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CONTEMPORARY CHALLENGES IN TERMS OF DEFENSE AGRICULTURE: SECURITY INFRASTRUCTURE CRITICAL IN AREAS RURAL

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Abstract*. Critical infrastructure located in rural areas plays a fundamental role in ensuring agricultural continuity, food security, and the socio-economic stability of the state. Contemporary rural infrastructure faces increasing pressure from complex and interrelated threats, including cyberattacks, climate-induced disasters, hybrid threats, supply-chain disruptions, and limited technological and financial resources. These challenges are particularly acute in Poland, where a significant share of strategic infrastructure supporting agriculture is dispersed across rural regions. The article aims to identify the key challenges associated with protecting agricultural critical infrastructure in rural areas and to propose strategic solutions that enhance its resilience and long-term security. The study is based on a critical analysis of domestic and international literature, legal regulations, security strategies, and policy documents related to critical infrastructure protection. The analysis reveals significant gaps in existing regulatory frameworks and management practices, especially in addressing the specific conditions of rural areas. The findings emphasize the necessity of integrated risk management, cybersecurity development, public – private partnerships, and active involvement of local communities. The article proposes systemic, organizational, and technological measures to strengthen resilience, reduce cascading failures, and improve crisis response capabilities. The results contribute to ongoing research on critical infrastructure protection by highlighting the rural dimension, which remains underrepresented in existing studies, and by offering practical recommendations for policymakers and security practitioners.*

Keywords*: critical infrastructure; rural areas; agricultural security; cybersecurity; risk management; resilience*

Introduction

Growing complexity problem security infrastructure critical located in the areas rural, with elements contemporary threats: cyberattacks, changes climatic tensions geopolitical, gives rise to essential question, extremely important both for practices management public and private, as also for theory security. What is effective? protects infrastructure critical in areas rural Before threats defensive elements infrastructure critical (systems energy supply, water supply, transport, communication, security health) constitute because foundation functioning agriculture, i.e. key elements influencing the level security food state. The problem of protection infrastructure agricultural Before contemporary threats is especially significant in Poland, due to the high participation areas rural areas where located are strategic for security countries elements infrastructure critical.

Concern for the state infrastructure critical located in areas rural Is justified her big meaning for correct functioning states, economies and general safety. Due to the large extent areas rural, weak access to modern technology, and also limited resources (financial and human resources) and dispersion elements infrastructure, difficult Is quick responding in case of disruptions in her functioning. Contemporary threats, such How catastrophic phenomena weather, cyberattacks and threats hybrid Whether chain disorders supplies, encourage active partner cooperation various entities, including administration public, enterprises and community local, in order to assurances effective protection infrastructure. In the current, dominated by quick changes environmental and technological environment, necessary stands

myself implementation interdisciplinary solutions that combine aspects technical, social and managerial.

The goal article Is identification basic challenges in protection infrastructure critical located in areas rural and proposal strategy limiting risk and long-term immunity this one infrastructure to disruptions, with indication roles and responsibilities administration public and community local. Way implementation goals article will enable indication conclusions and recommendations both for practitioners and the environment scientific and will allow identify areas for further research in the field of issues protection infrastructure critical.

In the article was carried out critical analysis literature, domestic and foreign reports in the field security, identified Polish regulations legal and strategies in the field of protection infrastructure critical. Conducted she was reflection strategic and systemic on the topic opportunities and needs protection infrastructure critical, what led to the formulation hypotheses about the existence important gaps in Polish regulations and methods management security infrastructure agriculture compared to analyses at the level European and international. Critically rated functioning mechanisms protection infrastructure critical and proposed solutions alternative in terms of national background concept included at the level international. State of research indicates a growing interest issues protection infrastructure critical due to the increasing threats for her functioning. However, many research refers to protection specific sector or aspects protection infrastructure Before specific threats and very rarely in relation to areas rural. This justifies taking up such issues in this article and consequently putting questions research. What solutions organizational, technical and systemic are effective in securing infrastructure critical agriculture in the areas rural areas in Poland ?

