2581-4575

International Journal For Recent Developments in Science & Technology

Crossref

A Peer Reviewed Research Journal

# SAFETY CONDITIONING TECHNOLOGY FOR MINING REGION'S ENVIRONMENTAL SYSTEM BASED CATASTROPHE THEORY IN COMPREHENSIVE ECOLOGICAL SECURITY

**D.CHANDRASEKAR, SK.SAMEER PASHA, N.S.R.KRISHNA PRASAD**

Department of Mining Engineering, Malla Reddy Engineering College (Autonomous)

## ABSTRACT

The safety of mining region's environmental system is a basic prerequisite of the sustainable development of mining region's economy and society. The maintenance of mining region's environmental system safety by taking effective measures has great significance for mining regions in China function as residential community. One of the major problems facing mining region's sustainable development is how to keep the safety of mining region's environmental system. This paper constructs a Cusp Catastrophe Model for mining region's environmental safety applying Catastrophe Theory. Beneficial factors and restricted factors affecting environmental system safety are used as control parameters, while the state of environmental system safety serves as state variable in the model construction process. The Catastrophe development rule of mining region's environmental system safety is analyzed based on Cusp Catastrophe Model's bifurcation set equation, 3 2 +=Δ 278 vu . Some methods of conditioning mining region's environmental system safety are also put forward.

## INTRODUCTION

Large amount of phthalate esters (PAEs) used as plasticizers in polyvinyl chloride (PVC) products has caused ubiquitous contamination to the environment and potential ecology security risk all around the world, especially in places plastic films were indispensably utilized due to the widely proposing of facility agriculture in China. A case of PAEs contamination in four suburb areas of Nanjing was analyzed and discussed in this study. A new frame work has been put forward based on multi-criteria evaluation model and mathematical method of catastrophe theory, using farming work, laboratory determination and relevant environmental standards to measure the ecology security risk of PAEs in study areas. The factors were selected based on the availability of the data and the local conditions.

The assessment model involves the contamination status of PAEs in soil and vegetables, the contamination effects of PAEs

2581-4575
International Journal For Recent Developments in Science & Technology
Crossref
A Peer Reviewed Research Journal


to human and soil organisms and the contamination source of PAEs from plastic films and other products in the four study facility agriculture areas. An evaluation system of the model was composed of thirteen mesosphere indicators and twenty-five underlying indicators including total PAEs concentration in soils, single PAE concentration in soils, total PAEs concentrations in roots, leafy, solanaceous and stem vegetables, PAE human risks, soil microbial counts, microorganism diversity indices, atmospheric deposition of PAEs, whether sewage wastewater irrigation, planting mode of the facility agriculture areas and climate condition of study areas. The modified evaluation system was used in the assessment of ecology security of the same place based on the data of 2012, and the results suggested that the ecology security indicators were reliable and were agree well with the practical situation of the study areas. The results could provide guidance for the application of health risk assessment of soil environment for the strong objectivity of catastrophe theory compared with other evaluation methods.

Catastrophe theory originated as a branch of topology designed to deal with discontinuous dynamic systems governed by a potential function and can be used as a modeling approach to analyze complex nonlinear systems and has been applied in fields such as biology, physics, ecology and so on. Date back to last century, catastrophe theory has been applied in a lake ecosystem to evaluate whether the introduction of more predatory fish could improve water conditions significantly. A new framework has been set up using catastrophe theory, laboratory experiment, field work, and 3S (geographic information system, global positioning system, and remote sensing) to explore soil fertility self-development in the Zhuxi watershed of Changting County in the red soil hilly region of China. Catastrophe theory also provided the conceptual framework for retrospective assessment of the impact of commercial grazing and soil water availability on the soil stability index (SSI), indicating that, the landscape became more susceptible to erosion events under multiple droughts and grazing.

