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CONCEPTUAL FRAMEWORK FOR BIOECONOMIC POTENTIAL INDICATORS IN DANUBE DELTA

Marian Butu[1,*], Raul Jilbotean[1], Corina Itcus[2,3], Maria Pasachiv[1], Iris Tusa[1], Alexandru Amarioarei[1]
[1]Department of Bioinformatics, National Institute of Research and Development for Biological Sciences, Bucharest, Romania
[2]Arctic and Antarctic Research Department, National Institute of Research and Development for Biological Sciences, Bucharest, Romania
[3]Microbiology Department, Institute of Biology Bucharest, Romanian Academy, Romania

ABSTRACT: The regional bioeconomic potential takes into consideration many sectors of the economy that use renewable biological resources. The plants are one of the main resources for the most sectors - food, health, environment, materials and energy. The assessment of bioeconomic potential involves the modeling of the biological and economical aspects. Establishing the indicators involved in the study of this aspect requires a "what we have and what we need" analysis. We started with the development of a database of plants to facilitate an easy access to information for all interested scientist from related research fields.

Keywords: bioeconomy, bioindicators, allelopathy, bioremediation, phytoremediation.

INTRODUCTION:

The implementation of a model for analyzing economic indicators enables the development of medium and long-term strategies to achieve an increase bioeconomy of the Danube Delta area. Modeling tools need to evaluate the biological and economical aspects of the existing strategy of development of the area and allow the identification of new medium and long-term strategies to avoid the identified risks. This approach should allow the identification, at an optimal level of effort, of the necessary measures to maximize the long-term bioeconomic results.

To have adequate data is necessary an aggregation of existing bioeconomic data and this should be done taking into account the spatial and temporal distribution of them.

Moreover, to allow meaningful integrated bioeconomic assessments, one must identify even the main species of plants that have / or may have an impact on local bioeconomy.

In this regard, to study the allelopathy, allelochemicals and competitive effects from the target region it is necessary the development of a database for plant species considered of interest based on their impact on local bioeconomy. To do this, the indicators which best fit the mode of action / interactions of selected plants for the study are identified.

The influence of some plants on the development of others was observed a long time ago. Hundreds years BC, Theophrastus noted the inhibitory effects of pigweed on Lucerne. In 1937, Professor Hans Molisch has used for the first time the term "allelopathy" in his book "The Effect of Plants on Each Other". Then in the '70s, because over the years allelopathy was considered a negative action of a plant on others, a new term was born: "allelochemicals" to describe all chemical interactions among organisms. Since then the term is in a continuous refinement of its basic significance. Part of this process, in 1993 Dr. D. L. Liu and Dr. J. V. Lowett (Liu and Lovett 1993, Liu and Lovett 1993) wrote 2 articles in which they describe the development of methods to separate the allelochemicals effects from other competitive effects, using barley plants and inventing a process to examine the allelochemicals directly. In 1996 The International Allelopathy Society defined allelopathy as follows: "Any process involving secondary metabolites produced by plants, micro-organisms, viruses, and fungi that influence the growth and development of agricultural and biological systems (excluding animals), including positive and negative effects" (Torres, Oliva et al. 1996).

Allelochemicals compounds play important roles in the determination of plant diversity, dominance, succession, and climax of natural vegetation and in the plant productivity of agroecosystems (Chou 1999).

STATE OF THE ART:

J-M Da Rocha and collab. developed an algorithm used to assess the southern hake recovery plan (Da Rocha, Cerviño et al. 2010). They used bioeconomic models taking into consideration the social and economical behavior and endogenous disinvestment decisions to analyze a recovery plan. Considering these endogenous constraints, they solved a dynamic optimization problem using the results from a Bayesian statistical catch-at-age model. In this way they find fishing mortality (F) trajectories that maximize discounted profits per vessel, subject to recovery of the stock to a spawning-stock biomass (SSB) target in 2015. They analyzed tree scenario: (a) current plan with an annual 10% reduction in (F); (b) optimum trajectory where profits must be positive all along and the SSB target is reached no later than 2015 and (c) optimum trajectory allowing profits to be negative. Their results indicate that the target might be achieved, but this might require a greater reduction in (F) than prescribed as a threshold by the recovery plan. In contrast to general expectations, compared with a constant annual reduction of 10%, a short-term reduction of 10% might actually improve the medium-

Correspondence*: *Marian BUTU, National Institute of Research and Development for Biological Sciences, Department of Bioinformatics, Splaiul Independentei no. 296, 060031, Bucharest, Romania, Tel. +40 21-220.77.80; +40 21-220.79.09, Fax. +40 21-220.76 95, email: marian_butu@yahoo.com*

term profits and at the same time increase the probability of recovery.

