paulo Northwestern Weather Network and promotes on the UNESP CLIMA Channel the weather variables, including reference evapotranspiration (ETo) based on the Penman-Monteith equation and accumulated precipitation, as a free tool to irrigators, allowing a very accurate water irrigation planning. Another users can help themselves on the available information, focusing on developing useful applications on hydrology and natural resources.

## METHODS

In 2010 was installed the São Paulo Northwestern Weather Network, it is available in World Wide Web over the CLIMA Channel of UNESP (http://clima.feis.unesp.br), where is provided the real time historical data bank and the internet users can follow weather changes and estimated reference evapotranspiration with a five minutes refresh delay.

The Northeastern São Paulo State Weather Network coverage area complies 60 cities, reaching 16.130 km$^2$, located at 49° 47' and 51° 34' W and 19° 47' and 21° 08' S (SILVA JÚNIOR, 2017), as showed in the Figure 1.

The weather stations have standardized sensors and ground surface with grass (*Paspalum notatum*) with the fetch of 10 x 10 meters until the sensors (http://clima.feis.unesp.br/listaestacao.php). The data is scanned every 10 seconds, being the data compilated every 5 (rain, temperature, relative humidity, wind, pressure ) and 60 (global and net radiation and reference evapotranspiration) minutes. All variables have their daily mean.

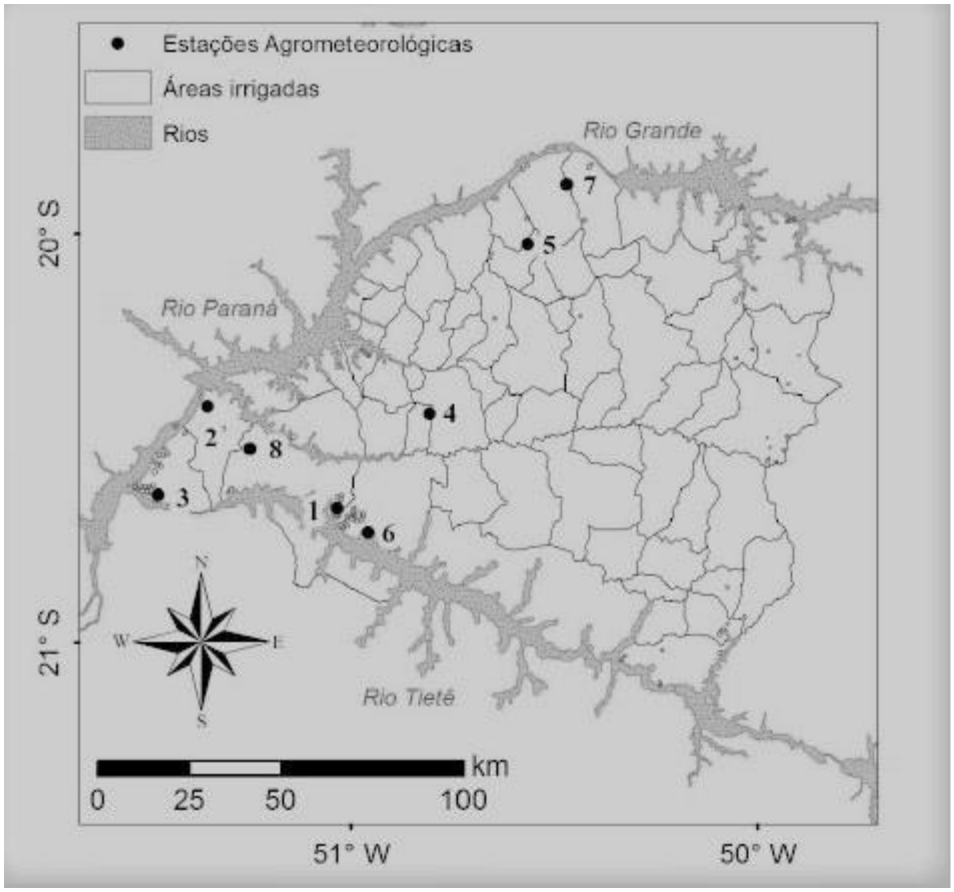


**Figure 1**. São Paulo Northwestern Weather Network Region. (After SILVA JÙNIOR, 2017).

The CLIMA Channel of UNESP offers the weather variables in real time and user do not need to log on to browse the information: 5 minutes graphic, all variables graphics and hourly tables, wind speed (average and maximum) and direction map, temperature (maximum, minimum and average), radiation (global, net and photosynthetic active) and humidity (maximum, minimum and average) map - Figure 1, reference evapotranspiration (hourly and daily) map and daily accumulated rainfall map.