A catastrophe model integrated multiple assessment indices of land eco-security according to the inherent contradictions and relative importance of indices without calculating weights were setup for assessing land ecological security in Shanghai, China. A geospatial assessment framework, by integrating remote sensing, geographical information systems, landscape metrics, geo-statistics and catastrophe theory, was proposed and applied to characterize the spatial variations of agroecosystem health for a typical region in the eastern coastal agricultural plain, China. However, in the

2581-4575
International Journal For Recent Developments in Science & Technology
Crossref
A Peer Reviewed Research Journal


assessment of soil ecology risk of organic pollutants, especially on PAEs, have been rarely seen up till now. It is necessary to combine practical data with the theoretical analysis results and to construct an integrative and comprehensive model. So, we developed a catastrophe model for the assessment of ecology security of the selected four study area contaminated by PAEs, selecting the environment and the living creatures as the most noteworthy factors based on the weight of data from 2011, to obtain a better understanding of the ecology security risk of target PAEs.

**The ILO and Mining**

The International Labour Organization (ILO) has been dealing with labour and social problems of the mining industry since its early days, making considerable efforts to improve work and life of those in the mining industry—from the adoption of the Hours of Work (Coal Mines) Convention (No. 31) in 1931 to the Safety and Health in Mines Convention (No. 176), which was adopted by the International Labour Conference in 1995. For 50 years tripartite meetings on mining have addressed a variety of issues ranging from employment, working conditions and training to occupational safety and health and industrial relations. The results are over 140 agreed conclusions and resolutions, some of which have been used at the national level; others have triggered ILO action—including a variety of training and assistance programmes in member States. Some have led to the development of codes of safety practice and, most recently, to the new labour standard.

In 1996 a new system of shorter, more focused tripartite meetings was introduced, in which topical mining issues will be identified and discussed in order to address the issues in a practical way in the countries and regions concerned, at the national level and by the ILO. The first of these, in 1999, will deal with social and labor issues of small-scale mining.

Labor and social issues in mining cannot be separated from other considerations, whether they be economic, political, technical or environmental. While there can be no model approach to ensuring that the mining industry develops in a way that benefits all those involved, there is clearly a need that it should do so. The ILO is doing what it can to assist in the labor and social development of this vital industry. But it cannot work alone; it must have the active involvement of the social partners in order to maximize its impact. The ILO also works closely with other international organizations, bringing the social and labor dimension of mining to their attention and collaborating with them as appropriate.

2581-4575
International Journal For Recent Developments in Science & Technology
Crossref
A Peer Reviewed Research Journal

Because of the hazardous nature of mining, the ILO has been always deeply concerned with the improvement of occupational safety and health. The ILO's International Classification of Radiographs of Pneumoconiosis is an internationally recognized tool for recording systematically radiographic abnormalities in the chest provoked by the inhalation of dusts. Two codes of practice on safety and health deal exclusively with underground and surface mines; others are relevant to the mining industry.

The adoption of the Convention on Safety and Health in Mines in 1995, which has set the principle for national action on the improvement of working conditions in the mining industry, is important because:

· Special hazards are faced by mineworkers.

· The mining industry in many countries is assuming increasing importance.

· Earlier ILO standards on occupational safety and health, as well as the existing legislation in many countries, are inadequate to deal with the specific needs of mining.

The first two ratifications of the Convention occurred in mid-1997; it will enter into force in mid-1998.

**Underground Mining**

There is also a variety of methods for underground mining. Their common denominator is the creation of tunnels from the surface to the coal seam and the use of machines and/or explosives to extract the coal. In addition to the high frequency of accidents—coal mining ranks high on the list of hazardous workplaces wherever statistics are maintained—the potential for a major incident involving multiple loss of life is always present in underground operations. Two primary causes of such catastrophes are cave-ins due to faulty engineering of the tunnels and explosion and fire due to the accumulation of methane and/or flammable levels of airborne coal dust.