A multi-species experiment meant to contribute to establishing the degree of generality of ecological mechanisms was presented by C. Del Fabbro and D. Prati (Del Fabbro and Prati 2015). They introduced in their experiment 23 exotic invasive species, 19 related native species and 6 exotic garden related species. They analyzed the soil, the germination and growth using the standardized mean difference Hedges' g as effect size. They computed Hedges' g for each combination of cultivation species, test species and sterilization treatment separately, using the respective combination of the control soil as control group. In their experiment pre-cultivation effects did not differ systematically between exotic invasive, exotic garden or native species and the results indicates general absence of allelopathic compounds and a shift towards a less antagonistic soil biota by cultivation species. They conclude that the results do not “support the hypothesis that invasive plants generally inhibit the growth of others by releasing allelopathic compounds or accumulating a detrimental soil biota”.

Exotic plants threaten the biodiversity of natural habitats and the integrity of agricultural systems throughout the World. Because, understanding, predicting and controlling plant invasions represent issues of great practical importance, many models were born. Fassoni and collab. proposed a model for plant invasion based on allelopathic suppression (Fassoni and Martins 2014). They studied the proposed model by using analytical methods and numerical integration. In this model they assume a homogeneous habitat, density-dependent growth and interspecific competition for resources between native and exotic species embodied in a system of three partial differential equations. The invasion spreading, starting from a single focus, was studied through numerical integration of the spatially explicit model. The patterns of invasion in a homogeneous native community found by them are circular with smooth fronts that advance with a constant speed. The presence of resistant native plants can locally pin the invasion front, but eventually it advances in between the blocked areas. Moreover, behind the invasion front the cellular automata model always predicts the extinction of the native plant, thus apparently excluding the possibility of plant coexistence. However, it is necessary to stress that an extensive exploration of the parameter space of the cellular automata model is almost unfeasible. In turn, the analysis of the present continuous model was not constrained to the realistic ranges of its parameters values, whatever they are. They point out the similarities between the results obtained from both approaches. They conclude that under weak competition, alien species can invade, but genetic diversity can be sustained.

In an analysis of a tropical coastal plant community was observed that the spatial segregation of subordinate species is not controlled by the dominant species (Garbin, Guidoni-Martins et al. 2016). ML Garbin and collab. tested the influence of dominant species on subordinate species. They hypothesized that the identity of dominant species determines abundance, dispersal and persistence trait values variation, within subordinate coexisting species. To validate their hypothesis they used the relative abundance of shrubs and trees from 83 vegetation patches in 2 ha. They determined trait value dissimilarities between dominant and subordinate species and within subordinates. Their results showed that dominant and subordinate species exhibit contrasted trait values for dispersal and persistence.

A study done by Huang and collab. to evaluate the allelopathic effects of *Solidago canadensis* L. on *Microcystis aeruginosa* showed that *S. canadensis* L. extracts could significantly inhibit the growth of *M. aeruginosa* (Huang, Bai et al. 2013). They done physiological and biochemical measurements and observed that the membrane permeability and malondialdehyde (MDA) content rapidly increased with the accumulation of reactive oxygen species (ROS), and the content of antioxidant molecules (ascorbic acid (AsA) and glutathione (GSH)) increased. They conclude that their study provided a new idea to utilize the detrimental weed *S. canadensis* L. to control harmful cyanobacteria.

