

Annual Project Progress Report

1. General Information

1.1. Program and Project information	
Name of the Program:	PROMIS
Name of the Project:	A Bioinformatics Approach to Dairy Cattle Breeding using genomic selection
The Project acronym:	BioITGenoSelect
Total Project budget:	169,769.96 €
Project realization period (from dd/mm/yyyy to dd/mm/yyyy):	Start date: 22/07/2020 End date: 21/07/2021
Reporting period:	Annual Report

1.2. Project participants information	
1.2.1. Principal Investigator (PI) and Lead Science and Research Organization (SRO)	
Name and last name of the PI:	Ljuba Štrbac
Academic and research title of the PI:	Assistant professor, PhD
SRO name:	University of Novi Sad, Faculty of Agriculture
SRO authorized person (legal representative) name and last name:	Nedeljko Tica

1.2.2 Project Partners - Science and Research Organizations (SRO) *	
SRO name:	University of Novi Sad, Faculty of Science
SRO authorized person (legal representative) name and last name:	Milica Pavkov Hrvojević
SRO name:	University of Novi Sad, Faculty of Technical Science
SRO authorized person (legal representative) name and last name:	Rade Doroslovački

*Copy this table as needed to provide information about all Partner SROs.

2. Annual Project Summary

2.1. Project and Progress Summary – brief description of annual project objectives, methodology, impact, and ambition with progress summary and achieved results for reporting period. *

Project BioITGenoSelect is focused on the improvement of dairy cattle population in Republic of Serbia using genomic selection. Project objectives are: forming a database of the origins and results of measuring the traits, genotyping of animals, developing software tools, developing appropriate statistical models and calculating genomic breeding values and educating breeders and experts in breeding organizations. During the first year of the project database formation, development of software tools and calculating of classical breeding values were done. The main application with the animal database was created. The application is integrated with a web interface that allows interested parties easy access to the needed data. Data importing, data exporting, data normalization and data preparation software are integrated into the main application. Quantitative genetic analysis was performed, and animals were ranked according to their breeding values. Laboratory for molecular genetics is equipped as planned. Two scientific papers are prepared for scientific conferences and multiple promotional activities with commercial media are done. During the next year, genotyping of animals, calculation of genomic breeding values and education of breeders and experts is planned.

*Recommended up to 250 words.

3. Project Implementation - Annual Overview

3.1 Project results overview

3.1. Summary of the annual Project results (as foreseen in Project Description) - short narrative description of the Project Results developed in the first year of project implementation. *

The main application with the animal database was created. Existing models have been extended to cover the important aspects of dairy cows. Part of the software development was also data importers. The existing data on animals was imported, and now the relations between generations can be fully followed. The application is integrated with a web interface that allows interested parties easy access to the needed data. It may be used for direct data entry from the breeding organizations. An integral part of the application is the export functions that adapt the data to formats needed for analytics software. Quantitative genetic analysis was performed, and animals were ranked according to the breeding values. Data normalisation software is developed as a part of the main application. New features were added and further tested with new data, included importing data output by the Wombat REML. Data preparation software is integrated into the main application.

Much of the activity was focused on the procurement of equipment for the laboratory for molecular genetics. Despite faced problems with delays and delivery of defective equipment, all procurements were completed and almost all equipment is installed.

Web page of the project had been created and updated in English and Serbian. WordPress platform had been used which allows both the presentation of the information about the project and implementation of an open database which is one of the expected outcomes of the project. Multiple appearances in newspapers and TV shows were made.

*Recommended up to 250 words.

3.1.1. In case of deviation or delay, please explain.

If all results scheduled for reporting period are reached, enter N/A.*

One part of equipment - freezer for molecular genetics laboratory is not delivered yet. Freezer initially delivered was found defective and after a failed attempt to get a new one from same supplier, that public procurement contract had been terminated. After that, a new public procurement was successfully finished and delivery is expected during the fifth quarter.

Reference population is not formed yet. Project started during vacation period and that prevented initial data collection from breeding organizations during first two months. That initial delay has resulted in a chain reaction of postponing all dependent tasks in few months. Also, databases collected contained unexpected level of inconsistencies. Great efforts are made to improve and complete database, and further steps that are highly dependent on database quality are postponed in few months. Formation of a reference population is expected during the fifth quarter.