There are some tools available on the CLIMA Channel where the user need to log on the system to browse any information. All databank is available and it is user friendly. The data can be exchanged to electronic spreadsheets: daily values, extreme events, data frequency and historical drought.

In locations where there is a weather station but the evapotranspiration value is not available, it is possible to calculate ETo after downloading SMAI application, a user friendly tool to calculate the reference evapotranspiration (http://clima.feis.unesp.br/smai.php).

## RESULTS AND DISCUSSION

The agrometeorological sensors and a geographic information system can optimize the water use and the sustainable use of natural resources and the Sao Paulo Northwestern Weather Network allows to compound satellite data with weather data to reach out best water productivity on related crops, focusing on deficits and wastes on irrigated areas and reducing pesticides and fertilizers to percolate to rivers.

The evapotranspiration (ET) is used to assess the total water consumption on the river basin area, always focusing on enhancing the irrigated area. Evaporation and transpiration occur simultaneously and there is no easy way of distinguishing between the two processes (ALLEN *et al*., 1998). The evaporation from a cropped soil is determined by the fraction of the solar radiation reaching the soil surface. This fraction decreases over the growing period as the crop develops and the crop canopy shades more and more of the ground area. When the crop is small, water is predominately lost by soil evaporation, but once the crop is well developed and completely covers the soil, transpiration becomes the main process.

The evapotranspiration rate is normally expressed in millimeters (mm) per unit time. The rate expresses the amount of water lost from a cropped surface in units of water depth, while the concept of the reference evapotranspiration was introduced to study the evaporative demand of the atmosphere independently of crop type, crop development and management practices. In order to estimate the evapotranspiration or the crop´s consumptive use, it is necessary to first estimate the reference evapotranspiration (ETo), which is made from the air temperature and relative humidity, net radiation, wind speed and atmospheric pressure, which are provided by the São Paulo Northwestern Weather Network, which also calculate the ETo and release it every hour (Figure 2), allowing irrigators after consulting the CLIMA Channel can estimate irrigation time at all stages of the phenological cycle of the different crops, establishing their irrigation schedule or rational use of water in agriculture.

Risks and uncertainties distress producers with unpredictable weather, insects, diseases, and price variability. For example, drought, hail, and poor weather can reduce farmer´s production. In general, water is a significant factor in the productivity. Whether or not sufficient water will be available, through irrigation or rainfall, is a major source of production risk.

Most risk management strategies either deal with price risk, production risk, or combinations of these aspects. The amount of investment in risk management strategies depends on the decision maker and how risk averse or risk loving the farmer is.

