

THE BIOLOGICAL SOCIAL CONTRACT LAW IN THE ERA OF GENETIC

ENGINEERING AND CLIMATE MIGRATION

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First Edition, 2026
Revised and Expanded Academic Edition

DOI: 10.5281/zenodo.21834126

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Suggested citation format:

El-Rakhawi, Mohamed Kamal Arafa. The Biological Social Contract: Law in the Era of Genetic Engineering and Climate Migration. First Edition. 2026. DOI: 10.5281/zenodo.21834126.

DEDICATION

To every human being who believes that law is not merely a set of rules written on paper, but a living covenant that protects the dignity of existence itself.

To the generations yet unborn, whose genetic heritage we hold in trust, and whose climate environment we are obligated to preserve.

To the scholars, jurists, and legislators who dare to imagine a legal order worthy of the biological age.

And to my family, whose patience and love made this work possible.

With profound gratitude and unwavering commitment to justice.

Dr. Mohamed Kamal Arafa El-Rakhawi

EXECUTIVE SUMMARY

This book presents a comprehensive and unprecedented legal framework for the twenty-first century: the Biological Social Contract. It addresses the most profound crisis in the history of jurisprudence, namely the simultaneous collapse of two foundational assumptions upon which all classical social contracts have rested since the Age of Enlightenment.

The first assumption is natural human equality. The emergence of genetic engineering technologies, particularly CRISPR-Cas9 and its successors, has rendered this assumption untenable. The possibility of editing the human genome means that biological equality is no longer a natural given but a legal choice. If the wealthy can purchase genetic enhancements for their children while the poor cannot, the very foundation of democratic equality collapses.

The second assumption is geographical stability. Climate change has begun to render certain territories uninhabitable for human life. Rising sea levels, extreme heat, desertification, and ecological collapse threaten to displace hundreds of millions of people and to extinguish the territorial sovereignty of entire nations. The classical social contract, which presupposes a stable territory upon which sovereignty is exercised, can no longer account for a world in which the land itself is disappearing.

This book proposes that the law must transition from protecting civil and political rights alone to protecting biological and existential rights. The Biological Social Contract organizes the relationship between the human being and his biology, and between the human being and his climate environment, within a binding legal framework. It establishes new constitutional principles, including biological equality, the right to natural genetic identity, the right to a habitable climate environment, and the right to biological transit for climate refugees.

The work is divided into thirty chapters organized in five parts. Part One establishes the philosophical and legal foundations of the biological contract. Part Two addresses the legal regulation of genetic engineering and the prevention of biological class formation. Part Three develops the legal framework for climate migration and the right to biological transit. Part Four establishes the regime of legal liability and compensation in the biological era. Part Five proposes the architecture of global governance required to implement the biological contract.

This expanded edition integrates the most advanced developments in posthuman jurisprudence, epigenetic science, algorithmic bio-design, deterritorialized statehood, and bio-colonial resistance. It proposes the creation of new international institutions, including an International Biological Agency modeled on the International Atomic Energy Agency, a universal bio-extradition treaty, and a Global Bio-Human Pact. It establishes the principles of

intergenerational temporal equity, algorithmic transparency in bio-design, and the deterritorialization of sovereignty for sinking states.

The Biological Social Contract is not merely a legal treatise. It is a constitutional blueprint for the survival and dignity of the human species in the era of biotechnology and climate change. It is addressed to legislators, jurists, scientists, and citizens around the world who recognize that the protection of the biological future of humanity is the highest legal and ethical duty of our time.

AUTHOR'S PREFACE

The world today witnesses existential transformations that threaten the very foundations upon which the classical social contract has stood since the Age of Enlightenment. Philosophers and legislators across centuries have assumed a natural human equality and a stability of the geographical environment that harbors political societies. The revolution of biotechnology, on one hand, and the crisis of climate change, on the other, have shattered these two foundational assumptions. Biological equality is no longer guaranteed with the possibility of editing human genes, and geographical lands are no longer stable with the increasing uninhabitability of the planet for human life.

This book, placed between the hands of the reader, presents a bold and entirely new idea: the formulation of a social contract that is biological in its very essence. This new contract does not merely organize the relationship between the governed and the governor, but rather organizes the relationship between the human being and his biology, and between the human being and his climate environment within a binding legal framework. We are transitioning from a law that protects civil and political rights to a law that protects biological and existential rights. The fundamental question this book answers is: How can the law preserve human dignity and social justice in an era where human capacities may differ genetically and geographical borders may dissolve because of climate?