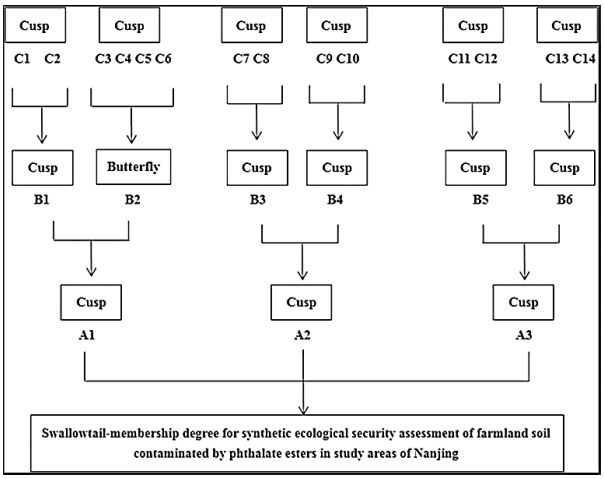

**Catastrophe theory**

Catastrophe theory is a mathematical subject that was proposed by Rene Thom aiming at rationally account for the phenomenon of discontinuous change in behaviors resulting from continuous change in different parameters in a given system. In catastrophe theory, system function variables

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

are divided into dependent state variable, which are the internal token variables of system, and control variables, which are the external influence factors while system is running. Catastrophe theory is widely used, and one common application is the use of the catastrophe progression method derived from catastrophe theory to solve multiple criteria decision problems. Based on catastrophe theory, the multi-criteria evaluation method draws on analytic hierarchy, utility function and fuzzy evaluation to obtain catastrophe fuzzy membership functions by normalized treatment of the bifurcation set, in which the dependency of state variables on control variables is determined by the catastrophe fuzzy membership functions, rather than weights assigned by the users and different control variables have different impacts on state variables in the multi-criteria evaluation method.

In the multi-criteria evaluation method, the system is divided into several subsystems with different evaluation indicators according to the inner mechanisms of the system being assessed. The initial data from the underlying layers are then normalized using catastrophe theory and fuzzy mathematics to give the optimal or cleanest data. To accomplish this, multidimensional catastrophe fuzzy membership functions assign values ranging from 0 to 1 to resolve the incomparability of various initial data induced by differences in the data span and dimensions. The total catastrophe fuzzy membership functions of the system are then determined by the normalized data. When normalizing the initial data from the underlying layers, the cleanest data should be set to 1, after which the remaining data are converted to catastrophe fuzzy membership functions with values ranging from 0 to 1. After being broken down according to their impacts on the higher-level indicators, the evaluation indicators from different layers are prioritized.




## METHODOLOGY

### Sampling and analytical method for soils

Soil and vegetable samples from 61 out of approximately 500 plastic film greenhouses for vegetable production in the four study suburban areas were selected in December 2011, considering the environmental status contour in terms of the distribution of agriculture and industry,

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

hydrogeological conditions of nearby rivers, and features of greenhouses (age and species of vegetables). From the selected 61 greenhouses, a total of 305 surface (0~15 cm) soil and vegetable paired samples (using quincunx sampling method in each greenhouse) were collected. The soil samples were collected by using a soil corer, while the plant samples were selected randomly for five fruit and compared after one quarter of each fruit was cut, mixed, and analyzed with three replicates. The fresh edible parts of each vegetable sample were collected and brought to the laboratory, washed with tap water, rinsed with distilled water, and wiped dry with paper tissue. Both vegetables and soils were then freeze dried in a Free Zone 2.5-Liter Freeze Dry System (Labconco Corp., Kansas City, MO). Ten grams of dried soils was ground and sieved (60 mesh), and 2 g of vegetable sample was homogenized for each replication in liquid nitrogen prior to storage at -20°C for subsequent analysis.

Glassware was washed by strictly following the procedure described by Ma et al prior to analysis. Sample processing procedure was conducted following the description of Ma et al for soils and Ma et al for vegetables. 10 μL of internal standard (BB) was added before hexane (HPLC grade) was added to bring the final volume to 1 mL. Samples were transferred to brown sample bottles and stored at -20°C before further analysis. Analysis of individual PAEs in samples was performed exactly following the description of Ma et al modified from USEPA method 8270C with an Agilent 7890GC-5975 MSD. Quality assurance and quality control results showed the high accuracy and sensitivity of this method and the reliability of the results. For every16 samples, two whole procedure blanks, two soil matrix blanks, and one certified reference material (CRM) 136–100 were analyzed to ensure the analysis reliability.

