INDEPENDENT JOURNAL OF MANAGEMENT & PRODUCTION (IJM&P)
http://www.ijmp.jor.br _v. 12, n. 3, Special Edition ISE, S&P - May 2021_
ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

INFLUENCE OF AGROMETEOROLOGICAL COMPONENT OF THE PROJECT ENVIRONMENT ON THE DURATION OF WORKS IN CHEMICAL PROTECTION PROJECTS OF AGRICULTURAL CROPS

Anatolii Tryhuba
Lviv National Agrarian University, Ukraine
E-mail: atryguba55@gmail.com

Volodymyr Ivanyshyn
Podillia State University, Ukraine
E-mail: volodymyrivanyshyn55@gmail.com

Inna Tryhuba
Lviv National Agrarian University, Ukraine
E-mail: atryguba55@gmail.com

Vitalii Chaban
Kyiv National Economic University named after Vadim Hetman, Ukraine
E-mail: lvolia@ukr.net

Iryna Mushenyk
State Agrarian and Engineering University in Podilya, Ukraine
E-mail: mushenik77@ukr.net

Olena Zharikova
National University of Life and Environmental Sciences of Ukraine, Ukraine
E-mail: ele0309@ukr.net

Submission: 12/22/2020
Revision:2/6/2021
Accept: 3/4/2021

ABSTRACT

The analysis of the state of science and practice of making managerial decisions in agricultural production projects is performed. The expediency of substantiation of the influence of the agrometeorological component of the project environment on the duration of works in the projects of chemical protection of agricultural crops is substantiated. The approach to the definition of fund of works time performance in projects of chemical protection of crops taking into account changing events of an agrometeorological component of the project environment is offered. It is based on the use of statistical data of agrometeorological stations in the regions where these projects are

implemented. The peculiarity of this approach is that it provides for the formation of databases and knowledge for planning work in projects of chemical protection of agricultural crops based on the characteristics of a given

project environment. To do this, computer simulation is used, which provides a systematic consideration of many variable agrometeorological components of the design environment and their impact on the limitation of the time allocated for work. This improves the quality of the database for forecasting the events of the components of the project environment, as well as gaining knowledge that underlies the acceleration of management decisions in projects of chemical protection of crops. It is established that the duration of agrometeorological determined daily fund of time for work in projects of chemical protection of agricultural crops is variable both during the life cycle of the project and in certain periods of its implementation, which is reflected by the relevant distribution laws. Further research on the planning of chemical protection projects for agricultural crops should be conducted to justify new methods and models of management decisions that will take into account the impact of changing events of the agrometeorological component of the project environment on the time and content of work in these projects.

Keywords: Projects; Planning; Events; Works; Agrometeorological Component; Chemical Protection; Agricultural Crops

1. INTRODUCTION

Every year, agricultural enterprises of Ukraine and the world, suffer significant losses of their crops from harmful objects (weeds, pests, and diseases). These losses in some years can reach 30% (Tryhuba et al., 2014; Tryhuba et al., 2019). To prevent them, chemical plant protection is used, which involves applying to the surface of crops in certain phases of their growth and development of a solution of appropriate chemicals.

To this end, appropriate projects are initiated, which may provide for the centralized implementation of work on chemical protection of crops in a given region. Effective performance of chemical plant protection work requires the use of a design approach that takes into account the systemic relationships between the components of the design environment and the content and timing of the work, as well as the need for resources.

The agrometeorological component of the project environment, which is a limiting factor in the duration of these works, has a significant impact on the content and timing of works in these projects (Fraisse et al., 2006; Islam et al., 2017; Roy, 2019; Rudynets et al., 2019). At the same time, there is a need to use tools for planning work in projects of chemical protection of agricultural crops (PCPAC), which takes into account the agrometeorological component of their design environment.

ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

For this purpose, it is necessary to have models of change of time fund for the performance of works in PCPAC for the set region which underlies planning of the specified works.

2. LITERATURE REVIEW

Solving management problems to determine the duration of work in projects and the impact on them of the project environment are based on the characteristics of the subject area and models and methods of project management (Hulida et al., 2019; Ratushny et al., 2019; Bashynsky, 2019).