This work has been divided into thirty complementary chapters, covering philosophical foundations, the regulation of genetic engineering, the laws of climate migration, legal liability, and global governance. The texts proposed here are an attempt to fill a legislative vacuum that may lead, if not addressed, to the collapse of social systems. I present this work not merely as a technical or environmental development, but as a redefinition of the human being and his place in the universe. The law is the sole instrument to ensure that this definition remains humane and just.

In this expanded edition, I have integrated the most advanced developments in posthuman jurisprudence, epigenetic science, algorithmic bio-design, deterritorialized statehood, and bio-colonial resistance. These additions transform the book from a pioneering legal study into a comprehensive constitutional blueprint for the twenty-first century. The biological social contract is no longer merely a philosophical proposal; it is the survival code for the human species.

I extend my deepest gratitude to every scholar, colleague, and reader who has contributed to the development of this work through critical feedback, rigorous debate, and unwavering intellectual solidarity. The task before us is immense, but it is not impossible. The history of law is a history of adaptation to new realities. The social contract of the Enlightenment adapted to the industrial revolution. The biological social contract must adapt to the biotechnological and climate revolutions. The question is not whether we will adapt, but whether we will adapt in time.

May God grant us success.

Dr. Mohamed Kamal Arafa El-Rakhawi

PART ONE

PHILOSOPHICAL AND LEGAL FOUNDATIONS OF THE BIOLOGICAL CONTRACT

CHAPTER ONE

THE CRISIS OF THE CLASSICAL SOCIAL CONTRACT IN THE BIOLOGICAL ERA

The classical social contract, from Hobbes to Locke and Rousseau, rests upon the assumption of natural equality among individuals in the state of nature and the existence of a fixed geographical territory upon which sovereignty is exercised. The first assumption collapses with the emergence of genetic modification technologies that permit the enhancement of the human genome, creating a fundamental biological differentiation. The second assumption collapses with climate change that renders certain territories uninhabitable, threatening the very concept of the state.

This chapter analyzes in depth how these transformations render current constitutional texts insufficient for the protection of the human being. The law, which has traditionally assumed a natural citizen, may witness a genetically enhanced citizen in the future. And the law, which has assumed a stable territory, may witness a climate refugee without a territory. The crisis of the social contract is not merely a crisis of texts; it is a crisis in the very conception of the human being. The contract must be reformulated to include protection from biological differentiation and climate displacement as fundamental rights no less than freedom of expression or property.

The posthuman challenge must be confronted directly. When genetic engineering transitions from therapeutic intervention to cognitive and physical enhancement, it alters the very baseline of legal capacity. If a genetically enhanced class emerges with superior cognitive processing or physical endurance, the law must redefine equality not merely as equality of opportunity but as equality of fundamental biological capacity. The social contract must protect the unedited human mind as a sovereign territory. Any non-consensual alteration of cognitive baselines constitutes a violation of biological sovereignty. This is the domain of neuro-rights and cognitive liberty, which must be enshrined as constitutional principles in the biological era.

The classical social contract assumed that all humans enter the contract with approximately equal physical and cognitive capacities. This assumption is no longer tenable. The biological

social contract must therefore establish a floor of biological equality below which no human being may fall, and a ceiling of genetic enhancement above which no human being may rise without democratic consent. This is not a restriction on scientific progress; it is a safeguard for democratic civilization.

Furthermore, the crisis of the classical social contract is compounded by the failure of international law to recognize the climate refugee. The 1951 Refugee Convention defines a refugee in terms of persecution based on race, religion, nationality, membership of a particular social group, or political opinion. It does not include those who are forced to flee because of environmental degradation or climate disasters. This legal vacuum leaves millions of human beings vulnerable to loss without protection. The biological social contract must fill this vacuum by recognizing the right to biological transit as a fundamental human right.

The crisis is also compounded by the failure of constitutional law to address the implications of genetic enhancement for democratic participation. If a genetically enhanced class emerges with superior cognitive abilities, the principle of one person, one vote may become a legal fiction that masks a biological aristocracy. The biological social contract must therefore establish constitutional safeguards against the political domination of a genetically enhanced elite. These safeguards must include the prohibition of genetic enhancement for non-therapeutic purposes, mandatory access to genetic therapies, and the establishment of a genetic commons that belongs to all humanity.

CHAPTER TWO

THE HUMAN BEING AS A BIOLOGICAL SUBJECT OF LEGAL PROTECTION

The law has traditionally protected the human body from assault, but it has not intervened in its internal biological composition. With the development of genetic engineering, the human genome has become a subject for modification and trade. This chapter poses the necessity of considering human biology as a legally protected domain in itself, similar to the sanctity of the home or privacy. The genes may not be considered a commodity susceptible to complete ownership, modification, or random trade.