Structure article consists of one of the most important definitions and scopes concepts infrastructure critical in the rural areas. In the further parts article described contemporary threats for infrastructure agricultural. Presented too system assurances security infrastructure critical agriculture That special taking into account procedures grades risks, ways prevention and minimization effects disruptions and development ability to defend infrastructure critical. In detail described also duties administration public in the field of assurances security infrastructure agriculture. In the last parts article presented conclusions from the conducted analyses and recommendations.

Infrastructure critical in areas rural areas – definitions and scope

Infrastructure critical in rural affects the safety of their inhabitants and stability economies. There are this systems and resources necessary for functioning energy electricity, water supply, transport, telecommunications and advanced technology. Failure these elements infrastructure critical Maybe lead to serious problems economic and social, lack continuity work sector agricultural and reducing security food (Vijayan, 2024, p. 1).

In a special way in the countryside important are systems irrigation, local sources energy and ICT and connections Communication failure a single one of them Maybe pull for yourself domino disruptions in others sectors, limiting too access to services health, education and care public (Vijayan, 2024, p. 1).

Therefore, definition infrastructure critical for areas rural, outside what about her should, ought to to contain characteristics related to reliability system, resistance to interference actions due to contemporary threats, cyberattacks, sabotage Whether Too disinformation. New threats destabilize system by break actions infrastructure critical on various levels (Mayorkas, 2024, p. 2; Setola et al., 2016, p. 19).

But infrastructure critical in villages characterizes myself many weaknesses that due to

the lack of centralization, small investments and weak automation, what makes it difficult monitoring potential threats. Systems irrigation, energy and transport in the countryside include wide areas with low density population, what creates difficulties in ensuring appropriate protection (Vijayan, 2024, p. 1; Setola et al., 2016, p. 12).

Also insufficient financing and services technical they limit development technological. Investments and modernization infrastructure rural they are progressing slower than in cities. It makes it easier this spread myself effects failure to other sectors (Vijayan, 2024, p. 1). Limited access to advanced technologies such as How sensors, communication satellite and telemetry, constitutes next problem, slowing down their integration.

Therefore, security infrastructure critical requires strategy responding to limited resources technologies and requirements areas rural, including assurances inclusion local administration, but too education in the field of management and implementation procedures security in sectors agricultural (Vijayan, 2024, p. 1). In addition education on the subject threats for local communities and their inclusion in the system security Maybe efficiently to correct protection and cooperation between various administrations will allow you to quickly way counteract potential damage.

Communities local they should to take active participation in shaping procedures protection and in response to accidents, in monitoring system safety to include their voice in improvement services security (Vijayan, 2024, p. 2).

Management and operation services public and system monitoring they can be data - based delivered by local stakeholders. Beyond identification challenges and needs system protection Maybe this lead to early warning about threats, what contributes to their prevention (Vijayan, 2024, p. 2). Besides this inclusion local community aims to lift awareness about threats and responsibilities for local safety. Practical testing effective procedures security local is in some countries part of mandatory training officers on duty. Additionally should to underline benefits solutions using partnerships public-private and local community. Projects implemented in this mode May the biggest chances good luck because they provide services on- site security, and what for this it's going better recognizing and adapting to needs local (Vijayan, 2024, p. 2).

In accordance with the requirements European and standards international, including Directive 2008/114/EC on identification and designation European infrastructure critical and evaluation needs in terms of improvement her protection, each country EU member states have designated units level national and lower. Selection level and criteria designations these units left to the decision countries member states.

Security infrastructure critical in the EU is because process multi-stage, and individual stages, e.g. designation entities or assessment threats, they can realize different institutions public and private. In countries EU member states identifying sectors infrastructure critical and related entities completed According to uniform methodology. It creates this but just theoretical a chance for transnational exchange information. In practice countries member states they are implementing independently developed solutions in the field procedures safety. There is this especially visible in areas rural, where local character infrastructure critical makes it difficult implementation concept rungs power organized at a higher level than municipal (Setola et al., 2016, p. 11).