Some studies were made on wheat and cucumber by the Jiang and collab. They analyze the allelopathic activities of 23 traditional medicinal plant species on the wheat and cucumber (Jiang, Zhang et al. 2005). In this experiment the extract from *L. radiata* drastically inhibited (> 90%) the growth of monocotyledon and dicotyledon plants. Its inhibitory effects stopped the germination of wheat and cucumber seeds. *C. komarovii* and *C. hederacea* plants extracts were most inhibitory (>80%) to root growth of both monocotyledon and dicotyledon plant roots. *C. komarovii* also inhibited the plant shoot elongation. Their conclusion clearly demonstrated that the medicinal plant species are potent sources of allelochemicals. So, these plants can be used for sustainable weed management and ecofriendly environment.

To show the role of soil microbial communities in bioassays in allelopathic research, Kaur and collab. have realized a study regarding the allelopathic effects of m-tyrosine (Kaur, Kaur et al. 2009). They show in their study that allelopathic effects of m-tyrosine, which could be seen in sterilized soil with particular plant species, were significantly diminished when non-sterile soil was used. That points to an important role for rhizosphere-specific and bulk soil microbial activity in determining the outcome of this allelopathic interaction.

In order to evaluate the importance of biogeographic origin of plant species, Ledger and collab. led a study to compare the competitive and allelopathic impact of *Solidago canadensis* on the growth of species from its native and non-native ranges (Ledger, Pal et al. 2015). In 2012 and 2013 they sampled in plots 68 *Solidago canadensis* stands from 6 European countries and 72 *Solidago canadensis* stands from 6 States from USA. They choose these stands to cover an altitude ranged from 123m to 2182 m. For all stands, they recorded elevation, latitude, and longitude, and for all high-density stands they recorded the stand area and the distance to the next stand. They conducted experiments for competitive effect and studied the root extracts. Their results indicate that the biogeographic origin of plant species can have an important effect on plant interactions and community organization.

Studying the allelopathic potential of invasive species, researchers have found that invasive foliar leachates can inhibit germination or growth of some target species more than native leachates do, but there are also invasive species whose allelopathic potential is comparable with the natives. They have observed that effects of invasive as a group are weaker than effects of individually species. The differentiation depends on the plant and soil community. The study was made on three invasive and three native species from Indiana forest (USA), regarding their influence on twelve plant species utilizing a bioassay test on soil treatments and foliar leachates (Shannon-Firestone and Firestone 2015).

The allelopathic effect was also investigated in the aquatic environments. The allelopathic interaction of two phytoplankton species was studied through a mathematical model. The toxic one, *C. polylepis* affects the other, *H. triquetra*, only when high concentrations are involved (>106 cells/l). It is inappropriate to generalize these results to other phytoplankton species, however this methodology could be applied to more complex models and it could be validated by laboratory experiments (Solé, García-Ladona et al. 2005).

In order to minimize the bioeconomic impact of some invasive aquatic plants from Florida Lakes, D.C. Adams and collab. analyzed the *Hydrilla verticillata* (hydrilla), *Eichhornia crassipes* (water hyacinth), and *Pistia stratiotes* (water lettuce) and their impacts on angler effort. They studied the effects of hydrilla, water hyacinth, and water lettuce presence in 38 Florida lakes over 20 years. If left unattended, hydrilla may cause several economical problems, so keeping a low coverage is more economically efficient than dealing with high coverage. This type of species need to be controlled in order to have a minimal effect on Florida's economy (Adams and Lee 2005).

The assessment of bioeconomic potential for a region could also include the medicinal plants from this area.

In the salty meadows from the Aradului plain (W. Romania), some researchers have found several plant species that are valuable for medicine. *Achillea millefolium*, *Matricaria recutita* and *Mentha* are some of the most important species found that are used in pharmaceutical industry. *Artemisia santonicum* subsp. santonicum and *Limonium gmelinii* could be used in biochemical and pharmaceutical research. Investigating local remedies from plants it is a way to encourage people involvement in conservation (Daraban, Arsene et al. 2013).

