**УДК 330.342.001.36**

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**The fundamental approach to assessing the risks of sustainable development of the forest complex**

*In this article, the authors propose a principled approach to the assessment of risk of the forest complex load. The approach involves the construction of "antifragile" system capable of adaptation and co-evolution. Since the forest complex is an open system, the impact of the external environment will inevitably create imbalances and contradictions. Detection of imbalances and contradictions, as well as the assessment of the risk burden on the industry, generated by them, should contribute to the sustainable development of the forest complex. The framework of the approach proposed a new classification sign of risk: the level of mutual influence. So the authors distinguished the private risk (white risk), complex (gray) risk, as well as an integrated complex (black) risk. The author's approach is that the industry risks tend to accumulate and animation, and therefore the consequences of realization of the risks may be of a fatal, destructive. Since the multiplier effect entails the simultaneous implementation of a set of events, evaluation of the probability of such event is extremely difficult, therefore, this approach focuses on the assessment of potential damage, identification and description of complex risks. The result of application of a technique should be forecast, which will allow the user carry out a set of measures to minimize the damage.*

**Принципиальный подход к оценке рисковой нагрузки устойчивого развития лесного комплекса**

*В настоящей статье авторами предлагается принципиальный подход к оценке рисковой нагрузки лесного комплекса. Подход предполагает построение «антихрупкой» системы, способной к адаптации и коэволюции. Поскольку лесной комплекс является открытой системой, воздействие внешней среды неизбежно создаст дисбалансы и противоречия. Выявление дисбалансов и противоречий, а также оценка рисковой нагрузки на отрасль, порождаемой ими, должны содействовать обеспечению устойчивого развития лесного комплекса. В рамках реализации подхода предложен новый классификационный признак рисков – уровень взаимного влияния. Так авторами выделяется частный риск (белый риск), сложный (серый) риск, а также сложный комплексный (черный) риск. Авторский подход предполагает, что риски отрасли склонны к аккумуляции и мультипликации, поэтому и последствия от реализации рисков могут носить фатальный разрушительный характер. Поскольку мультипликативный эффект влечет за собой необходимость одновременной реализации множества событий, оценка вероятности возникновения такого события является крайне затруднительной, поэтому данный подход концентрируется на оценке потенциального ущерба, идентификации и описании комплексных рисков. Результатом применения методики должен стать прогноз, который позволит пользователю провести комплекс мероприятий для минимизации ущерба.*

***Keywords:*** *forest complex, unsustainable development, systemic risk, risk assessment, «black risk», «gray risk», synergistic impact of risks, аdaptive development, sustainability, antifragile, stabilizing and coevolutionary strategies, discrepancy factors, evaluation of discrepancy (imbalances).*

***Ключевые слова:*** *лесной комплекс, неустойчивое развитие, системный риск, оценка риска, «черный риск», «серый риск», синергетическое влияние рисков, адаптивное развитие, устойчивость, антихрупкость, адаптивно-стабилизирующая и коэволюционная стратегии, факторы несоответствия, дисбалансы и их оценка.*

The forest complex is one of the most important industries of the national economy of the Russian Federation. Ensuring stability of its development, respectively, is one of the most urgent problems. In spite of the fact that the problem of assessment of stability rose repeatedly, it wasn't constructed yet the complex system of assessment which allowed constitute the most complete idea of situation in the industry.

If in case of sustainable development a number of researchers called the parameters determining stability of the system, then the factors of "instability" were, as a rule, determined vaguely.

In case of the term "instability of development" most of the authors determine it as a condition return the stability. Having agreed with this determination, it is necessary to analyse the forest complex as a system. From the point of view of the theory of the ILLC (integrated logging-lumbering complex) systems, it is possible to determine it as the open, difficult, dynamic system.

Achievement of dynamic balance requires interaction of the elements of the system as implementations of the property of self-control. Nevertheless, the open system can accumulate more contradictions and, due to interactions with the external environment, level them. Such system will keep itself, however degree of its stability will decrease as there will be a disharmony which will be caused by contradictions. In the absence of corrective action which will be able to level the influence of contradictions, the steadily developing system can be transformed to a system with unstable development [1, 2].

