ORIGINAL ARTICLE

Evaluation of Advice to The Irrigator in "Amistad Cubano Búlgara" Agricultural Production Cooperative

Evaluación del asesoramiento al regante en la Cooperativa de Producción Agropecuaria Amistad Cubano Búlgara

CU-ID: 2177/v31n3e10

Caridad Sánchez-Veranes[I], María del Carmen Falcón-Acosta[I*], Leonardo Sala-Hernández[II]

[I]Universidad Agraria de La Habana. San José de las Lajas. Mayabeque, Cuba.
[II]Universidad de Artemisa, ciudad de Artemisa, provincia de Artemisa, Cuba.

ABSTRACT: An exploratory diagnosis was carried out in the Agricultural Production Cooperative (APC) "Amistad Cubano Búlgara" to evaluate the current advice service to the irrigator (IAS). A characterization of the APC was made, surveys were applied, interviews and field evaluations were carried out in areas of watering systems for aspersion (Machines of Central Pivot). The information allowed determining as strengths the existence of a climatic station automated, the interest of the institution in introducing technologies, the disposition of the cooperativities to carry out improvements in the watering activity, even when they have as weaknesses a low educational level of the work force, the lack of specialist technicians in the watering activity, operators in the machines of pivot power station are not qualified, all what is reflected in the indicators of efficiencies that oscillate between 63 and 70%, and in the applications of inadequate watering norms that cause the low agricultural yields. These results allowed elaborating an action plan that will drive to improve the administration of the watering in a long term starting from the implementation of an advice system to the irrigator in real time. That will propitiate an appropriate training of the human resources, an appropriate and efficient use of the available resources, redounding in a good and appropriate use of water and bigger efficiency of the watering systems.

Keywords: Advice Service to Irrigation (IAS), efficiency, handling of the watering, administration of the watering.

RESUMEN: Se realizó un diagnóstico en la cooperativa de producción agropecuaria (CPA) Amistad Cubano Búlgara para evaluar el servicio de asesoramiento al regante que se brinda, para lo cual se hizo una caracterización de la CPA, aplicando encuestasy evaluaciones de campo en áreas de sistemas de riego por aspersión [Maquinas de Pivote Central (MPC)]. La información permitió situar como fortalezas, la existencia de una estación agroclimática automatizada, el interés de la institución para introducir tecnologías, la disposición de los cooperativistas a realizar mejoras en la actividad de riego; y como debilidades que tienen, el bajo nivel de escolaridad de la fuerza de trabajo, la no existencia de técnicos especialistas en la actividad de riego, el personal que trabaja en las máquinas de pivote central no han sido capacitados lo que se refleja en los indicadores de eficiencias que oscilan entre 63-70% y en las aplicaciones de normas de riego inadecuadas que ocasionan los bajos rendimientos agrícolas. Estos resultados permitieron elaborar un plan de acción que conducirá a largo plazo a mejorar la gestión del riego a partir de la implementación de un sistema de asesoramiento al regante en tiempo real, lo que propiciarán una adecuada capacitación de los recursos humanos, un uso adecuado y eficiente de los recursos disponibles, redundando en un uso óptimo y adecuado del recurso agua y mayor eficiencia de los sistemas de riego.

Palabras clave: servicio de asesoramiento al regante (SAR), eficiencia, manejo del riego, gestión del riego.

*Author para correspondencia: María del Carmen Falcón Acosta, e-mail: mfalcon@unah.edu.cu

Received: 06/09/2021
Accepted: 24/06/2022

INTRODUCTION

Agriculture is closely related to water security, it is the one that uses the largest volume of water, so it depends on the availability of appropriate and sustainable water resources to produce food.

Worldwide, this sector uses 70% of the total available water, and in many developing countries the figure is 85 to 95%, with the inconvenience that irrigation water is extracted faster than it is replenished (Zetina, 2002, cited by Castañeda *et al.*, 2008). Hence, the importance of proper irrigation management to optimize the use of this increasingly valuable resource in agricultural production systems, since it makes it possible in many cases to plant and harvest all year round.