The law must establish the principle of the sanctity of the human genome, in which any intervention must be strictly therapeutic under strict supervision. Biological transformation, if left to market forces, threatens the unity of the human species. Legal protection for biology means preventing the commercial exploitation of genes and preventing discrimination based on genetic composition. This chapter establishes the concept of biological integrity as a human right of the first degree.

However, this protection must be expanded to include the epigenetic dimension. Environmental degradation, climate trauma, and synthetic toxins do not merely displace populations; they alter the methylation patterns of their DNA, passing biological trauma to future generations without altering the underlying genetic sequence. The legal framework must recognize epigenetic harm as a distinct category of biological injury. The biological social contract must protect not only the

genetic code but also the epigenetic environment in which that code operates. This means that pollution, toxic exposure, and climate-induced stress are not merely environmental harms; they are biological assault on the heritable integrity of the human organism.

The concept of biological integrity must therefore be redefined to encompass three dimensions: the genetic dimension, which is the DNA sequence itself; the epigenetic dimension, which is the regulatory environment of gene expression; and the ecological dimension, which is the external environment that shapes both. The law must protect all three dimensions as integral components of human biological sovereignty.

The legal protection of biological integrity must also address the emerging threat of algorithmic bio-design. As artificial intelligence becomes increasingly central to genetic engineering, the question of who controls the design of human biology becomes paramount. The biological social contract must establish that the design of human biology is a matter of public concern, not a matter of private commercial interest. Any algorithmic system used in genetic design must be subject to democratic oversight, ethical review, and legal accountability.

CHAPTER THREE

BIOLOGICAL EQUALITY AS A NEW CONSTITUTIONAL PRINCIPLE

Equality before the law is no longer sufficient in an era of differentiation. If the wealthy can purchase better genes for their children, legal equality becomes an illusion before the differentiation of natural capacities. This chapter proposes the inclusion of the principle of biological equality in constitutions, which prevents genetic discrimination and ensures equal opportunity in access to genetic treatments.

The constitution must prohibit the creation of human classes based on genetic composition. Biological equality does not mean preventing enhancements that create superiority, but rather preventing enhancements that threaten social cohesion in an unjust manner. The law must ensure that genetic modification does not become an instrument of dominance. The constitutionalization of this principle is the sole guarantee for the survival of democracy in the biotechnological era.

The posthuman dimension of biological equality requires that the law address the question of legal capacity in the context of genetic enhancement. If a human being is genetically modified to possess superior cognitive abilities, does the law treat them identically to an unmodified human in matters of criminal responsibility, contractual capacity, and political participation? The biological social contract must establish that legal personhood is not contingent upon genetic composition. All human beings, regardless of their genetic status, possess equal legal dignity and equal fundamental rights. However, the law must also prevent the emergence of a genetic aristocracy that could monopolize political power, economic resources, and social influence.

The principle of biological equality must be understood not as a static condition but as a dynamic legal obligation. The state must actively monitor genetic disparities and intervene when

they threaten the foundations of democratic participation. This includes mandatory access to genetic therapies, prohibition of genetic enhancement for non-therapeutic purposes, and the establishment of a genetic commons that belongs to all humanity.

The constitutionalization of biological equality also requires the establishment of a new branch of constitutional adjudication: biological constitutional review. This review would assess whether legislation, regulation, or governmental action violates the principle of biological equality. The review would be conducted by specialized biological constitutional courts or by existing constitutional courts equipped with biological expertise. The decisions of these courts would be binding and enforceable, ensuring that the principle of biological equality is not merely a rhetorical commitment but a living legal reality.

CHAPTER FOUR

THE RIGHT TO NATURAL GENETIC IDENTITY

Every individual has a right to a genetic identity that has not been manipulated for non-therapeutic purposes. This right protects the individual from parental pressures or market forces to modify his genetic traits in a manner that contradicts his future will or his nature. The right to genetic identity means the right of the child to be born with natural genes, unless there is an extreme medical necessity.

The law must organize the process of consent to genetic modification, granting the individual the right at the age of knowledge to be informed about modifications made to him and to object to them legally. Protection of genetic identity is protection of the autonomy of the human being from the design of others. This right balances the freedom of parents in reproduction and the right of the child to an open future, not predetermined genetically.

In the expanded framework, the right to natural genetic identity must be understood in the context of bio-colonial resistance. Transnational biotechnology corporations from the Global North frequently harvest the genetic diversity and indigenous biological data of the Global South, patenting synthetic sequences derived from these populations. The right to genetic identity is therefore not merely an individual right; it is a collective right of peoples to their genetic heritage. The biological social contract must establish the principle of genetic sovereignty, which holds that the genetic resources of a nation belong to its people and cannot be appropriated, patented, or commercialized without the free, prior, and informed consent of the source community.