Complexity of the system follows from the interdependence of its elements, nonlinearity is caused by interaction of the accidental and determined processes and connected with availability in the system of a set of steady conditions [3], different potential structures [4], different modes of functioning [5]. Stability means return of the system after external impact in an equilibrium, stable condition. Stability is considered in a sheaf "stability-instability" and is determined as quasistability, that is as a change of the equilibrium conditions steady against the insignificant external impacts. Critical condition of the system is called still a bifurcation point, where as a result of fluctuations (case) there is a branching in a system trajectory, respectively there is a problem of anticipation [3].

In the management concept of the socio-ecological systems (including the forest complex – ILLC) stability or adaptability means not just recovery of a former condition of the separate subsystems, and not the reduction of natural equity, increase in the forest potential and growth of all potentials (ecological, social and economic) [1, 2].

There is a question: whether such understanding of stability suffices or it is necessary to expand it? We consider that very interesting and constructive moment is a use of the concept "antifragility" which means that under the influence of external factors, stressor, the system becomes better than the former [6].

"Uniqueness of antifragility consists that it allows us work with the unknown, to do something in the conditions when we don't understand that we do, – and to try to obtain success" [6, p. 20]. At the same time the author considers that the fragile or not fragile system is easier to understand, than to predict the event which can destroy, damage the system (tab. 1).

The concept "antifragility" is entered for fight against "A black swan" – an event, rare, unpredictable and big on consequences, [8]. The essence of a problem (fight) consists in complexity and impossibility to determine the risk of rare events and to predict their approach. "To understand how to become tolerant to a damage from variability, easily; it is much more difficult to predict the event which will lead to damage" [6, p. 22].

*Table 1*

**Comparison of the system properties or reactions to stressor**

|  |  |  |  |
| --- | --- | --- | --- |
| **Feature** | **Fragile** | **Impregnable** | **Antifragile** |
| **Impact** | Destruction | Recovery | Improvement |
| **Dichotomy** **"an event – reaction"** | Studying of events,measurement of risks,properties of events | Studying of reactions to the events, statistical properties of reactions | Transformationreactions onthe event |
| **Mistakes, failures** | Hates mistakes | Mistakes – information | Loves small mistakes |
| **Volatility** | Short | Flat | Long |
| **"Black****swan"** | Negative "Black swans" |  | Positive "Blackswans" |
| **Methodology** **(philosophy)** | Rationalism,separation | Empiricism | Scepticism, empiricism, holizm |
| **Regulation** | Rule, codeinstructions | Principles | Virtue,heuristics |
| **Acceptance****decisions** | Action,Assessment of probabilities | On the basis of heuristics | Not acton the basis of heuristics |
| **Bioeconomic** **systems** | Efficiency,optimality | Redundancy | Functionalredundancy |
| **Finance** | Debts | Capital stock | Venture capital |
| Ethics | Weak on a gameanything | Majestic,on a game the skin | Strong,on a game the soul |
| **Right** | Laws, systemlegal acts |  | Case law,justice |

*Source: [5] with changes of the authors, 2016.*

We consider that the invulnerability meaning the recovery or preserving a former condition of the system after external impact is more rare and less significant phenomenon in different development of the systems, first of all, natural and socio-natural.

Antifragility, in our opinion, is an essence of evolutionary processes in the nature in which continuously there is a complication, enhancement and improvement, that is this strategy is dominating in the natural systems. Stability or balance of development is the characteristic of artificial systems, of the systems constructed on a combination of natural and social regularities to a large extent. The last become a factor of modern development of the socio-natural systems [8, 9].

Ensuring invulnerability is very difficult case, on the one hand, on the other hand, it isn't that golden mean at which it is necessary to aim. Antifragility also very often costs very much, anyway it is more preferable than invulnerability, and stability should be considered as a peculiar compromise.

Hierarchy of the system characteristics of sustainable development – "invulnerability" < "antifragility" < "stability" – allows determin their place in the strategies of social-eco-economic systems. The first strategy is a stable development when changes are equal to zero, and there is a recovery or preserving a former condition of the system; movement from the invulnerability to vulnerability means the entropy growth, an increase of disorder. The second – the strategy of high-quality development when changes happen at the expense of quantitative and high-quality factors, at the same time dimension of the system can change in the big or smaller side, that is maybe "smaller –best of the bigger". The third strategy – the balanced development, that is pro rata growth of all elements of the system that actually also reflects a modern view on the prospect of SD [9].

These strategies have as appropriate something in common with the adaptive strategy of forest complex – adaptive stabilizing or adaptation and adaptive and forward or co-evolution [1, 2]. In this regard, the appeal to the concept "antifragility" which in the context of evolutionary development captures its essence is quite natural and, we believe, can strengthen the concept of adaptive development of ILLC and expand the instruments of its providing in practice [9].