In this regard, Castañeda *et al.* (2008) states that "food production, as considered by the Food and Agriculture Organization of the United Nations (FAO), depends on the availability of appropriate and sustainable water resources, given that irrigation water increases the yields of all crops between 100 and 400%"; performance, which is affected by the diversity of situations that arise in agriculture with aspects related to the availability of water, the existence of reservoir infrastructures, adequate or not suitable piping, the variable conditions of the areas, the agriculture environment and irrigation management, which influence the efficiency and irrigation management itself.

Another influential element is the current climate change scenario in which a reduction in rainfall and an increase in the water demand of crops is forecast as a result of the increase in temperature.

On the other hand, Fevrier *et al.* (2015) refers that the levels of knowledge about water management and the economic conditions of the producers are also determining factors of the technologies used for irrigation and drainage, as well as for the adequate management of water on the farm and that the demands in terms of requirements during the crop cycle, availability and quality of water are also different.

Taking into account the above, research to make efficient use of irrigation water is a priority at the international level; hence, Guiñazú (2017) studied the community management of irrigation water in areas of Contralmirante Cordero Río Negro, Argentina. Pérez & Sabatier (2015) propose the change of the sprinkler module in pivots according to economic criteria and apply it to two crops. Martínez (2015) proposes a plan of measures to reduce the energy consumption of the irrigation activity with electric central pivot machines of the UBPC 3 "Jesús Menéndez" in the Valle del Yabú Agricultural Company. Cisneros *et al.* (2015) determine evapotranspiration and crop coefficients for coffee in the province of Pinar del Río, Sifuentes *et al.* (2016) work on irrigation management focused on climatic variability in potato cultivation in the application to Irrigation District 075, Río Fuerte, Sinaloa, Mexico. Zelmer *et al.* (2018) analyze performance indicators as a contribution to irrigation management, Altamirano *et al.* (2019) evaluated the performance of irrigation districts in Mexico through technical efficiency analysis. Lima *et al.* (2019 use simulation tools to analyze the behavior of a collective irrigation network considering the plot irrigation schedule in Castilla-La Mancha, Spain.

Another field that has been scientifically addressed in many countries is the influence of advisory services to irrigators as a way to achieve adequate irrigation management. In this sense, Naroua (2015) evaluates the use and productivity of water in an irrigation community in Spain, Silva do Nascimento *et al.* (2016) studied the response of the onion crop under optimized deficit irrigation using irrigation advice recommendations and the influence of corn irrigation advice. Also in 2017, these authors make assessments about the importance of irrigation advisory services (IAS) to achieve efficient use of irrigation water. Olmedo *et al.* (2017) determined management indicators in the modules of the irrigation district in Mexico, Silva do Nascimento (2018) evaluated the technical and economic feasibility of irrigation advisory services and their socioeconomic and environmental impact in Albacete, Spain.

In the world, there are several reports on the creation and development of Irrigation Advisory Services (IAS) which have been showing great strength, since the volume of water per irrigation unit is more limited and leads to a rational and efficient use of water.

In Cuba, there are very few works carried out about the system of advice to the irrigator, although all the works on the subject of irrigation have the purpose of reaching the irrigator. In that sense, Cisneros *et al.* (2006; 2007; 2011; 2011; 2015) provide some considerations on the advisory service to the irrigator for the conditions of Cuba and as a need for the future, in addition, they propose the advisory service to the irrigator as an alternative to mitigate the negative effects of drought. Bonet *et al.* (2018) evaluate a technology for advising the irrigator as part of the confrontation with climate change in livestock areas of the Camagüey Province, aimed only at training and education.

However, it is necessary to have a vision of the problems that today hinder the introduction of an irrigation advisory service (IAS)in the province of Mayabeque, taking into account that with the development achieved in computerization there is a need to give a technological leap in terms of ASR so that the farmer is provided with the necessary information to achieve a more efficient management of irrigation facilities, as well as data on the water needs of their crops. That is why the objective of the

work is to evaluate the current advisory service to the irrigator that is provided.