In the scientific works (Pavlikha et al., 2019; Ratushny et al., 2019; Tryhuba et al., 2020) the analysis of the possibility of using project management tools to solve management problems to justify the duration of work. These models and methods involve the use of traditional approaches that do not take into account the specifics of the subject area.

Some authors in their works (Syrotiuk et al., 2020; Tryhuba et al., 2020) solve scientific and applied problems of substantiation of management decisions in agricultural production projects, which are based on forecasting processes. Their main advantages are taking into account the specifics of agricultural production. However, their use to determine the duration of work in the PCPAC is impossible, as they do not take into account the peculiarities of the agrometeorological component of the design environment.

In some works (Bazzaz et al., 1996; Lobell et al., 2007; Serrano et al., 2004; Boychenko et al., 2007) their authors propose to take into account the features of the agrometeorological component of the project environment, which requires the use of a personalized approach to justify management decisions. The research of some authors in this direction is performed in relation to the planning of agricultural production projects (Tryhuba et al., 2019; Tryhuba et al., 2020). However, all the above authors in their scientific works did not pay enough attention to the study and analysis of the impact of the agrometeorological component of the project environment on the implementation of PCPAC for a given region.

The available scientific papers have not considered the causal links between works and events with the probable time of their occurrence, which makes it impossible to effectively plan PCPAC for a given region (Tryhuba et al., 2019a; Tryhuba et al., 2019b). In particular, this applies to forecasting the content and timing of works, the need for resources, and the budget of projects, taking into account the changing characteristics of the agrometeorological component of their design environment for the specified parameters of technical support. This

ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

is the main reason for making erroneous management decisions when planning PCPAC. These arguments indicate the need to identify the events that underlie the development of new methods and models for PCPAC planning.

Therefore, the existing methods and models of project planning do not take into account the probable nature of the time of occurrence of events that determine the need to perform work in PCPAC, and, accordingly, this is the main reason for making wrong decisions when planning work and determining resource requirements.

Thus, there is a scientific and applied problem for substantiation of the approach to determining the fund of time of works in PCPAC, as well as models of events of the agrometeorological component of their design environment, which determine the duration of works for a given region. The formulated problem is solved in the article, which confirms its scientific and practical value.

The purpose and objectives of the study. The purpose of the work is to develop an approach and substantiate the knowledge base that provides a definition of the time fund of work in the PCPAC, taking into account the changing events of the agrometeorological component of the project environment.

To achieve this goal should solve the following tasks:

- to propose an approach to determining the time fund of work in the PCPAC, taking into account the changing events of the agrometeorological component of the project environment;
- substantiate the model of changing events, which is the basis for determining the time fund of work in the PCPAC.

3. MATERIALS AND METHODS

One of the components of the project environment, which directly affects the content and timing of work in the PCPAC, is agrometeorology. The agrometeorological component is characterized by basic and derivative events that are stochastic in nature and, accordingly, determine the probable beginning and duration of work in projects.

The basic events of the agrometeorological component of the project environment in the PCPAC projects include precipitation time; the time when the temperature exceeds 25oC; dew disappearance time; the time when the wind speed exceeds 5 m/s. A derivative

http://www.ijmp.jor.br v. 12, n. 3, Special Edition ISE, S&P - May 2021
ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

agrometeorological event is a time when agrometeorological conditions are favourable for the performance of work on PCPAC.

The experience of previous projects is used to substantiate the event models of the agrometeorological component of the PCPAC. In particular, on the basis of passive experiments, the collection, and analysis of statistical data of agrometeorological stations, namely the time of occurrence of the above agrometeorological events, the time of their cessation, and their quantitative value.

Collection of statistical data on the events of the agrometeorological component of the project environment is performed on the basis of archival materials of meteorological stations (Tryhuba et al., 2019d; Ljaskovska et al., 2018). In particular, the journals KM-1 (Book of Meteorological Observations) are processed, in which daily observations on the characteristics of agrometeorological conditions in a particular day are recorded. The obtained data are entered into the developed special registration forms.

Statistical information on the time of occurrence of the events of the agrometeorological component of the PCPAC is processed for the period (April – August). As a result of this study, an empirical series of fine and non-fine periods of time are obtained. The criteria for assessing the suitability of a particular day include 1) the presence of a light period of time of day; 2) the air temperature did not exceed 25ºC; 3) air velocity did not exceed 5 m/s; 4) no precipitation; 5) lack of dew (Bashynsky, 2019).