Directive 2008/114/EC suggests implementation system including procedures management risk, planning continuity actions and estimation threats. Implementation system there is so much more difficult that recipes Directives impose on states EU member states order estimation threats at the level national and domestic. Agricultural sector was left defined as relevant for the EU, and at the same time countries Member States. Important Is interoperability

systems and effective exchange information between systems national and private (Setola et al., 2016, p. 11).

As they show last research, protection Before new ones threats maybe to be achieved Thanks security newly specific elements infrastructure critical, i.e. infrastructure digital. Increasingly bigger number services critical in areas rural, such how contemporary activity agricultural, chains supplies and services public, based in a bigger way degree on it. Protection infrastructure digital requires but take into account threats related that application modern and universal available technologies and their use for purposes prohibited (Mayorkas, 2024, p. 2). In particular speech here about cyberattacks and threats related to fast development and dissemination myself computers quantum, using, but too without him, algorithms artificial intelligence and capabilities generating " deep fakes" (Setola et al., 2016, p. 19). Protection subsystems digital refers to cyberspace. Suitable security requires complex strategy cybersecurity. In the area cybersecurity countries member states Union European they have to take up actions to implementation strategic plans cybersecurity and cooperation with others countries Member States and the Commission European Union, in accordance with the guidelines contained in the NIS directive. It is this this more important that security digital sector critical depends first of all to everyone from frame managers subsystems digital. Hence Too important issue Is perfecting professional development internet and advanced technologies such as How communication satellite and IoT, allowing for more effective monitoring and protection infrastructure critical, requires simultaneous implementation strategy at the level state and at the level enterprises, but also solutions regarding coordination both national and global (Setola et al., 2016, p. 19). Therefore, infrastructure critical in areas rural requires specific solutions ensuring their protection. Characteristic for this area weaknesses infrastructure critical caused by, among other things, dispersion her elements, limited resources and specificity surroundings socio-economic they cause necessity development solutions that will increase their resistance to interference actions caused contemporary threats.

Contemporary threats For infrastructure critical agriculture

Contemporary cyber threats for infrastructure critical agriculture due to growing quantity cyberattacks using complicated procedures they illustrate possible effect attacks on infrastructure critical rural agriculture. Hacker attack on the network distribution electricity in Ukraine, which was deprived of electricity in 2015 energy electricity 225 thousand users, shows how vulnerable to attack Is rural infrastructure critical and in what areas the most vulnerable to disruptions actions basic services, affecting safety local communities, including production food (Limba et al., 2017, p. 4).

A large threat in the area infrastructure water and energy, which is part of agriculture, is control her actions by cyberattack and lack means technical preventing takeover by attackers control over basic mechanisms her actions, what maybe result in longer lack of deliveries energy electricity and water, important in agriculture (Mayorkas, 2024, pp. 4-5).

Low, in some cases lack of awareness and knowledge procedures service system security for staff operators infrastructure critical they result frequent effectiveness cyberattacks, despite that are they made aware users and operators. Additional a hindrance to rural agriculture is limited capacity organizational and financial infrastructure critical and consequently lack professional training in operation and implementation devices technical securing systems before failures, what makes possible violations in the system security are not detected in time, causing their cascading, extensive character (Limba et al., 2017, p. 9). Low redundancy and small resources financial in agriculture in the case of cyberattack and disruption infrastructure

critical in this rural area they cause large vulnerability to damage and lack resources material to quickly restoration efficiency her rural activities systems water and energy and communication and logistics may smaller alternative means action (a lot lower redundancy infrastructure critical) and lack reserves financial for possible repairs or reconstruction, what maybe result in longer lack of deliveries services critical. It causes this worsening myself level life and ebb people from the countryside in search of more stable and safer conditions life (Vijayan, 2024, p. 1).

Hybrid threats are more and more common, using cyberattack, sabotage physical, and also disinformation in the case of attack on infrastructure critical. Such attacks they cause disruptions actions the whole system telecommunications, also satellite, making it impossible or limiting communication in the countryside. Such attack on infrastructure satellite, limiting communication in the countryside, while Russian aggression against Ukraine in 2022, was attack on satellites communication companies Viasat (Mayorkas, 2024, p. 3).