The allelopathic effects of *Ambrosia artemisiifolia* L. in the invasive process was investigated on indicator crops and some weeds. Tomato was the most affected crop, its growth being reduced with more than 50%. Lettuce growth was also considerably influenced, not by root exudates, but by adding common ragweed residues to the substrate and D. sanguinalis germination was reduced (Vidotto, Tesio et al. 2013). The researchers used as crops: alfalfa, barley, maize, lettuce, tomato, and wheat and as weeds: *Echinochloa crus-galli*, *Solanum nigrum*, *Portulaca oleracea*, and *Digitaria sanguinalis.*

Another approach in bioeconomic analysis of the agroforestry practices was proposed by R.M. Wise and collab by studying the potential of Indonesian agroforests as carbon sinks. Agroforestry practices could be an optimal choice for degraded soils. Trees may bring positive effects on agricultural production such as providing biodiversity, carbon storage and rural subsistence services. Agroforestry systems are profitable and can contribute to forest conservation and to reduce forest land clearing in Indonesia (Wise and Cacho 2011).

Hypothesizing that allelopathy play an important role in biological invasion, K-M Zhang and collab. analyzed the photosynthetic electron-transfer reactions in the gametophyte of *Pteris multifida*. They used one of the main invasive plant from China, *Bidens pilosa* to reveal the presence of allelopathic interference on the gametophytic growth of *Pteris multifida*. Root exudates determine the decrease in the acceptors of light and electron transport for PS reaction and they influence the production of photochemical quantum yield in PS II (Zhang, Shen et al. 2016).

A documentary research over the Allelopathic studies made in Brazil was done by M Reigosa and collab. Some of them don't provide a clear and complete information thereby the research in domain has the following problems: there are no advanced studies on plants that might have allelopathic potential even if they do not naturally co-exist with others, the laboratory work does not always correspond with field studies, there are few studies on the impact that soil micro-organisms and mycorrhizal fungi have on allelopathic processes (Reigosa, Gomes et al. 2013). On the other hand, they have found that most of the analyzed studies were done in lab conditions.

Studying the allelopathic phenomenon we are aware of the fact that substances with an allelopathic effect can be released by any organ of the plant, especially through leaves, in the form of volatile compounds, or by the decomposition of dead roots and through root exudates or through the decomposition of dead tissues. Allelopathy interaction can take place both in interspecific and intraspecific level. The intensity of intraspecific interactions can sometimes be higher than that between different species. For example, in desserts, many plants eliminate allelotoxins with an inhibition effect not on the development of individuals of other species, but of those conspecific, because different plants from this environment have adopted different strategies for exploiting the water, so the competition is more intense at intra-population level.

In the Nile delta coast of Egypt a study regarding plant allelopathy was conducted. Researchers have established the impact of invasive *Acacia saligna* on plant diversity by establishing thirty stands with invaded and non-invaded areas and then analyzed the results by collecting soil samples and correlating vegetation and soil variables, determining which of the most popular plants found in the areas that are both invaded and not invaded. These areas are rich in valuable species and low in other invasive species. The content of bicarbonate, sulphate, Ca, K and Na was higher in the non-invaded areas. This research will help the costal ecosystem management and conservation in Egypt (Abd El-Gawad 2015).

The great plant variety from Danube Delta could permit us conducting similar studies that would help identify plant species, process that is useful for developing our data base, plants conservation and also growing people awareness about the plants properties from this region, growing through this the bioeconomy.

Allelopathy is also used for the development of new agrochemicals that have several benefits in opposition with synthetic products. A study was conducted in Iran to determine the allelopathic potential of some medicinal and wild plant species in Iran by using the dish pack method. By using this method 118 plants were identified, 104 species belonging to 34 families were analyzed for their allelopathic volatile substances. This method is used to analyze the presence of volatile substances released through different parts of the plant (S. Amini 2014).

Besides allelopathy, another process that could help us preserve our ecosystem and develop the regional bioeconomy is bioremediation. The plant communicates with neighbor plants through root exudate. The root exudates have specific chemical ingredients, depending on the plant species but also on the nearby biotic and abiotic environment. Examples of plants exudates are: sugars, organic acids, vitamins, amino acids, nucleotides and various other secondary metabolites. Through this process, roots may regulate the soil microbial community in their immediate vicinity and change chemical and physical properties of the soil. In some cases the root exudates remove the polluted matter and nourish the neighbor microorganisms present in the rhizosphere of the root (Keshav Prasad Shukla 2011).

In our days a major global issue that threatens the ecosystem conservation is constituted by the biological invasions. In their study, Mathias Christina and collab. assumed that allelopathy can also increase the biotic resistance of native species against invasion (Mathias Christina 2015).