All components of agrometeorological events are the basis for the substantiation of models of daily time funds for work in PCPAC. The analysis of individual agrometeorological events shows that in some months of the season of work on PCPAC (April – August) their presence and quantitative characteristics are modified. In particular, in April there are much fewer days with dew than in July or August.

Also in April, there are much fewer time intervals when the air temperature exceeds 25oC, compared to the summer months. Regarding the speed of air movement, in May and June, there are many more days compared to other months, where it exceeds 5 m/s. This indicates that the agrometeorological component of the PCPAC project environment during the season can be adequately reflected only by the models of the daily fund of work time in certain months.

Agrometeorological acceptable fund of time of performance of works on PCZS in a separate day is defined from an expression

INDEPENDENT JOURNAL OF MANAGEMENT & PRODUCTION (IJM&P)
http://www.ijmp.jor.br v. 12, n. 3, Special Edition ISE, S&P - May 2021
ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

$$\left(t_{ij}^{\phi}\right) = t_{cij} - t_{pij} - t_{vij} - t_{tij}, \quad (1)$$

where t_{cij} – duration of light interval in i-th day j-th month, h; t_{pij} – duration of light interval in i-th day j-th month, during which there is dew, h; t_{vij} – duration of light interval in i-th day j-th month, during which the air velocity exceeds 5m/s, h; t_{tij} – duration of light interval in i-th day j-th month, during which the air temperature exceeds 25oC, h.

The duration of the light interval is determined from the expression

$$t_{cij} = \tau_{\text{н}cij} - \tau_{ncij}, \quad (2)$$

where $\tau_{\text{н}cij}$ – the time of occurrence of the beginning of daylight in i-th day j-th month, h; τ_{ncij} – the time of occurrence of the event of cessation of daylight in i-th day j-th month, h.

The duration of the light period during which the available dew is determined from the expression

$$t_{pij} = \tau_{npij} - \tau_{\text{н}cij} + \tau_{ncij} - \tau_{\text{н}pij}, \quad (3)$$

where $\tau_{\text{н}pij}$ – the time of occurrence of the event of dew in i-th day j-th month, h; τ_{npij}– the time of occurrence of the event of cessation of dew in i-th day j-th month, h.

If on a particular day the dew was absent, then $t_{pij} = 0$ h. If the condition $\tau_{npij} < \tau_{\text{н}cij}$ performed, then accepted $\tau_{npij} - \tau_{\text{н}cij} = 0$ h. If the condition $\tau_{ncij} < \tau_{\text{н}pij}$ performed, then accepted $\tau_{ncij} - \tau_{\text{н}pij} = 0$ h.

The duration of the light period during which the air velocity exceeds 5 m/s is determined from the expression

$$t_{vij} = \sum_{n=1}^{k} \tau_{nvij}^{n} - \tau_{\text{н}vij}^{n} \quad , \quad (4)$$

where$\tau_{\text{н}vij}^{n}, \tau_{nvij}^{n}$ – respectively, the time of occurrence of events when the wind speed exceeds 5 m/s and less than 5 m/s, h; k – the number of time intervals during the day when the wind speed exceeds 5 m/s.

The duration of the light period of time during which the air temperature exceeds 25oC is determined from the expression

$$t_{tij} = \sum_{n=1}^{k} \tau_{ntij}^{n} - \tau_{\text{н}tij}^{n} \quad , \quad (5)$$

ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

where $\tau_{nvij}^{n}, \tau_{\text{н}vij}^{n}$ – respectively, the time of occurrence of events when the air temperature exceeds 25oC and less than 25oC, h; k – the number of time intervals during the day when the air temperature exceeds 25oC.

4. RESULTS AND DISCUSSION

In order to substantiate the models of the duration of fine weather and bad weather periods of time, we used the data of the Yavoriv Meteorological Station, located in the Lviv region. For this purpose, information was collected on the agrometeorological conditions of each individual day of the PCPAC work season (from April 1 to August 31) during 1982-2018. The main criteria for assessing the suitability of a particular day were: 1) the presence of a light period of time of day; 2) the air temperature did not exceed 25oC; 3) air velocity did not exceed 5 m/s; 4) no precipitation; 5) lack of dew (Bashynsky, 2019).