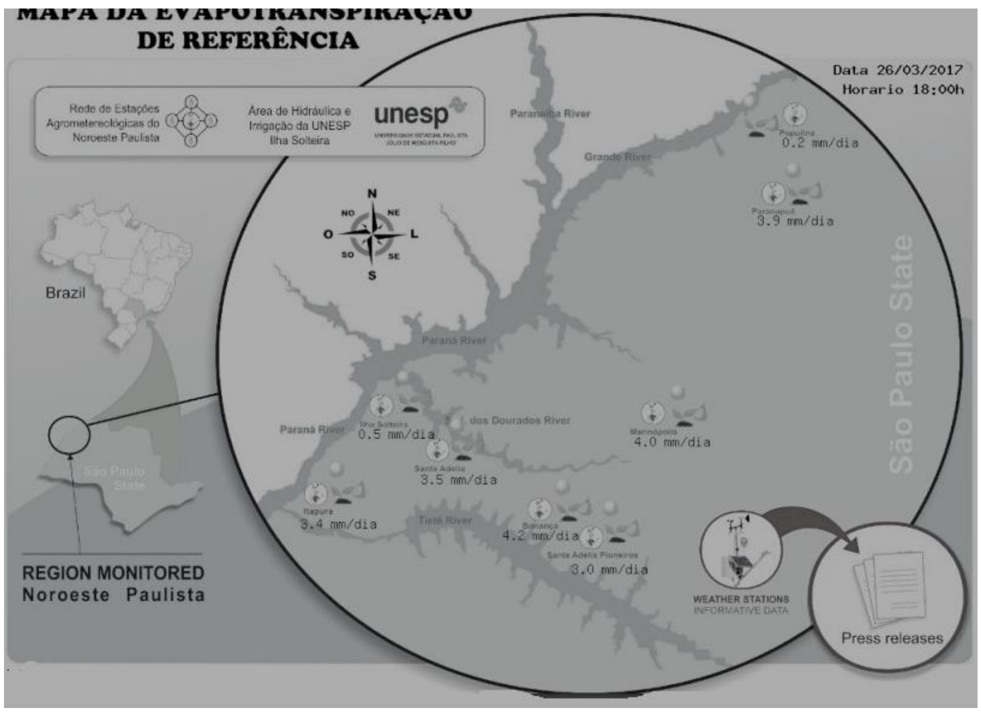


**Figure 2**. Map of reference evapotranspiration release of São Paulo Northwestern Weather Network. (After UNESP, 2017).

Water applications also affect yields, making irrigation a yield risk management tool as well and the irrigation strategies are commonly viewed as yield enhancing, thus they can serve as risk management strategies by reducing the possibility of low yields (SENFT, 1992).

Therefore, a group of tools to access the weather variables, allowing the irrigator to have reference evapotranspiration associated to crop reference value online, and also the opportunity to implement very complex irrigation´s schedule programs. It is important to refer to CLIMA Channel of UNESP as a freeware weather information databank, allowing user friendly access. From a long series of weather data acquisition and estimation of ETo and with the aim of the provide another alternative of irrigation management, more simplified, and based on historical data, was established the Map of Homegeneous Reference Evapotranspiration Map, allowing that the Irrigator use a fixed amount for each month, relative to the Zone where his irrigation system is located, instead to search for the ETo daily in the CLIMA Channel.

Evapotranspiration is quite stable but it can vary sharply in averse weather conditions, as seen in cold and intense rain. Usually this sharply variation on evapotranspiration is associated to convective rain and to develop a irrigation project, it is very important to know the rain frequency and volume and the drought periods.

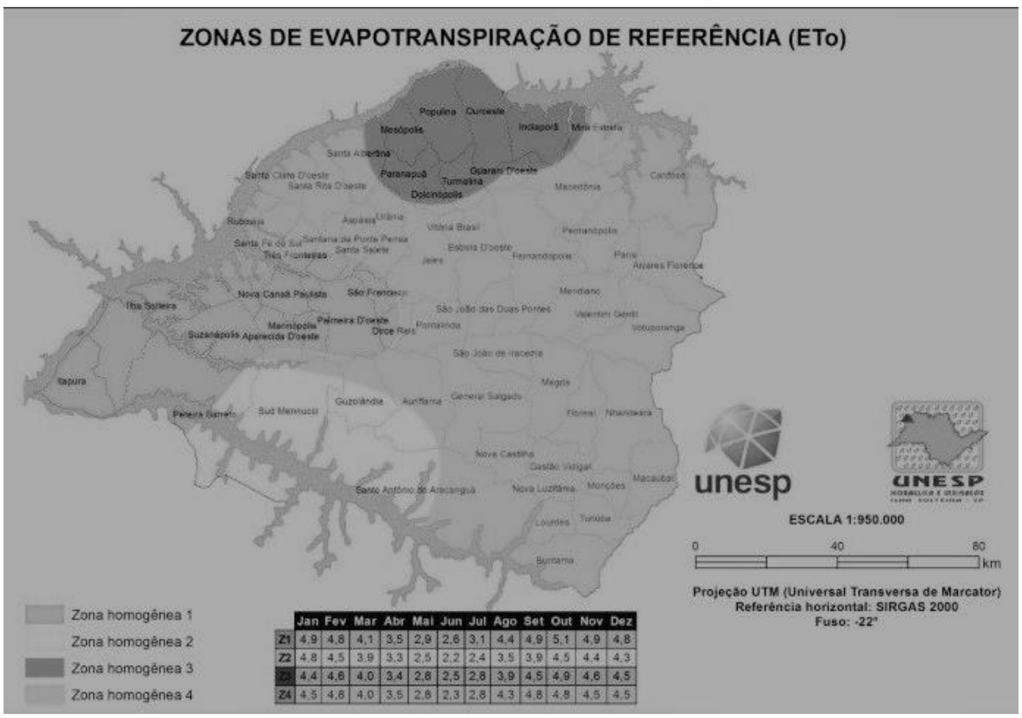


**Figure 3**. Homogeneous Evapotranspiration Zones. (After SILVA JUNIOR, 2017)

Considering the growing access to the Canal CLIMA da UNESP, the expansion of irrigated area in the Northwest of São Paulo and its importance in the economic development of the region, the Northwestern Weather Network plays a very important role for the sustainable management of irrigation (SILVA JUNIOR, 2017).