Phytoremediation describes the treatment of environmental problems using vegetation for treatment of contaminated soils, sediments, and water. It can be applied in sites with superficial contamination of organic, nutrient, or metal pollutants (Schnoor 1997).

Phytoremediation is a cost-effective plant-based approach that uses the ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. Toxic heavy metals and organic pollutants are the major targets for phytoremediation (Salt , Smith et al. 1998).

Plants stimulate the degradation of organic chemicals in the rhizosphere by the release of root exudates, enzymes, and the build-up of organic carbon in the soil. In the case of metal contaminants, through phytoextraction, plants are filtering the metals absorbed from water onto root systems (rhizofiltration), or stabilizing waste sites by erosion control and evapotranspiration (phytostabilization). Recent field tests of phytoremediation were reported on wastes containing petroleum hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes and polycyclic aromatic hydrocarbons, pentachlorophenol, polychlorinated biphenyls, chlorinated aliphatics, ammunition wastes, metals, pesticide wastes, radionuclides, and nutrient wastes (Schnoor 1997).

Some species of plants have been used in various applications as follows: *Salix spp*. (hybrid poplars, cottonwoods, and willow), grasses (rye, Bermuda grass, sorghum, fescue, bullrush), legumes (clover, alfalfa, and cowpeas), aquatic plants (parrot feather, duckweed, arrowroot, cattail, pondweed), and hyperaccumulators for metals (sunflowers, Indian mustard, and *Thlaspi spp.*) (Schnoor 1997).

Phytoremediation has successfully been applied to brownfields sites for remediation of soil contaminated with lead; in a small pond contaminated with uranium at Chernobyl; a riparian zone buffer strip at Amana, in Iowa for removal of nitrate and atrazine from agricultural runoff; and in a wetland in Milan, Tennessee for TNT removal. Phytoremediation was also applied in small sites such as agricultural cooperatives with pesticide and ammonia spills (Schnoor 1997).

DATABASE DEVELOPMENT:

For an easy access and a full understanding of the information from the “field” a database with the essential information was created. This will allow the plant biologists and other researchers to access the inquired information. In this stage we analyzed the needed information and developed the structure of the database.

The content of this database will be derived from both traditional knowledge (based on intensive search of actual relevant information) and further scientific researches. The category of information that would be found in the database is: taxonomy, morphology/physiology, growth, reproduction, distribution, ecology, phenology, technologies, suitability, legal status and additional information.

The taxonomy category refers to description, identification, nomenclature, and classification of plants, and contains information about: scientific name, popular name, genus, family, order, class, division, phylum, and kingdom.

The morphology/physiology refers to information such as: height at maturity, growth rate, foliage and flower color and texture, lifespan, and few others.

The growth category refers to requirements for plant growth, like: texture of soil, tolerance for specific factors (e.g. drought, fire, shade, salinity or lime or anaerobic soils), fertility requirement, pH (min/max), root depth and few others.

The reproduction category refers to: vegetative spread rate, bloom period, begin and end for fruit and seed, abundance of fruit and seed, and others.

The distribution category refers to data associated with the position of plant individuals and contains information regarding: country, region (which includes regions inside a country as well as macro-regions like South-Asia, north-Africa, etc.).

The ecology category takes into consideration the following subcategories: allelopathy information, nitrogen fixation, toxicity, is this plant invasive? and also few other aspects.

The phenology category refers to data regarding the temporal and cyclic evolution of plant: germination, sprouting and bud development; leaf development; stem elongation or rosette growth; development of harvestable vegetative plant parts or vegetative propagated organs; inflorescence emergence; flowering; development of fruit; ripening and maturity of fruit and seed and other information.

The technologies category contains information regarding technologies for cultivation, technologies for reproduction and other related information.

The suitability category contains information like: is some part of plant suitable for the commercial production?; is the plant or part of it known to be used as animal fodder product?; could be use the plant or part of it for biofuels production?; is the plant or part of it suitable for use as a commercial lumber producer?; is the plant suitable for production of nursery stock?; does the plant produce berries, nuts, seeds, or fruits that are tasty to humans?; etc..