Statistical processing of the obtained information on fine weather and bad weather periods made it possible to determine their numerical characteristics, as well as to substantiate the theoretical distribution laws, which agree on the three-parameter Weibull distribution laws, the density function of which has the form (Figure 1, 2):

– for fine weather periods of time

$$f(t_n) = 0.303 \cdot \left(\frac{t_n - 1}{3.667}\right)^{0.113} \cdot exp\left[-\left(\frac{t_n - 1}{3.667}\right)^{1.113}\right], \quad (6)$$

– for bad weather periods of time

$$f(t_{\text{н}}) = 0.712 \cdot \left(\frac{t_{\text{н}} - 1}{1.622}\right)^{0.154} \cdot exp\left[-\left(\frac{t_{\text{н}} - 1}{1.622}\right)^{1.154}\right], \quad (7)$$

The statistical characteristics of these distributions have the following meanings: estimates of mathematical expectation – $M[t_n] = 4.53$ days and $M[t_{\text{н}}] = 2.54$ days; estimates of standard deviation – $\sigma[t_n] = 3.22$ days and $\sigma[t_{\text{н}}] = 1.35$ days.

ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

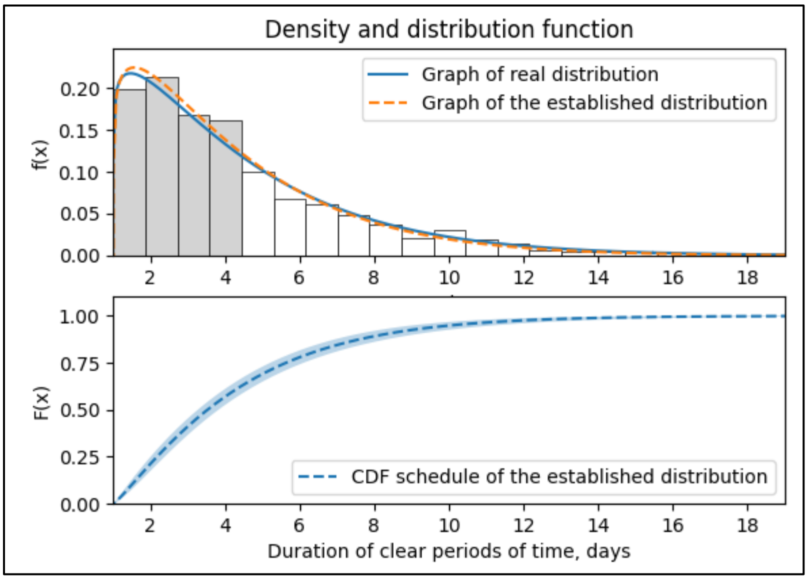

Figure 1: Density and function of for fine weather periods of time

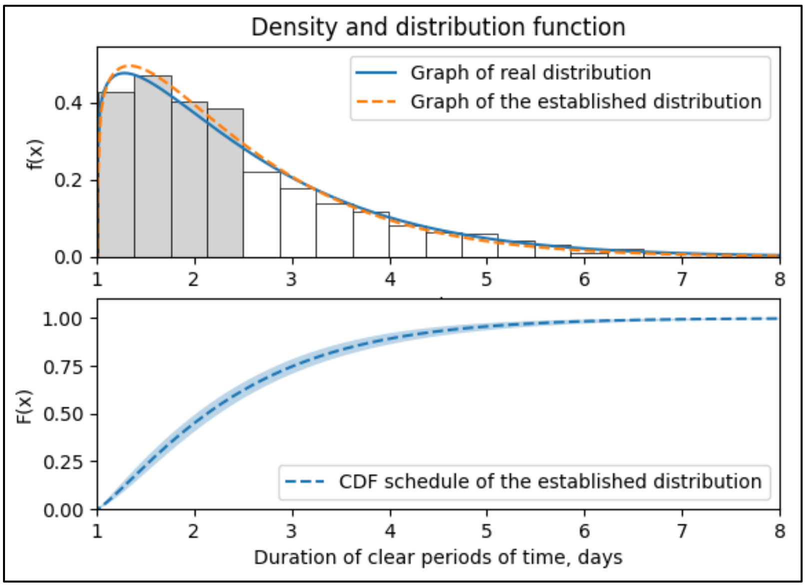

Figure 2: Density and function of for bad weather periods of time

It is established that each of the months of the PCPAC work season the daily time fund differs because the time and number of basic agrometeorological events (time of onset and cessation of daylight hours; precipitation time; the time when the temperature exceeds 25ºC; dew disappearance time; the time when wind speed exceeds 5 m/s) in some months are different.