Sabotaging activities infrastructure critical in the countryside remotely, most often by attack in cyberspace, causes destabilization technically simple systems operating in the area transport, supply and logistics, disrupting functioning enterprises and action chain logistics agriculture, causing chaos in the markets production agricultural on a larger scale area. Sabotage infrastructure is difficult to identify due to large vastness and dispersion physical objects system in the countryside, as well as with low consciousness staff operators, what requires construction own systems monitoring (Mayorkas, 2024, p. 3).

Activities disinformation they use situation chaos and lack information while various kind conflicts in countries that were left attacked. Infrastructure attacks IT they cause lack access to reliable information about possible disruption services local, what limits and often makes it impossible identification kind threats, e.g. local failures or attack on infrastructure. Disinformation causes chaos in reception information, even when actions systems technical are correct, destabilizing the situation on a given area. Chaos causes population stops trust messages government and local administrator, by What are deprived chances for a quick reaction, e.g. to actions terrorist (Brodacki et al., 2023, p. 10). Phenomena in the field of climate and environment they cause more frequent threats infrastructure critical in the countryside, in the form of various kind disasters that they disturb functioning rural logistics transport and supply of various kind means of production agricultural in the countryside. Phenomena such as floods, droughts and tornadoes, on the one hand pages they cause destruction and damage alone infrastructure critical in agriculture, but too a break in the chains supplies in the countryside. Their characteristics are low predictability time speeches and huge losses material – often they cause long-lasting downtime in the area deliveries basic materials production (Setola et al., 2016, pp. 5, 12). Example disruptions chain logistics in the aftermath actions nature this eruption volcano Eyjafjallajoekull in 2010. Effect chain domino was phenomenon dominant, hindering logistics transport and supplies, causing elongate time expectations, what severely felt areas rural with delayed deliveries materials operational for agriculture, e.g. fuels (Setola et al., 2016, p. 12).

Weak and often Very weak, resistance to excessive loads in the areas rural with scattered building and low redundancy rural infrastructure critical are the biggest the problem that they evoke phenomenon domino. There is this most often occurring problem, because disruption situation actions one sector, e.g. distribution energy electrical, affects the disruption work next – delivery water (limitation irrigation fields, preventing work rural plants processing agricultural, lack power supply farms household, transport refrigeration, trucks fire brigade, ambulance emergency services rescue), and then food supply (lack of deliveries food and restriction her transport, trade food limited by not working store cash registers and devices

storage food demanding power supply). Such a situation domino repeats myself also in the sphere agriculture, while disruptions in the global system transport, what an example was COVID-19 pandemic and lockdown availability materials consumables for machines agricultural in the countryside, lack of markets station fuels due to quarantine staff (Setola et al., 2016, p. 12; Mayorkas, 2024, p. 3). Global problem more and more bigger fuel demand liquid within ten years fugitive follow the trend limitations import oil From eastern neighbour. In Poland also tendency Is growth – by 33% over decades (Brodacki et al., 2023, p. 7), therefore necessary Is development existing national bases warehouse For fuels. Poland achieved in 2020–2022 level storage fuel for 75 days. Domestic warehouses fuels liquid they enlarge base supplies (PERN), and in addition add up should growth abilities storage at the terminal in Dębogórze. Budgets for the annual checks national databases oil petroleum and products oil are not enough controlled. States developing myself more and more they limit import oil that strategically important, but more and more inflammatory, areas. The consequence Is lack possibilities purchase stocks to cover possible, unpredictable disruptions global chain logistics oil, and on the market national are created deficiencies (Brodacki et al., 2023, pp. 7-8).

Functionality and operation elements components infrastructure critical in the area agriculture in large measure depend From chain flow data and materials logistics, where more and more bigger meaning plays monitoring and control risks and diversification infrastructure transport has basic impact on delivery products agricultural to others, also endangered areas, causing global problem supplies population in basic means life, including food (Setola et al., 2016, p. 19). Directive Union The European NIS of 2016 imposes on countries member states duty implementation coherent, national strategy cybersecurity (Setola et al., 2016, p. 19).