MATERIALS AND METHODS

For the development of the work, the "Amistad Cubano-Búlgara" Agricultural Production Cooperative was selected (Figure 1), located in Güines Municipality, Mayabeque Province, which limits to the north with the CCS "Miguel Camacho", to the south with the APC "Restituto Alonso", to the east with the town of Güines and to the west with the UBPC "Sierra Maestra", located at the geographic coordinates: 22°50`49.99" N, 82°04`08.11"W, 22°47`54.35" N, 82°01`51 .24" W according to the North Cuba coordinate system and Lambert Conformal Conic projection (PCCL).

It has an automated agrometeorological station.

It has a total area of 643 ha, which is currently served by Miguel Soneira Ríos Agricultural Company of the Ministry of Agriculture and plays a leading role in fulfilling the programs prioritized by the Agricultural and Forestry Group of Mayabeque focused on the production of viands, vegetables, grains and fruit trees, but mainly in the production of potatoes (*Solanum tuberosum*) for consumption in the capital of the country (Figure 2).

In the investigation, a survey was carried out on managers (2) and agricultural workers related to the irrigation activity (6 operators of central pivot machines).

The indicators evaluated were

1. Area under irrigation
2. Work force.
3. Age of staff.
4. Cultural level of the staff.
5. Experience of staff operating irrigation systems
6. Level of knowledge and willingness of the board of directors and irrigation personnel regarding the IAS.
7. Training for irrigators.
8. Utility given to the agroclimatic station.

Evaluations of the technical characteristics of the evaluated machines, rainfall evaluations were also carried out on 3 sprinkler irrigation systems (Central Pivot Machines) to determine the exploitation parameters and to know the values of the Coefficient of Uniformity (C.U), the Uniformity of Distribution (U.D), determining the quality of the irrigation at along the side, using the Pluviopivot software. The

FIGURE 1. "Amistad Cubano-Búlgara" Agricultural Production Cooperative.

Cultivable Area	56.7 %	364.59

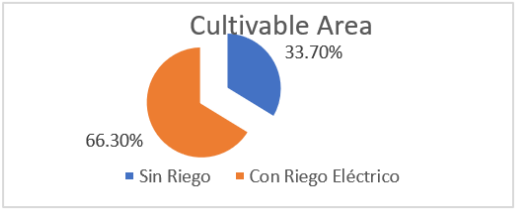

FIGURE 2. Percent of cultivable area in the "Amistad Cubano-Búlgara" Agricultural Production Cooperative (APC)

irrigation application efficiency was determined through the formula:

$$Ef = \frac{hm}{h}$$

Where:

Ef- Efficiency of irrigation application by the machine (%).

hm- Average layer of water collected by the pluviometers (mm).

h - Gross partial norm applied by the machine for a determined % ($m3 \cdot ha^{-1}$).

In addition, other parameters were determined such as: adequately irrigated area (AIA): based on the sheet that is within the range of 10% above and below the average sheet, excessively irrigated area (EIA): based on the sheet that is above 110% of the mean sheet and Area Insufficiently Irrigated (AII): based on the sheet that is below 90% of the mean sheet.

All this allowed characterizing the productive environment, diagnosing the technical-organizational conditions and the willingness of the labor group to promote the implementation of an IAS in real time, as an alternative that leads to improve irrigation management and productivity.

RESULTS AND DISCUSSION

Difficulties Encountered that Make It Impossible to Correct Implementation Provide Advice to the Irrigator

Low level of schooling and job fluctuation.

Graph of Figure 3 shows the number of workers that the APC has by age and sex.

With a total of 148 workers, 47.3% of the workers are over 50 years old, and only 21 (14.2%) are women, so more must be done to increase the number of women, taking into account that the highest percentage is over 50 years of age.

The school level of the workforce is one of the most affected indicators, most of the workers have only 9th grade (Figure 4).

When looking for the causes of these results, it was evidenced that there is an exodus of personnel with a higher cultural level, who only carry out their social service and then abandon their work, remaining those with a lower cultural level and other personnel due to proximity, living in areas adjoining the cooperative.