Statistical processing of the received information on the agrometeorological determined daily fund of time for performance of works in PCPAC allowed to define their numerical characteristics, and also to substantiate theoretical laws of distribution and their characteristics (table 1.).

http://www.ijmp.jor.br *v. 12, n. 3, Special Edition ISE, S&P - May 2021*
ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

Table 1: Characteristics of distributions of agrometeorological determined daily time fund for performance of works in PCPAC, h

Month	The law of distribution	Distribution function	Numerical characteristics	
			$M[t_{kd}^{i}]$, h	$v[t_{kd}^{i}]$
April	Weibull	$f(t_{kd}^{4}) = 0.29 \cdot \left(\frac{t_{kd}^{4}-2}{6.226}\right)^{0.806} \cdot exp\left[-\cdot\left(\frac{t_{kd}^{4}-2}{6.226}\right)^{1.806}\right]$	7,53	0,57
May	Normal	$f(t_{kd}^{5}) = 0.12 \cdot exp\left[-\cdot\left(\frac{t_{kd}^{5}-8.91}{22.2}\right)^{2}\right]$	8,91	0,48
June	Weibull	$f(t_{kd}^{6}) = 0.227 \cdot \left(\frac{t_{kd}^{6}-2}{8.086}\right)^{0.839} \cdot exp\left[-\left(\frac{t_{kd}^{6}-2}{8.086}\right)^{1.839}\right]$	9,18	0,56
July	Weibull	$f(t_{kd}^{7}) = 0.253 \cdot \left(\frac{t_{kd}^{7}-2}{7.23}\right)^{0.828} \cdot exp\left[-\left(\frac{t_{kd}^{7}-2}{7.23}\right)^{1.828}\right]$	8,42	0,56
August	Weibull	$f(t_{kd}^{8}) = 0.26 \cdot \left(\frac{t_{kd}^{8}-2}{6.418}\right)^{0.669} \cdot exp\left[-\left(\frac{t_{kd}^{8}-2}{6.418}\right)^{1.669}\right]$	7,32	0,61

From the table, it is seen that the characteristics of the agrometeorological determined daily fund of time are variable and depend on the month of the season of work in the PACCP. The obtained results indicate that the mathematical expectation of the agrometeorological determined daily fund of time from the beginning of the season of work in PCPAC (April) increases to its middle, where in June it reaches its maximum value and decreases again by the end of the season. In addition, the limits of the confidence interval change similarly.

According to the results of the obtained data, the tendency of changing the mathematical expectation of the agrometeorological determined daily fund of time for performance of works in PCPAC (t_{kd}^{i}) during the season is constructed (figure 3).

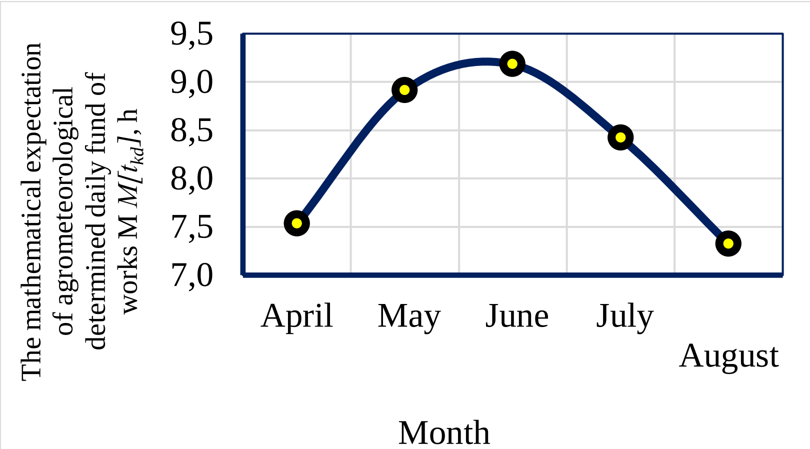

Figure 3: The tendency to change the mathematical expectation of the agrometeorological determined daily fund of time for performance of works in PCPAC (t_{kd}) during a season.