Mostly research regarding protection rural infrastructure Is described and explained security systems telecommunications and security critical objects material infrastructure physical activity in the countryside, but lack in them mentions of taking into account elements systemic in procedures planning and management due to their poor developed technology and lack staff to service them. Average system security cyberspace has large number weak points because of different specifics areas management and limited systems monitoring their safety (Mayorkas, 2024, pp. 4-5). Development system cybersecurity Is necessary and has big impact on protection resources digital in the countryside, e.g. accounts customers in the systems banking. According to TNO research was more than 9500 incidents, of which effects in the sphere economic were multi-sectoral (Setola et al., 2016, p. 19). The consequences of their effects the most they touch population, including rural.

Hedging Strategies infrastructure agricultural

Effectiveness security infrastructure agricultural in areas village requires organized management risk catastrophic and developing abilities protective. Challenge this assumes in today's world both implementation tasks preventive measures, as well as the use of new technology increasing resistance systems on the impact forces nature and action cybernetic. Includes strategy minimization effects and assurance continuity critical processes economic areas village, entering into a wider context protection infrastructure critical described in the work.

Management risk catastrophic

Management risk catastrophic in agriculture in the areas rural creates essential barriers resulting from the limitations scale and amount Help financial. In the years 2009–2014, ad hoc

aid could be provided to count only 487 farms, which accounts for <1% of all individual farmers. Average sum Help financial she hesitated around 13 thousand zlotys, but in areas the most affected a disaster, which was Masovia and Podlasie, payments exceeded 100 thousand zlotys. Minimum range support excludes from the group recipients help large hi people because of too small scale damage. Relatively low sum support will not allow reconstruct agricultural infrastructure after severe disaster, especially in areas haunted her cyclically (Soliwoda et al., 2017, pp. 9–10). Large differentiation amounts Help financial breakdown territorial confirms legitimacy politics regional diversified That due to the scale risks, based on type risks and scale losses (example Mazovia and Podlasie) for limitations precipitate caused an event catastrophic. Help financial directed is in large small and medium - sized companies, what Is right action for their survival after disaster, but on the other hand pages maybe lead to a situation lack of support that pages countries for farms with the largest surface land use agricultural (Soliwoda et al., 2017, p. 10).

Enabling reduced threshold minimal precipitate required to receive support financial from 30% to 20% of the value production aims to improvement availability Help financial For farms in difficult situation. Too restrictive criteria they can to be a factor that makes it difficult satisfaction demand for the system insurance related to liquidation barriers access. Increase level management competences risk at the level micro Is as important How reduction costs insurance. Probability use insurance index is 24% higher in farms with higher level competences owner / manager in management risk catastrophic (Kulawik, 2025, pp. 23, 27). Shortage capital financial (decreasing allocation management capital risk catastrophic) maybe create opportunities for development new, more effective ways to protect Before consequences risks catastrophic. Insurance index they offer transparent, fast and hassle-free element subjective interpretation compensation way support farmers after defeat (Kulawik, 2025, p. 23).

In relation to the national system security food necessity systemic actions states in terms of management risk catastrophic in the sector agriculture spends myself necessary in response to the ongoing global change climate. Identification these areas and types risks catastrophic (mapping threats) may bring practical value on many levels, including planning preventive means intervention minimizing their negative effects (practical example - flood in Wrocław in 1997 and practices preventive) (Wieteska -Rosiak, 2016, pp. 8–9).

Enabling management preventive (detection threats and control, risk response) may allow for limitation time devoted to rebuilding farms after catastrophe. Growth competences farmers in terms of management risk Is important from the perspective effectiveness intervention public (Wieteska -Rosiak, 2016, p. 8).