The exodus and labor fluctuation generate difficulties in the suitability and experience of the workers, where only 16 (10.8%) work in the irrigation activity and are responsible for operating the central pivot machines, the knowledge of 100% is empirical and they only dominate the operations to turn the MPC on and off, most of them have other jobs in the same area and as another way of income they perform the activity of machine operator.

Inadequacy and Little Work Experience

The head of the irrigation activity does not have experience or mastery of the activity, which affects the quality and efficiency of the irrigation activity reflected in the results of MPCs evaluations.

These negative indicators affect the efficiency of the irrigation activity and show the need for a constant and systematic preparation of the labor force due to

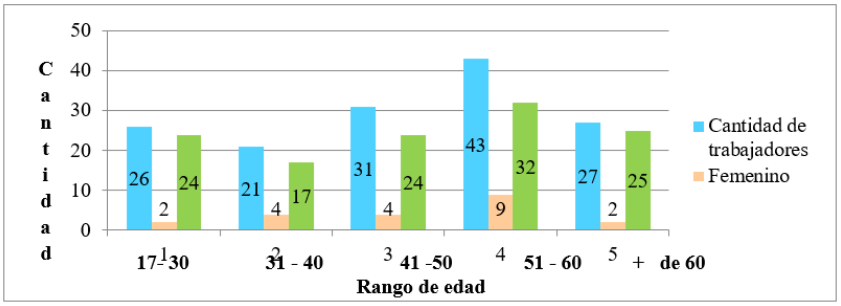

FIGURE 3. Number of workers that the APC has by age and sex.

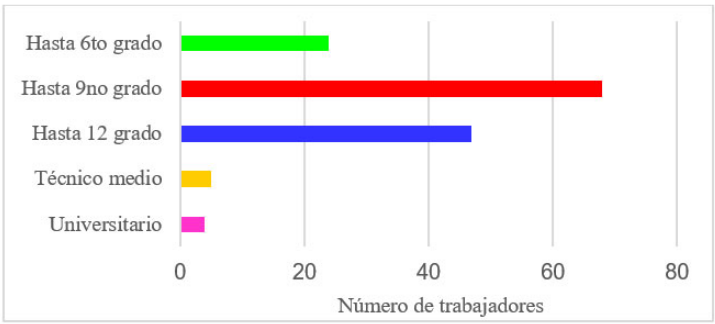

FIGURE 4. Cultural level of the staff.

their non-permanence in the job. That can only be achieved through a training and advice system to the irrigator, taking into account that experience in the management and operation of irrigation systems is vital for their better use and that the operation of irrigation systems is an extremely expensive activity.

Lack of Training for Workers Linked to the Irrigation Activity

The staff of the irrigation activity has not received training to carry out pluviometry evaluations, nor any other type of training in the irrigation activity that allows controlling the amount of water applied, which reflects that the irrigation community is not seen as the engine that plans, promotes and executes the strategies for the development of irrigation in the territory.

In this regard, Playán (2014) refers that it is not expected that the technology that arrives in boxes to a community of irrigators will be absorbed the next day by the users, a process of maturation of people and a very individualized training on the new technologies are needed. In addition, he states that public administrations recognize twenty years after the closure of Agricultural Extension Services, the importance of direct and continuous advice.

Analyzes Fitted to the CPA Conditions

Lack of Technical Instruction Handbook on CPM Operation

The APC does not have the regulatory documentation of each CPM, which causes that inadequate irrigation standards are empirically applied, where the change and location of nozzles or sprinklers between towers also influences. Moreover, the existing humidity in the soil is not taken into account to carry out the irrigation and although the directors are aware of the usefulness and importance of the agroclimatic station, workers of the irrigation activity are not linked to it and its data, due to the lack of qualified personnel, advising and training in the use of this technology, which limit the determination of water losses due to evapotranspiration and thus the water needs of the crop.

Another element that shows that the advisory service to the irrigator is not carried out is the lack of pluviometry evaluation and the incorrect handling of irrigation systems.

This means that the producer does not know the working parameters of the machines before starting the irrigation campaign, preventing their regulation to work with better efficiency and quality of irrigation application.

Table 1 shows the results of the pluviometry evaluation of three irrigation machines put to work without their evaluation before the start-up.