It is described by a polynomial of the third degree:

$$M\left[t_{kd}^{i}\right] = 9.74 \cdot 10^{-2} \cdot (N_m-3)^3 + 1.24 \cdot (N_m-3)^2 + 4.5(N_m-3) + 4.16. \qquad (8)$$

http://www.ijmp.jor.br v. 12, n. 3, Special Edition ISE, S&P - May 2021
ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

Thus, the time of occurrence of the events of the agrometeorological component of the project environment on a particular day is probable, which determines the variable duration of the agrometeorological daily time fund for work in the PCPAC $\left(t_{kd}^{\mathrm{i}}\right)$ during the season. The obtained models of agrometeorological determined daily time funds are the basis for planning work with PCPAC.

5. CONCLUSIONS

To propose an approach to determining the time fund of work in the PCS, taking into account the changing events of the agrometeorological component of the project environment is based on the use of statistical data of agrometeorological stations in the regions where these projects are implemented.

The peculiarity of this approach is that the formation of databases and knowledge is based on the characteristics of a given design environment through computer simulation, which systematically takes into account many variable agrometeorological components of the design environment and their impact on time constraints. This is the basis for improving the quality of database formation for forecasting the events of the components of the project environment, as well as obtaining the knowledge that underlies the acceleration of management decisions in PCPAC.

Mathematical processing of the official data of the agrometeorological station allowed to substantiate statistical models of the time for events occurrence of the agrometeorological component of the project environment, which take into account the causal relationships between them, identified on the basis of previous projects.

It is established that the duration of agrometeorological determined daily fund of time for performance of works in PCPAC is variable during a life cycle of the project, and in separate periods of its performance that is reflected by the corresponding laws of distribution (table 1). Further research on PCPAC planning should be conducted to substantiate new methods and models of management decisions that will take into account the impact of changing events of the agrometeorological component of the project environment on the time and content of work in these projects.

REFERENCES

Bashynsky, O. (2019) Coordination of dairy workshops projects on the community territory and their project environment. In: **14-th International Scientific and Technical Conference**

ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

on Computer Sciences and Information Technologies. Lviv Polytechnic National University, 17–20 September. Lviv, pp. 51–54.

Bazzaz, F., & Sombroek, W. (1996) Global climate change and agricultural production: direct and indirect effects of changing hydrological soil and plant physiological processes. **FAO, Rome, Italy**. Available at: http://www.fao.org/docrep/w5183e/w5183e00.htm#Contents

Boychenko, S., & Voloshchuk, V. (2007) The stochastic semi-empirical model of space-temporal transformation of the modern climate of Ukraine. **National Academy of Science of Ukraine**. 1, 105-109.

Fraisse, C. W., Breuer, N. E., Zierden, D., Bellow, J.G., Paz, J., Cabrera, V. E., & O'brien, J. J. (2006) AgClimate: a climate forecast information system for agricultural risk management in the southeastern USA. **Computers and Electronics in Agriculture,** 53(1), 13–27.

Hulida, E., Pasnak I., & Koval, O. (2019) Determination of the Critical Time of Fire in the Building and Ensure Successful Evacuation of People. **Periodica Polytechnica Civil Engineering,** 63(1), 308-316.

Islam, S., & Mandal, W.A. (2017) A fuzzy inventory model (EOQ model) with unit production cost,time depended holding cost, without shortages under a space constraint: a fuzzy parametric geometric programming (FPGP) approach. **Independent Journal of Management & Production,** 8(2), 299-318. DOI: 10.14807/ijmp.v8i2.535.

Ljaskovska, S., Martyn, Y., Malets, I., & Prydatko, O. (2018) Information technology of process modeling in the multiparameter systems. In: **II International Conference on Data Stream Mining and Processing.** Lviv Polytechnic National University, 21–25 August. Lviv, pp. 177–182.

Lobell, D., & Field, C. (2007) Global scale climate–crop yield relationships and the impacts of recent warming**. Environ. Res. Lett.** 2, 1-7.

Pavlikha, N., Rudynets, M., Grabovets, V., Skalyga, M., Tsymbaliuk, I., Khomiuk, N. & Fedorchuk-Moroz, V. (2019) Studying the influence of production conditions on the content of operations in logistic systems of milk collection. **Eastern-European Journal of Enterprise Technologies: Control processes,** 99(3/3), 50–63.