The study of the selected samples in four areas was carried out on private lands, and we confirm that the owner of the land gave permission to conduct the study on these sites. We state clearly that no specific permissions were required for these locations/activities, because the farmers agreed with our behavior of sampling and investigation on the soils and vegetables. We confirm that the field studies did not involve endangered or protected species.

## CONCLUSION

When explore the mine, human should take practical measures to promote the safely development of mining region's environment in order to keep it in a safe status. With Catastrophe Theory, set the favorable and unfavorable factors that economical system makes to environmental system as control

parameters and resource and environmental safety status as status variable, and can establish the Mining Environmental Control System Safety Model and by solving and analysis bifurcation set

**REFERENCES**

[1] Ahmed K, Shahid S, Bin Harun S, Ismail T, Nawaz N, Shamsudin S (2014) Assessment of groundwater potential zones in an arid region based on catastrophe theory. Earth Sci Inf. doi:10.1007/s12145-014-0173-3

[2] Akgun A, Sezer EA, Nefeslioglu HA, Gokceoglu C, Pradhan B (2012) An easy-to-use MATLAB program (MamLand) for the assessment of landslide susceptibility using a Mamdani fuzzy algorithm. Comput Geosci 38(1):23–34

[3] Al-Abadi AM, Shahid S (2015) A comparison between index of entropy and catastrophe theory methods for mapping groundwater potential in an arid region. Environ Monit Assess 187(2015):576. doi:10.1007/s10661-015-4801-2

[4] Al-Abadi AM, Shahid S (2016) Al-al AK (2016) a GIS-based integration of catastrophe theory and analytical hierarchy process for mapping flood susceptibility: a case study of Teeb area. Southern Iraq Environ Earth Sci 75:687. doi:10.1007/s12665-016-5523-7

[5] Al-Adamat RAN, Foster IDL, Baban SMJ (2003) Groundwater vulnerability and risk mappingfor the basaltic aquifer of the Azraq basin of Jordan using GIS, remote sensing and DRASTIC. Appl Geogr 23:303–324

[6] Alam F, Umar R, Ahmad S, Dar AF (2012) Anew model (DRASTICLU) for evaluating groundwater vulnerability in parts of central ganga plain, India. Arab J Geosci 7:927–937

[7] Aller L, Bennett T, Lehr JH, Pretty RJ, Hacket G (1987) DRASTIC: a standardized system for evaluating ground water pollution potential using hydrogeologic settings.US Environmental Protection Agency, Ada, Oklahoma (EPA-600/2-87-035).

[8]Al-Saud M (2010) Mapping potential areas for groundwater storage in Wadi Aurnah Basin, western Arabian peninsula, using remote sensing and geographic information system techniques. Hydrogeol J 18:1481–1495

[9] Antonakos AK, Lambrakis NJ (2007) Development and testing of three hybrid methods for the assessment of aquifer vulnerability to nitrates, based on the drastic model, an example from NE Korinthia, Greece. J Hydrol 333:288–304. doi:10.1016/j.jhydrol.2006.08.014

[10] Causape J, Quilez D, Aragues R (2006) Groundwater quality in CR-V irrigation district (Bardenas I, Spain): alternative

scenarios to reduce off-site salt and nitrate contamination. Agric Water Manag 84(2006):281–289

[11] Chen SK, Jang CS, Peng YH (2013a) Developing a probability-based model of aquifer vulnerability in an agricultural region. J Hydrol 486:494–504. doi:10.1016/j.jhydrol.2013.02.019

[12] Chen SK, Jang CS, Peng YH (2013b) Developing a probability-based model of aquifer vulnerability in an agricultural region. J Hydrol. doi:10.1016/j.jhydrol.2013.02.019

[13] Chen KL, Shi YL, Lin ZL, Wang JK, Ouyang YR, Jiang JL (2012) An approach for integrated assessment of ecorisk in coastal waters based on catastrophe theory: taking Luoyuan Bay as a case. Chin J Appl Ecol 23(1):213–221

[14] Chen Y, Zhang S, Zhang Y, Xu L, Qu Z, Song G, Zhang J (2016) Comprehensive assessment and hierarchical management of the sustainable utilization of urban water resources based on catastrophe theory. J Taiwan Inst Chem Eng 60(2016):430–437