The legal status category refers to legal information about plant that includes: is this plant prohibited for cultivation? is this noxious weed?; and other related information.

The additional information category is divided in: images gallery; plants presentation and other general information.

The database structure resulted from our analysis could be observed in figure 1 - the conceptual data model designed as Entity-Relationship Diagram which emphasizes some important entities (category of data) that need to be considered for a plant database aiming to capitalize the bioeconomic potential. The entities and the relationships between them are described next.

Plants entity is the major one, which offers basic information about plants through its attributes such as *scientific name*, *origin*, *development period*, *flowering*, *bioaccumulation type*, *legal status* and many others. This entity is part of 8 relationships.

The taxonomy information is given by *plants_hierarchies* entity which has the following attributes: *genus*, *family*, *order*, *class*, *division*, *phylum* and *kingdom*. The relationship between plants and plants_hierarchies is formulated as “plants_derive_from_plants_hierarchies” which state the fact that a plant derives from a hierarchy. The relationship has minimum cardinality 1:1 as a plant must derive from one hierarchy and a hierarchy must report at least one plant. The maximum cardinality is 1:n as a plant can derive from a single hierarchy and a hierarchy can report many plants.

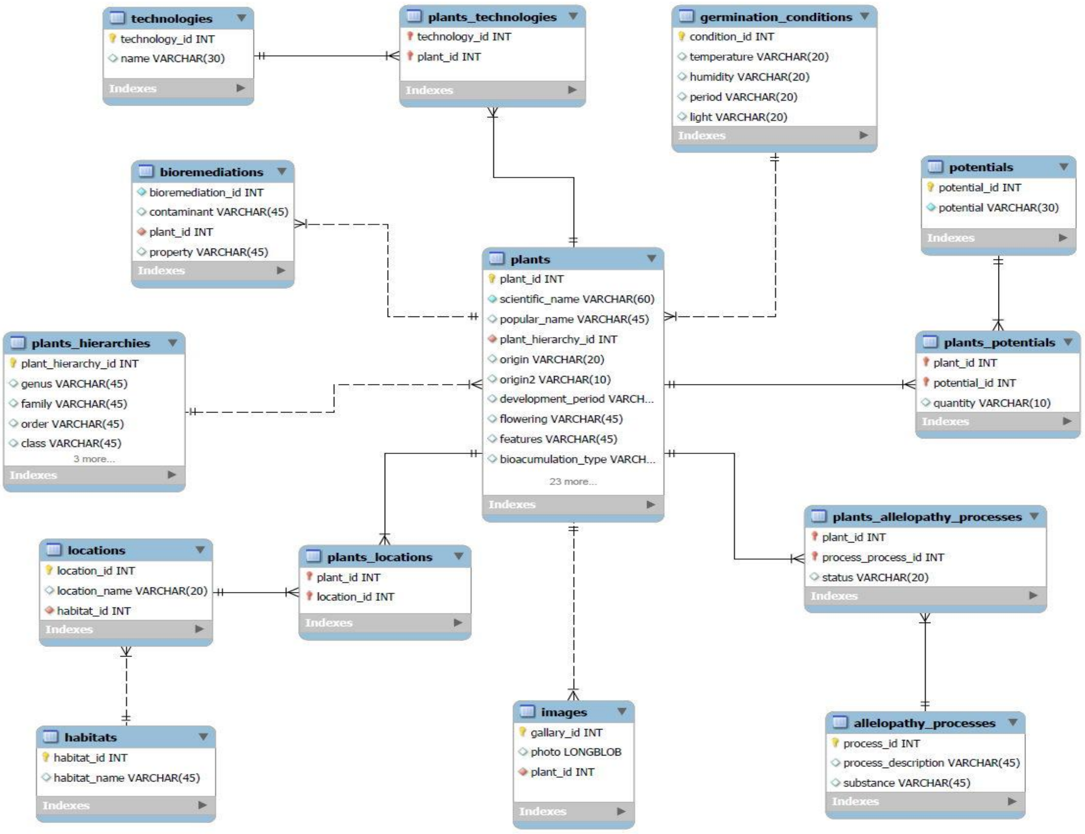


Figure1. Structure content of the database

The area where a plant grows can be registered through *locations* and *habitats* entities which have the following attributes: *location_name* and *habitat_name*. The relationship between plants and locations is formulated as “plants_grow_locations” which state the fact that a plant grows in one or more areas. The minimum cardinality is 0:1 (a plant must grow at least in one location and it is not mandatory that a location to have plants) and the maximum cardinality is n:m (a plant can grow in many locations and a location can have many plants).