Ratushnyi, R., Khmel, P., Martyn, E., & Prydatko, O. (2019) Substantiating the effectiveness of projects for the construction of dual systems of fire suppression. **Eastern-European Journal of Enterprise Technologies: Control processes,** 100(4/3), 46–53.

Ratushny, R., Bashynsky, O., & Ptashnyk, V. (2019) Development and usage of a computer model of evaluating the scenarios of projects for the creation of fire fighting systems of rural communities. In: **XI-th International Scientific and Practical Conference on Electronics and Information Technologies**. Ivan Franko National University of Lviv, 16–18 September. Lviv, pp. 34–39.

Roy, P. C., Guber, A., Abouali, M., Pouyan Nejadhashemi, A., Deb, K., & Smucker, A. (2019) Crop yield simulation optimization using precision irrigation and subsurface water retention technology. **Environmental Modelling & Software**, 119, 433–444.

Rudynets, M., Pavlikha, N., Kytsyuk, I., Korneliuk, O., Fedorchuk-Moroz, V., & Seleznov, D. (2019) Establishing patterns of change in the indicators of using milk processing shops at a community territory. **Eastern-European Journal of Enterprise Technologies: Control processes,** 102(3/6), 57–65.

ISSN: 2236-269X
DOI: 10.14807/ijmp.v12i3.1531

Serrano, I. V., Gonzalez–Hidalgo, S. M., De Luis, J. C., &Raventos, M. J. (2004). Drought patterns in the Mediterranean area: the Valencia region (eastern Spain). **Climate Research**. 26, 5-15.

Syrotiuk, V., Syrotiuk, S., Ptashnyk, V., Baranovych, S., Gielzecki, J., & Jakubowski, T. (2020) A hybrid system with intelligent control for the processes of resource and energy supply of a greenhouse complex with application of energy renewable sources. **Przegląd elektrotechniczny**, 96(7), 149-152.

Tryhuba, A. (2014) Argumentation of the parameters of the system of purveyance of milk collected from the private farm-steads within a single administratinve district. **Econtechhod : An international quarterly journal on economics in technology, new technologies and modelling processes**, 3(4), 23-27.

Tryhuba, A., Tryhuba, I., Ftoma, O., & Boyarchuk, O. (2019) Method of quantitative evaluation of the risk of benefits for investors of fodder-producing cooperatives. In: **14-th International Scientific and Technical Conference on Computer Sciences and Information Technologies**. Lviv Polytechnic National University, 17–20 September. Lviv, pp. 55–58.

Tryhuba, A., Boyarchuk, V., Tryhuba, I., Ftoma, O., Francik, S., & Rudynets, M. (2020) Method and software of planning of the substantial risks in the projects of production of raw material for biofuel. In: **International Workshop IT Project Management.** Ukrainian Project Management Association "UKRNET" & Lviv Polytechnic National University, 18–20 February. Slavsko, pp. 116–129.

Tryhuba, A., Hridin, O., Slavina, N., Mushenyk, I., & Dobrovolska, E. (2020) Managerial decisions in logistic systems of milk provision on variable production conditions. **Independent Journal of Management & Production,** 11(8), 783-800.

Tryhuba, A., Bashynskyi, O., Medvediev, Y., Slobodian, S., & Skorobogatov, D. (2019) Justification of models of changing project environment for harvesting grain, oilseed and legume crops. **Independent Journal of Management & Production,** 10(7), 658-672.

Tryhuba, A., Tryhuba, I., Mushenyk, I., Pashchenko O., & Likhter M. (2020) Computer model of resource demand planning for dairy farms. **Independent Journal of Management & Production (2nd Special Edition ISE, S&P),** 11(6), 658-672.

Tryhuba, A., Boyarchuk, V., Tryhuba, I., & Ftoma, O. (2019) Forecasting of a lifecycle of the projects of production of biofuel raw materials with consideration of risks. **International Conference on Advanced Trends in Information Theory (ATIT),** pp. 420-425.

Tryhuba, A., Boyarchuk, V., Tryhuba, I., Boyarchuk, V., & Ftoma, O. (2019). Evaluation of risk value of investors of projects for the creation of crop protection of family dairy farms. **Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis**, 67(5), 1357–1367.