Due to the corona virus pandemic, some conferences that were planned for presenting the research were canceled. Results were presented and will be presented at other conferences, and in case that there are not enough opportunities, conference presentations will be substituted with journal papers.

*Recommended up to 250 words.

3.2. Progress of the annual project activities for reporting period

3.2.1. Milestones - Short description of milestones achieved during the reporting period, with reference to the Project Description and Gantt Chart.

Milestone's title – insert milestone name*		Delivery month (Mx) from Gantt Chart	Milestone reached	If not reached, enter estimated month (Mx)
1.	Forming of the initial animal database	4	Yes	
2.	Ranking the animals	8	Yes	
3.				
...				

*Based on milestones planned in Table 3.3 in the Project Description and Gantt Chart (Annex 1 and Annex 3 of the Contract on the Project financing).

3.2.2. If a milestone is not reached, please explain – based on milestones planned in Table 3.3 in the Project Description and Gantt Chart (Annex 1 and Annex 3 of the Contract on the Project financing).

If all milestones scheduled for reporting period are reached, enter N/A. Recommended up to 250 words.

N/A

3.2.3. Deliverables- Short description of deliverables achieved during the reporting period, with reference to the Project Description and Gantt Chart.					
Tasks/activities*		Deliverable name**	Delivery month (Mx) from Gantt Chart	Achieved Deliverable	If not achieved, enter estimated delivery month (Mx)
1.	Creation of animal database Pedigree and production data collection; Development of software tools for automated normalization of data.	Data normalization software	3 (4)	Yes	
2.	Creation of animal database Data integration.	Initial animal database	4	Yes	
3.	Calculation of population parameters: pedigree analysis, genetic parameters and classical breeding values (BV) Development of software tools for input data preparation for specialized software.	Data preparation software	5 (8)	Yes	
4.	Calculation of population parameters: pedigree analysis, genetic parameters and classical breeding values (BV) Calculation of genetic parameters and BV using different models; Accuracy comparison and best model selection; Animal ranking.	Quantitative genetic analysis	8 (10)	Yes	
5.	Formation of a reference population	Reference population	9	No	13
6.	Results dissemination Creation of a web site with the basic project data	Project web site	2	Yes	

*Based on tasks presented in Table 3.2. in the Project Description and Gantt Chart (Annex 1 and Annex 3 of the Contract on the Project financing).

**Based on deliverables presented in Table 3.4 in the Project Description and Gantt Chart (Annex 1 and Annex 3 of the Contract on the Project financing).

3.2.4. If a deliverable is not reached, please explain - based on deliverables presented in Table 3.4 in the Project Description document and Gantt Chart (Annex 1 and Annex 3 of the Contract on the Project financing).

If all deliverables scheduled for reporting period are reached, enter N/A. **Recommended up to 250 words.**

Deliverable “Reference population” is not reached yet. One reason is the initial delay that resulted in chain reaction of postponing all dependent tasks in few months. Project started in July of 2020, so first two months of project were in the summer months, during vacation period. Due to that, effective communication with breeding organizations, which provided the necessary data for database formation, started during September. Another reason observed inconsistencies in the existing databases, due to human error in data input, and/or different treatment of the same data in different bases. Also, work was done on improving the database, which was supplemented with new information necessary for breeders and breeding organizations. Additional analyzes were conducted using different mathematical models to define the best model for estimating traditional breeding values. This activity was not implemented in time since it was concluded that it is better to correct and complete the database first.

3.3. Implementation plan

3.3.1. Please shortly describe if project activities were implemented in line with approved project schedule – Gantt Chart *

Project activities were implemented with a certain delay compared to the project schedule presented in the Gantt Chart. Creation of the animal database was postponed from 3rd to 4th month, certain parts of the calculation of population base parameters (pedigree analysis) and classical breeding values (BV) were postponed from 5th to 8th month and others to the 10th month, while formation of a reference population was postponed from 9th to the 13th month. Equipment delivery also experienced certain delays, and parts of the budget were transferred from planned quarterly periods to the subsequent ones.

*Recommended up to 250 words.