The relationship between locations and habitats is formulated as “locations_have_habitats” thereby is possible to map which habitat the location refers to. For example, a lake can have brackish water and swamp too. The relationship has minimum cardinality 1:1 as a location must have at least one habitat and a habitat must be located in at least one area. The maximum cardinality is n:1 as a location can refer to a single habitat and a habitat can be present in many locations.

Bioremediation processes are mapped by *bioremediation* entity with the following attributes: *contaminant* and *property* which state that a plant can be used in a bioremediation process to counterattack a contaminant. The relationship between plants and bioremediations is formulated as “plants_participate_bioremediation”. The minimum cardinality is 0:1 (it is not mandatory for a plant to participate to a bioremediation process and a bioremediation process must include at least one plant) and the maximum cardinality is 1:n (a plant can participate to many bioremediation processes and a process can include a single plant).

Allelopathy is given by *allelopathy_processes* and *plants_allelopathy_processes* entities which have the attributes: *status*, *process_description* and *substance*. The relationship between plants and allelopathy processes is formulated as “plants_participate_allelopathy_processes” which state the fact that a plant can participate to many allelopathy processes. The relationship has minimum cardinality 1:0 (it is not mandatory for a plant to participate to an allelopathy process and a process must include at least one plant) and maximum cardinality n:m (a plant can participate to many allelopathy processes and a process can include many plants).

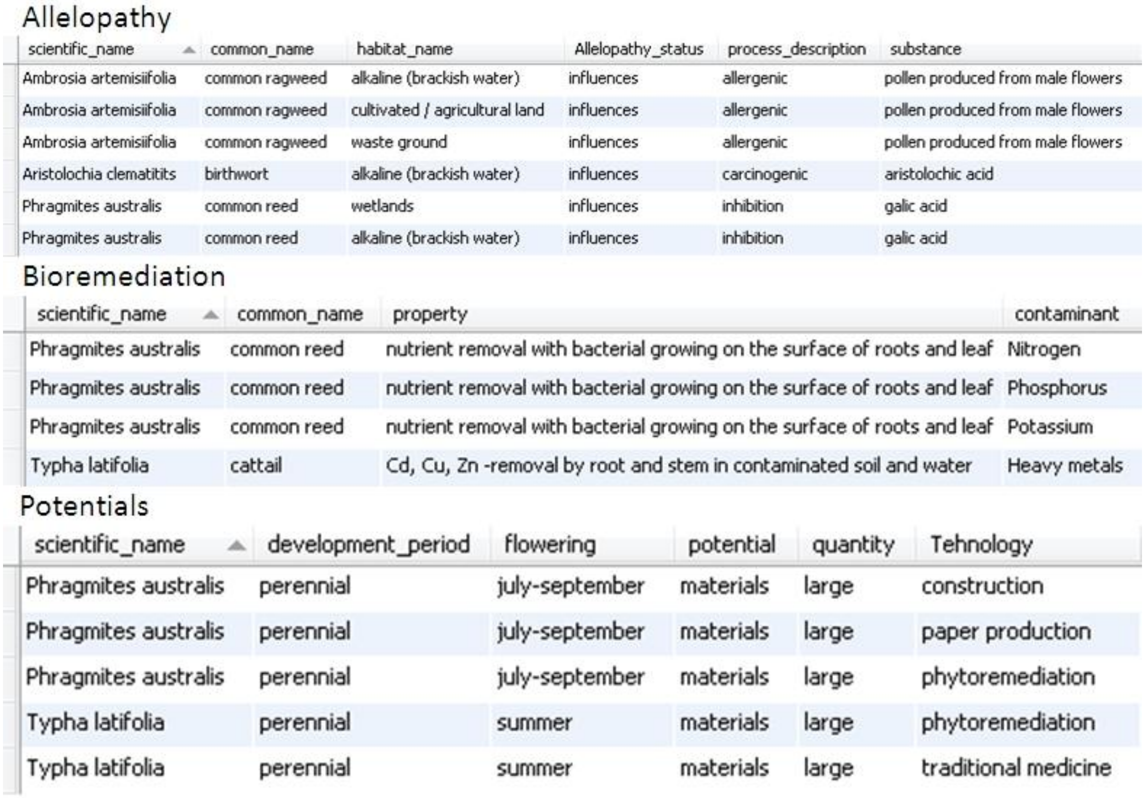
The germination information is mapped by *germination_conditions* entity with the following attributes: *temperature*, *humidity, period, light* and *observation*. The trivial relationship between plants and germination conditions is expressed as “plants_have_germination_conditions”. The minimum cardinality is 1:1 as a plant must have at least one set of germination conditions and a set of conditions must refer at least one plant. The maximum cardinality is n:1 (a plant can have a single set of germination conditions and a set can refer to many plants.