The results of the three CPMs reflect that the application efficiency of the evaluated CPMs is in the range of 70%, which is consistent with this type of technology, but could be higher if they had been regulated. The CPM Nombre de Dios III has the highest application efficiency, however, it has the smallest properly irrigated area, which means that the application efficiency is not related to the uniformity coefficient of the machine and the AIA. These elements have an impact on the speed and direction of the wind, the regulation of the machine, as well as the characteristics of the sprinklers, the topographical characteristics of the soil, evaporation and wind drag.

Despite the shortcomings detected, it is possible to work to eradicate them and to act on the implementation of an advisory service to the irrigator supported by the strengths and opportunities and working with the related weaknesses:

Main Strengths for the Implementation of an ASR in the APC

- To have the equipment in the APC.
- Willingness of the board of directors for the implementation of the IAS.

Main Weaknesses for the Implementation of an IAS in the APC

- Low level of schooling

TABLE 1. Evaluation Parameters of Irrigation Efficiency in Irrigation Machines before Start-Up

Evaluation Parameters	CPM: Nombre de Dios III	CPM : Arango	CPM C: Nombre de Dios I
Crop	Potato	Potato	Sweet potato
Machine regulation (%)	20 %	25 %	25 %
Applied Mpb (m3.ha-1)	250	280	280
Weighted Mean Sheet Applied (mm)	19.68 mm	20.87 mm	20.17 mm
Weighted Uniformity Coefficient (%)	63.8 %	69.71 %	65.37 %
Weighted Coefficient of Variation	44,6 %	48.9 %	41.04 %
Application efficiency (%)	78.7 %	74.2 %	72 %
AIA	8 %	32.49 %	18.24 %
AII	47 %	41.05 %	43.12 %
EIA	45 %	26.46 %	38.64 %

- The advisory service to the irrigator is not carried out due to the lack of qualified technicians to do the activity.
- Lack of a training and qualification program for workers linked to the irrigation activity.

Opportunities Offered by the Environment

- Existence of a weather station that provides part of the information necessary to establish the crop irrigation regime in real time.
- University interest in introducing comprehensive technologies for sustainable water management.
- Need to raise production indicators by making rational use of water resources.

CONCLUSIONS

- Of the workers surveyed and linked to the exploitation of irrigation systems, 45.5% are not aware of what an IAS is and they are not curious about the contributions it can make to their training and to the irrigation activity.
- The low cultural level (45.5% reach the 9th grade) and the little training are weaknesses that influence the implementation of the IAS, while the existence of a climatological station in the APC areas and the willingness of the directive board and workers are strengths for the implementation of the IAS.

REFERENCES

ALTAMIRANO, A.A.; VALDEZ, T.B.; VALDEZ, L.C.; LEÓN, B.J.I.; BETANCOURT, L.M.; OSUNA, E.T.: "Evaluación del desempeño de los distritos de riego en México mediante análisis de eficiencia técnica", *Tecnología y ciencias del agua*, 10(1): 85-121, 2019, ISSN: 2007-2422, DOI: https://doi.org/10.24850/j-tyca-2019-01-04.

BONET, P.C.; GUERRERO, P.; DUARTE, C.; RAMOS, S.; RODRÍGUEZ, P.W.; RODRÍGUEZ, D.; HERNÁNDEZ, J.; LA ROSA, Y.: *Tecnología de asesoramiento al regante como parte del enfrentamiento al cambio climático en áreas pecuarias de la Provincia Camagüey, Cuba*, Inst. Instituto de Investigaciones de Ingeniería Agrícola (IAgric), Informe técnico, Camagüey, Cuba, 2018.

CASTAÑEDA, M.T.; FRANCO, M.S.; GONZÁLEZ, E.C.; ESPINOZA, O.A.: "Evolución y uso del agua de riego en los sistemas campesinos de producción de leche del noroeste del Estado de México", *Economía, sociedad y territorio*, 8(28): 1033-1058, 2008, ISSN: 1405-8421.