3.4.Scientific publications			
3.4.1.Insert the full reference with the link of the publication.			
Type of scientific publication*	DOI	Full reference	Publication status**
Publication in conference	10.1109/INFOTEH51037.2021.9400672	L. Tarjan, I. Šenk, D. Pracner, D. Rajković and Lj. Štrbac, "Possibilities for applying machine learning in dairy cattle breeding," 2021 20th International Symposium INFOTEH-JAHORINA (INFOTEH), 2021, pp. 1-6, https://ieeexplore.ieee.org/document/9400672	published
Publication in conference		Ivković, M. Šaran, V. Sapundžić, Lj. Štrbac and S. Trivunović, "Effective population size and inbreeding rate of Holstein population in Vojvodina autonomous province (Serbia)", 12 th International Agriculture Symposium AGROSYM 2021, 2021.	accepted

Important note: state only publications that were referenced and accepted within the PROMIS project Quarterly Administrative Reports.

*Type of scientific publication: article in journal, publication in conference/workshop, book/monograph, book chapter etc.

** Status can only include: submitted, accepted, or published.

3.5.Open research data				
3.5.1. Insert the full reference with the link of the publication: article in journal, publication in conference/workshop, book/monograph, book chapter etc.				
DOI	Title with short description (specify the data in terms of size, structure, format, to whom the dataset is accessible, is it primary or secondary data, what are the terms of use etc.)	Is the data set openly accessible?	Is the data set reusable?	If the dataset is linked to a publication, specify the DOI of the publication
		YES/NO	YES/NO	
		YES/NO	YES/NO	
		YES/NO	YES/NO	

3.6. Intellectual property rights resulting from the project (if applicable to this project)				
3.6.1. Insert all necessary information regarding intellectual property rights				
Type of IP Rights	Date of the application	Official title of the application	Has the IPR protection been awarded?	If available, official publication number of award of protection
			YES/NO	
			YES/NO	
			YES/NO	

3.7. Ethical approvals (if applicable)					
	Ethical approval*	Period covered by the ethical approval	Issuing authority	State which SRO is covered by the ethical approval	State which work package/task is covered by the ethical approval
1.					
2.					
3.					

*List all documentation (approvals, decisions etc.) required by relevant laws.

3.8. Environmental and social management
3.8.1. Please describe project impact on environment. In case that your research involves the use of elements that may cause harm to humans, environment, to animals or plants, if your research has negative impact to any vulnerable individuals or groups, if the new or old equipment is not disposed properly, if project implementation includes discharge of wastewater and/or requires environmental protection measures, if existing employees of the SRO(s) are not regularly registered for pension and disability insurance, or in case your project has any other environmental and social management effects, please shortly describe relevant environmental and social management. Otherwise, state N/A.
N/A

4. Scientific Impact – Annual Overview

4.1. Please describe scientific impact of project activities and results in the first year of project implementation

The scientific importance is reflected in the fact that the participants of the research team were introduced to different types of data, methods and software for their analysis. Bioinformatics is a multidisciplinary field that allowed project participants to extend their current knowledge with current methods in the field of molecular genetics, statistics and informatics. During project realization, modern software and methodologies were used to evaluate breeding values that project participants had the opportunity to use. Two scientific papers were prepared to be published in international scientific conferences. Here, the members of the research team had/will have the opportunity to share with other participants in the gathering, their current and new experiences, and to establish contacts for further cooperation. Scientific paper on the applicability of machine learning in breeding and similar tasks was prepared in order to gather information on current achievements in this field. This prepares the ground for further work and was made into a conference paper entitled "Possibilities of machine learning applications in dairy cattle breeding" that was presented at 20th International Symposium INFOTEH-JAHORINA, March 17-19, 2021, Jahorina, Bosnia and Herzegovina. Other scientific paper on the current state of our cattle population was prepared in order to gather information on problems current breeding plan is facing and possible problems that will result from the use of new technology. Conference paper entitled "Effective population size and inbreeding rate of Holstein population in Vojvodina autonomous province (Serbia)" was submitted and subsequently accepted for 12th International Agriculture Symposium AGROSYM, planned for October 7-10, 2021, Jahorina, Bosnia and Herzegovina.

*Recommended up to 250 words.

5. Project Management Information - Annual Overview

5.1. Project management information – please describe the overall program management, team performance, collaboration among team members and partner institutions (management of scientific, administrative, and financial tasks and dissemination and visibility activities).

The project team members performed their roles and tasks in line with the approved Project Proposal and cooperation between team members were adequate. Online meetings were organized monthly to agree on further work. Communication was organized by e-mail and via shared online documents (Google drive) in order to monitor the realization of the activities of team members. During the reporting period there were no unforeseen circumstances requiring a change in any of the team members.