In 2011 there were 8.840 page views on CLIMA Channel. Showing its sharply access development in 2016, there were 193.742 page views, what means 531 daily page views.

In Sao Paulo Northwestern there are 137 center pivots, reaching an estimated irrigated area of  9.541 ha (AMENDOLA et all, 2017).

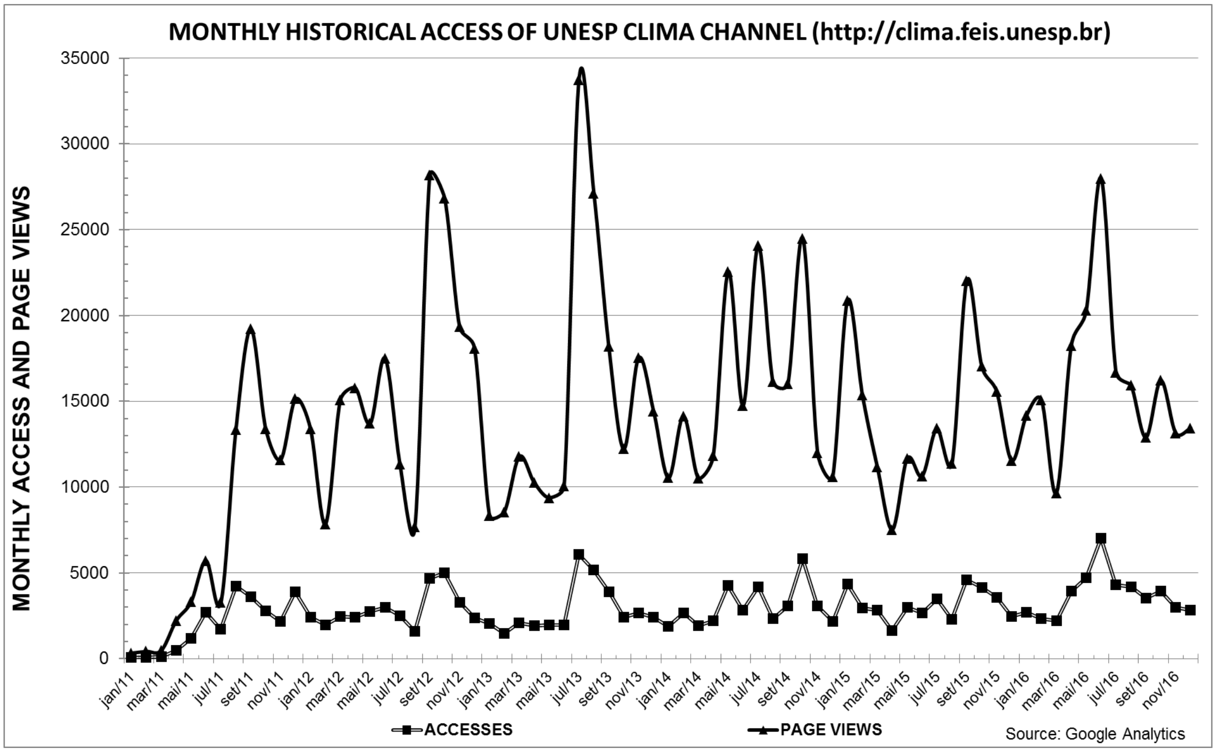


**Figure 4**. Monthly historical access of the CLIMA Channel of UNESP Ilha Solteira. (After Google Analytics, 2017)

## CONCLUSIONS

The brazilian economy is leveraged by agricultural because of its national and international role. The agriculture also supports many jobs positions and gives access to food to many families.

The irrigated agriculture plays a key role on water consumption, estimated a rate of 70% of total use of water. Therefore, it is very important a good water use planning, avoiding wastes. An integrated automated irrigation system, linked to agrometeorological data can improve the water use, improving the balance between water use and a sustainable environment.

The natural resources are indispensable for life on earth, what puts a lot of pressure on water demands.

The Clima Channel shows its importance to irrigators because of the growing page access, helping to develop a sustainable water use and an environment friendly.

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