CISNEROS, E.; GONZÁLEZ, P.; SOLANO, O.; PLACERES, Z.; LAMBERT, M.: "El servicio de asesoramiento al regante una alternativa para mitigar los efectos negativos de la sequía", *Revista Ciencias Técnicas Agropecuarias*, 16(1): 37-40, 2007, ISSN: 1010-2760, e-ISSN: 2071-0054.

CISNEROS, Z.E.; GONZÁLEZ, B.P.; SOLANO, O.O.: "Servicio de asesoramiento al riego una necesidad del futuro", *Revista Ciencias Técnicas Agropecuarias*, 15(4): 48-53, 2006, ISSN: 1010-2760, e-ISSN: 2071-0054.

CISNEROS, Z.E.; LÓPEZ, S.T.; LEYVA, L.A.; PLACERES, M.Z.: "Consideraciones sobre el servicio de asesoramiento al regante para las condiciones de Cuba", *Revista Ciencias Técnicas Agropecuarias*, 20(3): 41-45, 2011, ISSN: 1010-2760, e-ISSN: 2071-0054.

CISNEROS, Z.E.; REY, G.R.; MARTÍNEZ, V.R.; LÓPEZ, S.T.; GONZÁLEZ, R.F.: "Evapotranspiración y coeficientes de cultivo para el cafeto en la provincia de Pinar del Río", *Revista Ciencias Técnicas Agropecuarias*, 24(2): 23-30, 2015, ISSN: 1010-2760, e-ISSN: 2071-0054.

FEVRIER, S.; SOLÓRZANO, L.D.; POMAREDA, C.; MONTENEGRO, D.: "Innovación y gestión del agua para el desarrollo sostenible en la agricultura", *[en línea]*, En: *Junta Interamericana de Agricultura (JIA). México*, San José: C.R., p. 104, documento para ser presentado por la Dirección General del IICA ante la Junta Interamericana de Agricultura (JIA). México, 2015, ISBN: 978-92-9248-581-8, *Disponible en:* https://www.redinnovagro.in/pdfs/gestion_del_agua.pdf.

GUIÑAZÚ, M.M.S.: "Estudio de caso sobre gestión comunitaria del agua de riego en parajes lote G y el 15, Municipio Contralmirante Cordero, Río Negro, Argentina Cuyonomics", *Investigaciones en Economía Regional*, 1(2): 111, 2017, *Disponible en:* https://revistas.uncu.edu.ar/ojs/index.php/cuyonomics/article/view/1338/860.

LIMA, F.A.; CÓRCOLES, J.I.; TARJUELO, J.M.; MARTÍNEZ, R.A.: "Collective irrigation network analysis considering plots irrigation scheduling", *Ingeniería del agua*, 23(2): 77-87, 2019, *Disponible en:* https://doi.org/10.4995/Ia.2019.95.

MARTÍNEZ, A.B.: *Plan de medidas para la disminución del consumo energético de la actividad de riego con máquinas de pivote central eléctricas de la UBPC-3 "Jesús Menéndez" en la Empresa Agropecuaria "Valle del Yabú"*, *[en línea]*, Universidd Central de las Villas «Marta Abreu», Tesis en opción al título académico de máster en Ingeniería, Santa Clara, Villa Clara, Cuba, publisher: Universidad Central´´ Marta Abreu´´ de Las Villas, 2015, *Disponible en:* http://dspace.uclv.edu.cu:8089/handle/123456789/2585.

NAROUA, I.: *Evaluación del uso y de productividad del agua de la Comunidad de Regantes "Río Adaja"*, *[en línea]*, E.T.S.I. Agrónomos (UPM) [antigua denominación], Thesis (Doctoral), España,

publisher: Agronomos, 2015, *Disponible en:* https://oa.upm.es/35511/.

OLMEDO, V.V.M.; CAMACHO, P.E.; RODRÍGUEZ, D.J.A.; MINJARES, L.J.L.; HERNÁNDEZ, H.M.L.: "Determinación de indicadores de gestión en los módulos del Distrito de Riego No. 041, Río Yaqui (Sonora, México)", *Revista de la Facultad de Ciencias Agrarias. Universidad Nacional de Cuyo*, 49(2): 149-168, 2017, ISSN: 1853-8665, e-ISSN: 0370-4661, *Disponible en:* https://www.redalyc.org/articulo.oa?id=382853527011.