*Recommended up to 250 words.

6. Risk Management – Annual Overview

6.1. Risk management in the first year of project implementation- methodology risks, timing, milestones and deliverables, participants and scientific institutions, procurement, budgetary issues, and other risks.			
Type of risk*	Category**	Describe in detail the risks and the risk management actions, applied mitigation measures, undertaken actions and their results. Were the measures successful? What was the result of these actions? If the risks still apply, state expected time frame of the risk mitigation. What are the possible implications to project implementation if the risks are not resolved?	Risk level***
Procurement	Foreseen risk	There had been a possibility that the required equipment could not be procured inside Republic of Serbia. A planned action to be undertaken was arrangements with importers about specific equipment. Foreseen risk did not occur but other complications with procurement did, as explained below.	**
Participants and scientific institutions	Foreseen risk	Since the members of the team work at three different institutions, there was a low chance of communication problems. Solution was regular meetings and online communication.	*
Budgetary issues	Foreseen risk	Possibility of price changes for the listed items. Actions to be undertaken were finding cheaper alternatives, or giving up on the item at hand. Risk did occur. From the period of writing the project budget to the moment of procurement of equipment, there were changes in the price of equipment and consumables. But despite these changes, a detailed analysis of bids, the procurement was carried out within the projected budget. One item from the procurement of consumables (Plastic Blood Collection Tubes with Sodium Citrate) was abandoned due to the fact that we subsequently determined that we would not need this item for the realization of the project.	**

Procurement	Unforeseen risk	Delay of suppliers in delivery of equipment and delivery of defective equipment did happen. To overcome delays, constant contact with the suppliers was maintained. Regarding defects, the freezer for molecular genetics laboratory was defective. After defect was detected, we have filed a complaint and returned the defective delivery. Despite all efforts, supplier had not provided a new one, and the public procurement contract had been terminated. A new public procurement was launched, and it was successfully finished during the fourth quarter.	
Milestones and deliverables	Unforeseen risk	Some members of the team were prevented from participating in the conferences that were canceled due to the outbreak of the corona virus pandemic. Scientific papers planned for the canceled conferences were presented (or will be presented) at other conferences in the later period.	
Methodology risks	Unforeseen risk	Inconsistencies in the existing databases, due to human error in data input, and/or different treatment of the same data in different bases were observed. To overcome this, multiple measures were taken: Additional integrity checks were made in the importer software; Checks in the central application that can be done on the already imported data; Elimination of the inconsistent data, with the impact of sacrificing the size of the dataset for the quality of the data.	
Methodology risks	Unforeseen risk	Problems in analysis have arisen due to the incompleteness of the database. As a result of a previously described problem with databases inconsistencies, delays in tasks 3.4, 3.5, 3.6 and subsequently in formation of reference population did happen. To overcome this, measures are taken to complete databases.	

* Type of risk: methodology risks, timing, milestones and deliverables, participants and scientific institutions, procurement, budgetary issues, and other risks.

** Categories: foreseen risk and unforeseen risk.

***Risk level: high, medium, low.

6.2. Risk management in the second year of project implementation- methodology risks, timing, milestones and deliverables, participants and scientific institutions, procurement, budgetary issues, and other risks.

Type of risk*	Describe the possible risks, risk management actions that will be undertaken and their desired results and applicable mitigation measures. What are the possible implications to project implementation if the risks are not to be resolved?	Risk level **
Methodology risk	Although mathematical methods for gEBV have already been proven as reliable in practice, there is a possibility that the accuracy will be low. In that case, calculation parameters can be adapted. Literature and colleagues abroad can be consulted for more options.	*
Timing, milestones and deliverables	The samples need to be sent abroad, and since this is animal tissue there is a potential for complications with permits. Efficacy of the sampling in the field can also be affected by the weather and farmers schedules. Actions to be undertaken are: consultations with experts in international shipping, studding of manuals and best practices. The visiting order of the farms can be optimized based on the real world environment.	*
Participants and Scientific institutions	Since the members of the team work at three different institutions, there is a low chance of communication problems. Solution is regular meetings and online communication.	*
Budgetary issues	Possibility of price changes for the listed items. Actions to be undertaken are finding cheaper alternatives, or giving up on the item at hand.	**
Other risks	The breeders might show low interest in applying the results of the project. Solution is the education of the breeders. Having meetings and showing the advantages of genomic selection. Public appearances (newspapers, TV, Internet, etc.).	*

* Type of risk: methodology risks, timing, milestones and deliverables, participants and scientific institutions, procurement, budgetary issues, and other risks.