Enabling recovery / rebuilding farms agricultural after touching them by disaster lively maybe serve in building capital social local community. Important is too systemic flow information about losses, but too fast reaction to change risks, and also prevention growth interdependencies risks in the economy. Fast and effective disaster response enables growth immunity societies, limiting dependence between systems economic at the level local and regional and better capacity absorption and adaptation enterprises (Wieteska -Rosiak, 2016, p. 8). Help financial small farms Is good action countries, apart from scale help and its efficiency. Ensuring Help financial in situations crisis improves stability income (base immunity social response to crises), but limits expenses in another area - on prevention. To put it simply - prevention does not provide possibilities control and verification incurred losses in the disaster. You have to remember that stability in the country this just half problem security in the system distribution food, anxiety general in turn this risk of “conspiracy to limitations supplies” (Soliwoda et al., 2017, p. 11). Moving to the level systemic maybe deliver integrated control and planning approaches flows information and communication in order to prevention negative

consequences risks catastrophic. Interoperability this is one of the most important arguments in favour use systems informational as systems, not a package tools. One-sidedness approaches leaning on the model verification Just one type system informational makes it difficult creation model integrated system in which everyone his element Maybe cooperate by providing current information about system and environment. New technologies IT they enable controlling state infrastructure for help tools based on applications mobile, such as integrated systems early warning / monitoring, control state threats local / regional infrastructure. Systems systemic they can analyse data from several sources and provide scenarios changes to the system and they carry out processes analysis sensitivity and analysis risks. It allows this developing indicators in monitoring state system along with his the environment, and this in turn gives possibilities forecasting development the situation in the environment and adjustments strategic in relation to environment and expected directions his development (Kulawik, 2025, p. 23).

Development abilities protective

Development abilities protective infrastructure critical in areas rural involves the implementation modern technology digital, such How systems telemetry, smart grids Whether automation response to anomalies. They serve one to the current one monitoring infrastructure and limitations risks breaks delivery energy Whether water in areas with limited redundancy. They favour diversification sources energy Thanks application micro-installations photovoltaic or biogas plant. A barrier Is whereas Cost implementation and education appropriate competences staff managing director such systems (Vijayan, 2024, p. 2; Mayorkas, 2024, p. 2). Management incidents stands myself more effective Thanks investments in competences staff management. Research indicate that are this difficult to copy resources that determine competitiveness organization. Training staff responsible for management infrastructure in the areas rural should to combine component technical, process (management risk, response crisis) and skill inclusion local community in the project modernization. Recommended Is implementation certificates competence and leading audits readiness operational. Equally important Is special offer innovation and culture organizational favourable learning myself By whole life (Krupski et al., 2014, p. 12). Construction relationship institutional and implementation PPP models are action that allows to limit risk and increase effect synergy, as a result distractions outlays. PPP allows also implement strategies cooperative competition that activate in local communities mechanisms capital social and build trust in managers institutions. Instruments financing such How crowdfunding, finance mixed, CSR programs allow bind capital local enterprises, residents, and also institutions international (Vijayan, 2024, p. 2; Krupski et al., 2014, p. 13).

Implementation coherent procedures security measures (physical and digital) based on international standards (NIS directive, guidelines American DHS) is process incessant. It involves continuous identification elements infrastructure and inclusion in the network management risk and testing security (tests penetration audits cybersecurity, implementation systems detection intruders etc.). There is especially important to risks attacks hybrid, i.e. combination aggression with elements sabotage in the physical and digital environment. Effectiveness Yes outlined strategy protection requires on the one hand pages commitment high- ranking staff competences digital (engineers cybersecurity, security managers), on the other hand and regular analyses risks and procedures (Setola et al., 2016, p. 19; Mayorkas, 2024, pp. 4-5). Analysis interference, for example eruption volcano Eyjafjallajoekull in Iceland, and its effects on the global system distribution goods and capital this relevant element construction immunity systemic. It indicates the need implementation approaches systemic,

which assumes prediction and simulation (predictions cascading). Management crisis has to be consistent with the process analysis incidents, because disruptions they indicate directly to the elements that should improve. Improvement procedures repair and investments in analysis predictive allow shorten time to return to normal from before incident (Setola et al., 2016, pp. 5, 12).