Sustainable development is possible only when the change management oriented to increase in potential of all three subsystems – economic takes place, social and ecological. That is, it is about adaptive management which is considered as the main implementation method of sustainable development and comes down to use of feedback, and it is based on regulation [1, 2].

At the same time several approaches or models of this management can be realized. The first model is based after forming of an ideal of sustainable development (the program and target wood) and the co-evolution strategy constructed on the synthesis of adaptation, adaptivising and management of volume and time parameters of a sincicle of forest exploitation [1, 2]. The second approach relies on a formulation of system of imbalances of SD of the forest complex and assumes the corresponding corrective actions by these imbalances on the basis of their integrated social-eco-economic evaluation [10, 11]. The third "risk" approach of providing SD of the forest complex – determination of the corresponding risks and their assessment [12, 13, 14, 15].

Within the second model (according to the requirements of a paradigm of sustainable development) the sphere of public administration (administrative and managerial), ecosphere, technosphere, social and institutional spheres shall constitute a single system of restrictions of effective functioning of the forest complex. For descriptive reasons understanding of operating conditions of the forest complex the three-level scheme where "… each contour of self-control has the so-called "homeostatic range" of deviations …" is offered [16].

There is an area of relative stability when there are intrasystem imbalances, and also external, mediated by interaction with ILLC, however, they are counterbalanced with the operating influences and for the present don't bring the system out of an equilibrium state (dynamic balance or a condition of sustainable development).

In this context the concrete analyzed system can be recognized steady if data of the imbalances arising in its framework, their permission don't remove the system out of the limits of the acceptable risk when the negative consequences of activity are counterbalanced with the positive actions (activity optimization), i.e. the system is in safety. The concept of safety in this case is treated as some kind of limiter of growth which exit for indicators is fraught with the entry into a zone of dangerous development (irreversible changes of ecosystems, etc.) [17].

Thus, it is once again emphasized that there are tough restrictions in the form of admissible range of deviations (imbalances) within which the functional system is capable to perform the self-control [16], and inadmissible (critical).

Imbalances need to be considered as a single system of factors constraining the sustainable development as the ecosphere, technosphere, social and institutional spheres, and also the sphere of public administration are connected among themselves and are, on the one hand, "complementary", and with another – limiting each other.

Within the "risk" model of providing SD of forest complex, the revealed contradictions and imbalances require more detailed description, and also the development of measures for protection against these phenomena. For this reason we consider necessary to consider in the concepts of antifragility and the questions of determination of risk loading of sustainable development of the forest complex industry. Contradictions arise in the course of interaction of elements of the system with the environment and in the course of interaction with the other parts of the system. Implementation of contradictions has a certain probability and is, as a rule, connected with a certain damage that is close, in essence, to such category as "risk".

As a risk most of the authors understands probability of the emergence of damage from the made decision in the course of implementation activities by the entity. The risk as economic category is extremely various in its manifestations (tab. 2). So, for example, in the forest complex it is possible to speak about ecological, economic, entrepreneurial, financial, industrial, technological, social, legal and the other risks.

Different risks which can be shown at the same time are inherent in the forest complex and strengthen the damage. It is possible to call the similar phenomenon synergy effect of risk loading. Systemic risks by the determination shall be specific, capable to accumulate the influence and are inclined to the synergy. In other words to the systemic risks the same properties, as directly are inherent in the system elements.

The description and forecasting of separate types of risks was made repeatedly [12, 13] therefore it is reasonable to be concentrated on their synergy impact.

Assessment of such risks is represented more difficult as requires accounting of interference of the risks (fig. 2). Interference of the risks complicates assessment procedure as requires more careful analysis. Nassim Taleb in his work "Black swan. Under the sign of unpredictability" determined an unpredictable event as "A black swan", the difficult to predict event was called "a gray swan" and a predictable event – "a white swan" [19].