**Risk level: high, medium, low.

7. Promotion, Publicity, and Visibility – Annual Overview

7.1. Project promotion, publicity, and visibility	
Type of dissemination and communication activities*	Link (if available)
A website was created with basic information about the Project and the project team. Information with photos about the laboratory for molecular genetics analysis after the installation of equipment is available on the project website. The site was regularly updated with information regarding the dissemination of results, ie the participation of the team members in conferences.	http://bioitgenoselect.polj.uns.ac.rs/
Initial animal database was made available. Subsequently, a database with the rank of animals was made available.	https://bioitgenoselect.polj.uns.ac.rs/genoselect/
The paper entitled "The possibility of applying machine learning in the breeding of dairy cattle" presented at INFOTECH conference aroused great interest of participants and local media, so Dr. Laslo Tarjan was one of the interlocutors in the BN television report.	https://youtu.be/2SQQswge2lk
Interview was given for the daily newspaper "Novosti" by dr Ljuba Strbac and dr. Mirko Ivković.	https://www.novosti.rs/vesti/ekonomija/974744/software-prave-krave-budu-zdrave-projekat-novosadskih-naucnika-unapredjenje-stocarstva-vece-izvozne-sanse .
Interview was given for the TV show "Nauka privredi" by MSc. Momčilo Šaran and dr. Mirko Ivković.	https://www.youtube.com/watch?v=tqt6z8MEtdM

*Organisation of a conference, organisation of a workshop, press release, non-scientific and non-peer reviewed publications (popularised publications), exhibition, flyers, training, social media, website, communication campaign (e.g. radio, TV), participation to a conference, participation to a workshop, participation to an event other than a conference or workshop, video/film, brokerage event, pitch event, trade fair, the type of audience reached and other.

8. Annual Financial Overview

8.1. Annual Financial Overview		
8.1.1. An integral part of this report is Annual Financial Progress Report, which form is separately attached in Excel format. Information provided in this report should be in line with the approved budget and approved realised costs.		
Total amount received for the reporting period in EUR*	Project realised cost for the reporting period in EUR**	Unspent funds at the end of the first year in EUR (deviation)***

*Total amount received for all SROs in total.

** Total amount of realised costs for all SROs in total.

*** Unspent funds at the end of the first year should be equal to total amount received for the reporting period lowered for project realised costs for the reporting period.

8.12. Briefly describe financial management of the project in the first year of implementation, total amount planned by the approved project budget vs amount spent, all deviations and challenges that were encountered related to the financial aspects of the project management. *
<p>In the first year of project implementation, the total budget amounted to € 124,120.69; we spent € 76,482.99 (about 60%). Unspent funds (€ 47,637.70) relate to conferences and travel that had to be postponed due to the pandemic. Unspent funds will mostly remain in the planned cost category, but certain redistributions will be proposed in the budget revision. The redistribution will mostly refer to office supplies because all three institutions during the first year of project implementation in this category had surpluses. Other categories of expenses will be spent mainly as planned in the coming quarters.</p> <p>Travel costs, Services and Subcontracting and Other costs, all planned for the Q4 were not spend in time due to a delay in project activities, but are planned to be spent in Q5.</p> <p>Large part of Conferences and dissemination costs is not used due to the fact that most of the conferences are cancelled due to the corona virus pandemic. Cost will be spent on future conferences and part of the funds will be proposed by the rebalance to be transferred to the category of procurement of equipment.</p> <p>Small part of consumables fund is not used, mostly due to reduced buying of office supplies, and due to deviation in prices.</p> <p>Most of the equipment fund is used, but payment of the freezer and software for calculation genomic breeding values is yet expected. Public procurement is successfully finished in Q4, and realization is expected in Q5.</p>

*Recommended up to 250 words.

Date and signature

We hereby confirm that all information in the Annual Report is accurate.

Name and last name of the authorized person

1. _____ September 06. 2021

Prof. Dr. Nedeljko Tica

date

2. _____ September 06. 2021

Dr. LjubaŠtrbac, assistant professor

date

3. _____ September 06. 2021

Prof. Dr. Milica Pavkov Hrvojević

date

4. _____ September 06. 2021

Prof. Dr. Rade Doroslovački

date