The above challenges are for most systems of a nature rural apart from range possibilities That due to their limited resistance, hence exists need take up by managers institutions infrastructural activities proactive, allowing strengthen system responding to crises and disruptions.

The role of administration public in protection infrastructure

Administration public constitutes important actor process protection infrastructure critical in areas rural, which on the one hand pages involves designing and implementing politician, but also coordination and enforcement law. In Poland role this rests on determining procedures and connecting actions various organs administration. Actions preventive in terms of protection infrastructure critical conducted by administration public they should to be comprehensive, yes to secured areas security - related both physical and digital infrastructure critical. Effectiveness Police as actor security common in large measure depends from resources that they will be made available for their actions related to protection infrastructure critical. Actions entities sector public cooperating with entities from the sector private require that together secured evacuation, property and people (Kowalski et al., 2022, pp. 7, 11). Remember But it is necessary that differences regional and other needs that has characteristic area the countryside, make security infrastructure critical still stands a sign inquiries.

Continuous deficiency means technical, and also low employment, especially in entities Police having impact on infrastructure critical in the rural areas, make 74 % of respondents representing services public points out shortcomings hardware, what influences negatively on the degree implementation tasks (Kowalski et al., 2022, p. 14). Deficit hardware makes time reaction while damage infrastructure gives in elongation, and the same repair damage lasts much longer. Effective response to the effects, for example failure power supply in the areas rural Whether destruction waterworks stands myself by this more and more difficult. Deficit frame whereas reduces resistance infrastructure critical for possible disruptions in processes and limits exercised over her supervision. Development technical and systematic increase frame are necessary. It must be in it but take place improvement on all planes. Improvement tasks implemented by staff, as well as changes in the area organizational, for example appropriate chapter tasks, support social and activation residents for the needs implementation tasks protection infrastructure critical, improve indicator effectiveness in the area infrastructure critical in the countryside.

Currently security infrastructure critical brings to security both areas both digital and physical. Responsibilities countries Member States in the scope implementation requirements in the area protection infrastructure critical are based on guidelines NIS Directives. National regulations in large measure they reflect also guidelines Department Security Internal States States (Setola et al., 2016, p. 19; Mayorkas, 2024, pp. 4-5), point to the protection networks ICT and mechanisms control and supervision in the sector infrastructure. Without systematic measurement risks protection cannot to be appropriate. Prevention system cyberattacks and attacks of a hybrid requires cyclical and systematic analysis risks. System disruptions water and telecommunications, which they had place in areas rural, proved that threats this should to counteract because infrastructure digital stands myself attractive an object of attack for purposes

destabilization. Protection in this dimension should therefore to be also focused on improvement competences staff and regular updating and improving infrastructure and procedures security in the area cybersecurity. Based on experiences others countries, especially events of a nature cascading disruptions and cyberattacks (Setola et al., 2016, p. 12; Mayorkas, 2024, p. 3), administration public implements innovative tools preventing disruptions processes in the sector infrastructure critical. Launched are also tools alarming and systems monitoring automated in the context management crisis. Real scenario crisis allows identify weaknesses systemic in protection resources infrastructure critical. Through testing immunity resources you can therefore improve protection and planning system for the future. States implementing innovative and modern strategies management crisis in the area infrastructure critical they can be myself model for solutions national, such as marking out strategy and policy protection, indicators and procedures response. States implementing advanced strategies protection resources they should therefore to be used in the aspect benchmarking.

Cooperation with local communities within process protection infrastructure critical in the areas rural improves effectiveness system. Activation and activity communities in the process monitoring Whether reporting damage infrastructure and presence communities in training regarding crises (Kowalski et al., 2022, p. 11; Setola et al., 2016, p. 19) strengthens general system protection resources critical. Inclusion community rural to the process planning in the field protection resources at the level local improves fit system at the level regional and local. Launch interactive management That communities rural at the level local government enables more efficient realization function protective, but too more efficient use available resources infrastructure and hardware.