PÉREZ, L.R.; SABATIER, C.Y.: "El cambio del módulo de aspersión en pivotes según criterios económicos: aplicación a dos cultivos", *Revista Ciencias Técnicas Agropecuarias*, 24(4): 25-30, 2015, ISSN: 1010-2760, e-ISSN: 2071-0054, *Disponible en:* https://www.redalyc.org/articulo.oa?id=93241002004.

PLAYÁN, J.E.: "La innovación en el regadío. Nuevas tecnologías y optimización del binomio agua-energía", *[en línea]*, En: *XXIII Congreso Nacional de Comunidades de Regantes de España, Palos de la Frontera, Huelva, España*, Palos de la Frontera, Huelva, Zaragoza, España, 2014, *Disponible en:* https://digital.csic.es/bitstream/10261/95754/1/PlayanE_XIIICongNalReg-Huelva_2014.pdf.

SIFUENTES, E.; MACÍAS, J.; OJEDA, W.; GONZÁLEZ, V.M.; SALINAS, D.A.; QUINTANA, J.G.: "Gestión del riego enfocada a variabilidad climática en el cultivo de papa: aplicación al Distrito de Riego 075, Río Fuerte, Sinaloa, México", *Tecnología y ciencias del agua*, 7(2): 149-168, 2016, ISSN: 2007-2422.

SILVA DO NASCIMENTO, A.K.: *Viabilidad técnica y económica de los servicios de asesoramiento al regante (SAR), así como su repercusión socioeconómica y medioambiental. Aplicación a un caso en España*, *[en línea]*, Inst. Universidad de Castilla-La Mancha, España, publisher: Universidad de Castilla-La Mancha, 2018, *Disponible en:* http://hdl.handle.net/10578/18475.

SILVA DO NASCIMENTO, A.K.; LIMA, F.A.; ROMERO, A.M.; PARDO, J.J.; PADILLA, A.D.; TARJUELO, M.B.J.M.; NAVARRO, A.M.: "Respuesta del cultivo de la cebolla bajo riego deficitario optimizado utilizando recomendaciones del asesoramiento en el riego", *Tierras de Castilla y León: Agricultura*, (247): 10-18, 2016, ISSN: 1889-0776.

ZELMER, H.; LUI, E.N.; MARTINEZ, R.S.: *Los indicadores de desempeño como aporte a la gestión del riego: estudio de caso en el canal secundario VII del Valle Inferior del río Negro*, *[en línea]*, Inst. El Canal Secundario VII Del Valle Inferior Del Río Negro, Argentina, 2018, *Disponible en:* http://hdl.handle.net/20.500.12123/4061.

Caridad Sánchez Veranes, Profesora, Universidad Agraria de La Habana, Carretera de Tapaste y Autopista Nacional km 23 ½, San José de las Lajas, Mayabeque, Cuba. caridadsv@unah.edu.cu
María del Carmen Falcón Acosta, Profesora, Universidad Agraria de La Habana, Carretera de Tapaste y Autopista Nacional km 23 ½, San José de las Lajas, Mayabeque, Cuba. mfalcon@unah.edu.cu
Leonardo Sala Hernández. Profesor, Universidad de Artemisa. Abraham Lincoln km 4, *Artemisa, Cuba,* leonardosala@uart.edu.cu

AUTHOR CONTRIBUTIONS: Conceptualization: C. Sánchez. **Data curation:** C. Sánchez, M. C. Falcón. **Formal analysis:** C. Sánchez, M. C. Falcón, L Salas. **Investigation:** C. Sánchez, M. C. Falcón, L Salas. **Methodology:** C. Sánchez, M. C. Falcón, L Salas. **Supervision:** C. Sánchez. **Validation:** C. Sánchez, M. C. Falcón. **Roles/Writing, original draft:** C. Sánchez. **Writing, review & editing:** C. Sánchez, M. C. Falcón, L Salas.

The authors of this work declare no conflict of interest.