*Table 2*

**Generalized classification of risks of sustainable development of ILLC**

|  |  |
| --- | --- |
| **Classification sign** | **Type of risk** |
| Emergence nature | Natural, anthropogenous, mixed |
| On complexity of influence | Simple, complex |
| Time aspect | Incidental, constant |
| On possible consequences | Pure, speculative |
| On the level of losses | Accepted, critical, catastrophic |
| By the form losses | Direct, indirect |
| On universality | Universal, specific |
| On the object of emergence | Risk of separate operation, risk of the direction activity, risk of a kind of activity in general |
| On activity | Production, financial, marketing ecological, social, managerial innovative etc. |
| On connection with business activity | Enterprise, consumer |
| On an activity stage | Risk of decision-making, risk of realization |
| Criterion of correctness | Reasonable, partially reasonable, adventurous |
| Whenever possible forecasting | Predicted, hardly predicted, not predicted |
| Whenever possible diversifications | Diversifiable, not diversifiable |
| On controllability degree | Operated, partially operated, uncontrollable |
| On realization of risks | Realized, unrealized |
| On the level of mutual influence | "White" (private), "Grey" (complex), "Black" (difficult, multicomponent) |

*Source: it is made on the basis of [10,12,18].*

By analogy we suggest to designate risks on the extent of mutual influence. So the private risk (fig. 2) is highlighted with white color. Forecasting and assessment of such risk doesn't require accounting of other circumstances. Gray risks in which forecasting and assessment requires accounting of the factors connected with several risks are marked out. Black risks requiring accounting of a great number of groups of factors, study of their mutual influence are marked out. It is obvious that the offered drawing is exaggerated. However it is necessary to understand that creation of a model of risks assessment of sustainable development of ILLC will require creation of the complex integrated model as "black" and "gray" (difficult systemic risks) will be of the greatest interest, but not the "white", obvious and repeatedly described risks.

In spite of the fact that assessment of private, specific risks is rather popular, preserving such approach isn't always reasonable in the modern economic situation [7].

"Black" and "gray" risks need to be designated as the factors of instability of development. Black risks should be designated as extremely improbable as require confluence of a mass of circumstances at the same time, and proceeding from determination of the work of probabilities, it is possible to say that the probability of their approach can tend to zero.

Risk 1

Risk 2

Risk N

Gray

(Complex) risk 1

Gray

(Complex) risk M

"Black risk"

…

Mutual influence of risks

**The leveling influence of the operating influence**

**The leveling influence of the operating influence**

*Fig. 2. Synergetic influence of risks and their leveling*

Gray risks though have the complex character, but demand confluence of the smaller quantity of factors, than black risks. And their wide variability complicates the task [20].

As the variability of manifestation of synergetrics of the risks can be various, creation of the cards for separate groups of risks is required. In this regard, there is a need of modification of algorithms of the risks assessment. The algorithm offered by us assumes the accounting of mutual influence of risks and creation of the cards of complex risks by means of which "gray" and "black" risks will come to light and be evaluated (fig. 3).

**Description of risks**

Description of risks

**Allocation of factors of the systems of complex risks**

**Drawing up the cards of mutual influence of the risks**

**Allocation of risk factors**

**Drawing up a card of risks**

**Description of the systems of complex risks**

**Creation of a model of assessment of risks**

*Fig. 3. Algorithm of assessment of complex risks*

Points 1 – 3 are standard transactions in the risks assessment today. However points 4 – 5 shall allow start the analysis of complex risks. The forecast which will allow hold the events directed to an increase in stability of the system shall be a result of application of an algorithm and to prevent critical or catastrophic damage. A benefit of similar approach is a lack of need for upgrade of a mathematical apparatus as the offered algorithm doesn't provide its upgrade.

This basic approach pursues the aim of creation of steady system of the forest complex industry capable to adaptation and evolution. Forming of anti-fragile system requires forecasting of the destructive phenomena that requires the system analysis of contradictions and imbalances of the industry, and also the management of risk loading of the industry. It is important to emphasize that when using the concept "antifragility" the need for assessment of probabilities of events disappears, and anticipation will consist in determination of what we shan't do, namely not allow today with what we will have in the future serious consequences – "Black swans". In the zones or areas of antifragility of the socio-natural systems is reached maximum efficiency / effectiveness of its development therefore the hit is very important during the impact in these zones, that is, important is not only an intensity, but also topology, configuration of economic actions.

The immediate tasks connected with the development of steady management of the woods consist in the reasons for the principles of allocation of anti-fragile areas and in identification of such zones of antifragility of the forest complex that will allow develop essentially the methodology of ensuring sustainable development of the forest complex of the country and the regions. The technique of creation of forecasts of risk loading of sustainable development of the forest complex industry of the Khabarovsk territory will become a result of further researches in this direction. The forecast, in turn, will allow hold the preventive actions directed to the non-admission of catastrophic consequences (black swans) and putting the damage to the minimum values.

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