Summary

Implementation purpose work – in-depth analysis strategy protection infrastructure critical in areas rural areas – allowed for answers to the goals set in operational questions regarding characteristics threats and strategies protective. The need identification meanings infrastructure critical For safety, sustainability and development areas rural was motivation For taken work, and obtained as a result research results were left presented in the work of a nature interdisciplinary.

Implementation goals cognitive led to the establishment beings infrastructure critical in areas rural, taking into account her dispersion, availability resources and potential multiples threats to which Maybe to be exposed. Confirmed it turns out that imperfection redundancy systems, difficulties monitoring and limited availability modern technology security in areas rural increase risk disorders of a nature cascading and long-term. Currently, the biggest danger identified is in cyberspace, that due to the possibilities violations security systems ICT and phenomena hybrid, disinformation and consequences changes climate and disturbances chains supplies. Research lead to the conclusion that management catastrophic risk and competences and technologies digital Mutually myself complement each other in creating integrated strategy security infrastructure critical in areas rural. Implementation purpose cognitive possible was Thanks combination critical analysis literature with identification areas knowledge in which in Polish conditions necessary Is taking into account special aspects. Classification support and security infrastructure indicates the essence adjustments financial, political, regional and tools management risk to different needs farms, especially distinctions small and large farms, taking into account their strategic meanings for security food. Within the framework of synthetic shots strategy management risk catastrophic and developing immunity infrastructure critical in areas rural, identified strategies and instruments determining resistance infrastructure, taking into

account insurance index and tools IT competences resources human rights, partnership public-private and activation and education communities local.

Article enters in the developing myself current research over resistance infrastructure critical in areas rural areas. Compared to the dominant global literature direction research immunity cities, this Work brings identification and evaluation the most important weak points infrastructure critical in areas rural. Development this indicates that security key assets and services infrastructure in the areas rural Is process systemic. It should this constitute set integrated solutions technological, operational and management, which they provide efficient implementation tasks administration public, business and resources human in areas rural. At work were left developed practical recommendations in the field protection infrastructure critical, especially important That due to the specificity Polish the village where features distinctive are first of all to everyone dispersion infrastructure, limited resources and imperfections management crisis. Limitations related to the study result in particular from the unavailability current and aggregated at the level municipal data, what results in limitation analyses quantitative to data secondary. Furthermore, due to restrictions financial were not completed tests empirical on a larger scale and necessary Is supplement research That special taking into account areas different under in relation to development regional and differentiation farms.

Recommendations for the future they should concentrate myself first of all everyone in the area research in the field of research systemic at a higher level complexity and studies cases in a wider scale interdisciplinary. In the area research concerning studies cases recommended are further analysis comparative between regions and countries, expansion areas research on policy and education related to security infrastructure at the level municipalities and tests quantitative effects practical politician security infrastructure and identification restrictions. Recommended Is further development analyses in relation to competences personnel, management resources crisis, analysis technology and evaluation applications technology, research regarding efficiency partnerships public- private situations crisis areas rural.

Analyses and syntheses research lead to the following recommendations:

1. Launch multi-stage system education for protection and management infrastructure critical, encompassing horizontal schools primary, middle, high school and professional.
2. Development cooperation between entities public and private in order to increase security and protection infrastructure critical, through introduction solutions of a nature systemic, including certification safety (ISO).
3. Strengthening protection infrastructure critical by building immunity network, redundancy, diversity and systems cybersecurity.
4. Determination role, resources and responsibilities for building resistance in systems infrastructure critical, also apart from enterprise (chain supplies).
5. Categorization assets enterprises infrastructure from the point of view goodbye risks interruption of activity.
6. Strengthening cybersecurity infrastructure critical in enterprises and IT networks, including assurance resources specialists in this field.

Personal reflection from work over this article from one page makes you realize need interdisciplinary perception beings problems, on the other hand pages assures of the rightness parties interdisciplinary approaches to conducting research, where analyses of the nature financial complement deal with the issues economic, technical, technological, but too sciences political and management.

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