The entity *potentials* emphasize the economic value of plants, with the attributes *potential* and *quantity*. The relationship between plants and potentials is expressed as “plants_have_potentials” and has the minimum cardinality 1:0 as it is not mandatory for a plant to have economic potential and a potential must refer to at least one plant. The maximum cardinality is n:m as a plant can have many potentials and a potential can refer to many plants.

Technologies are represented in the schema through *technologies* entity containing for now just the *name* attribute. The relationship between plants and technologies is formulated as “plants_are_used_in_technologies” and gives the possibility to register which plants are used in which technologies. The relationship has minimum cardinality 1:0 (it is not mandatory for a plant to be used in a technology and a technology must refer at least one plant) and maximum cardinality n:m (a plant can be used in many technologies and a technology can refer many plants).

The images can be registered to database through *images* entity which has an attribute of *type blob*. The relationship between plants and images is expressed as “plants_have_images”. The minimum cardinality is 1:0 as it is not mandatory for a plant to have recorded images and an image must refer at least one plant. The maximum cardinality is 1:n as a plant can have many images and an image can refer a single plant.

Querying the database can generate different reports according to user requirements. Some examples are shown in figure 2.



Allelopathy

scientific_name	common_name	habitat_name	Allelopathy_status	process_description	substance
Ambrosia artemisiifolia	common ragweed	alkaline (brackish water)	influences	allergenic	pollen produced from male flowers
Ambrosia artemisiifolia	common ragweed	cultivated / agricultural land	influences	allergenic	pollen produced from male flowers
Ambrosia artemisiifolia	common ragweed	waste ground	influences	allergenic	pollen produced from male flowers
Aristolochia clematitits	birthwort	alkaline (brackish water)	influences	carcinogenic	aristolochic acid
Phragmites australis	common reed	wetlands	influences	inhibition	galic acid
Phragmites australis	common reed	alkaline (brackish water)	influences	inhibition	galic acid

Bioremediation

scientific_name	common_name	property	contaminant
Phragmites australis	common reed	nutrient removal with bacterial growing on the surface of roots and leaf	Nitrogen
Phragmites australis	common reed	nutrient removal with bacterial growing on the surface of roots and leaf	Phosphorus
Phragmites australis	common reed	nutrient removal with bacterial growing on the surface of roots and leaf	Potassium
Typha latifolia	cattail	Cd, Cu, Zn -removal by root and stem in contaminated soil and water	Heavy metals

Potentials

scientific_name	development_period	flowering	potential	quantity	Tehnology
Phragmites australis	perennial	july-september	materials	large	construction
Phragmites australis	perennial	july-september	materials	large	paper production
Phragmites australis	perennial	july-september	materials	large	phytoremediation
Typha latifolia	perennial	summer	materials	large	phytoremediation
Typha latifolia	perennial	summer	materials	large	traditional medicine

Fig. 2. Examples of database queries

CONCLUSIONS:

The development of a database in order to be integrated in a model which analyzes the economic indicators necessary to increase the bioeconomy of the Danube Delta area is a complex problem. We covered just a part of this project and the remains action requires further investigation. However, the constructed database responds to the main question related to the bioeconomical impact of plants in the studied area.

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