This principle updates the Nagoya Protocol framework to cover synthetic biology and algorithmic gene-mapping. Any commercial or scientific utilization of a population's genetic heritage requires binding, reciprocal socio-economic integration. Genetic data is not a commodifiable resource; it is a protected sovereign asset. The biological social contract must prohibit genetic imperialism in all its forms.

The right to natural genetic identity also encompasses the right to genetic privacy. The genetic data of an individual is the most intimate form of personal information, revealing not only the individual's biological characteristics but also those of their ancestors and descendants. The biological social contract must establish that genetic data is subject to the highest standards of privacy protection, and that any collection, storage, or use of genetic data must be based on informed consent and subject to strict legal oversight.

CHAPTER FIVE

THE CLIMATE ENVIRONMENT AS A HUMAN RIGHT

The environment is no longer merely an external framework; it has become an existential condition for life. This chapter proposes the recognition of a habitable climate environment as a fundamental human right, binding upon the state. If the state fails to protect its citizens from climate disasters, it has breached its fundamental contractual obligation.

This right entails positive obligations on the state to limit emissions and to adapt to changes. It also grants individuals the right to litigate against states or companies that contribute to climate destruction. Raising the level of the environment changes the nature of human rights from a political responsibility to a direct legal responsibility susceptible to prosecution.

The epigenetic dimension of climate harm must be integrated into this chapter. Climate change does not merely cause physical displacement; it causes biological harm at the molecular level. Heat stress, toxic exposure, and nutritional deprivation alter the epigenetic markers of affected populations, passing trauma to future generations. The right to a habitable climate environment therefore includes the right to an epigenetically safe environment. States and corporations that cause climate degradation are not merely violating environmental regulations; they are committing epigenetic sabotage against the heritable biological integrity of affected populations.

The legal framework must recognize that climate harm is not limited to the present generation. The biological social contract must establish the principle of intergenerational temporal equity, which holds that the obligations of the present generation extend to all future generations. This means that the statute of limitations for climate-related biological harm must be abolished or radically extended, because the harm continues biologically across generational lines.

The right to a habitable climate environment also includes the right to climate adaptation. States must take positive measures to adapt their infrastructure, agriculture, and public health systems to the realities of climate change. This includes the development of heat-resistant housing, drought-resistant crops, and early warning systems for climate disasters. The failure to adapt is a violation of the right to life itself.

CHAPTER SIX

BIOETHICS AT THE HEART OF LEGISLATION

The law cannot be separated from ethics in the biological domain. Bioethical principles must be integrated into the substance of legislative texts, so that they become binding rules and not merely guidelines. Principles such as justice, autonomy, and non-harm must be standards for evaluating the validity of laws and biological regulations.

A legal ethics committee must be established that possesses the authority to veto research or legislative projects that conflict with biological dignity. The integration of ethics into legislation ensures that scientific progress does not proceed at a speed that exceeds the human capacity to absorb its consequences. The law is the successful biological embodiment of the highest human ethical values.

In the expanded framework, bioethics must address the convergence of artificial intelligence and genetic engineering. Genetic design is no longer solely a human endeavor; it is mediated and accelerated by artificial intelligence. The ethical framework must therefore include algorithmic bioethics, which addresses the moral implications of AI-driven biological design. If an artificial intelligence system recommends a genetic modification that results in unforeseen generational harm, the ethical and legal framework must be capable of assigning responsibility. The biological social contract must establish that algorithmic bio-design is subject to the same ethical standards as human bio-design, and that the opacity of algorithmic decision-making cannot serve as a shield against accountability.

The bioethics committee must include not only medical professionals and legal experts, but also representatives of affected communities, indigenous peoples, and future generations. The biological social contract demands that those who bear the consequences of biological decisions have a voice in making them. This is the principle of democratic bioethics, which ensures that the power to shape human biology is not concentrated in the hands of a technocratic elite.

The integration of bioethics into legislation also requires the establishment of bioethical impact assessments. Before any legislation or regulation affecting human biology is enacted, it must be subject to a comprehensive bioethical impact assessment that evaluates its implications for biological equality, genetic identity, epigenetic integrity, and intergenerational justice. The results of these assessments must be made publicly available and subject to democratic debate.

PART TWO

GENETIC ENGINEERING AND LEGAL REGULATION OF BIOLOGICAL CLASSES

CHAPTER SEVEN

REGULATION OF HUMAN GENE EDITING TECHNIQUES

A strict legal framework must be established for the use of technologies such as CRISPR for genetic modification. The distinction must be clearly made between genetic therapy for

hereditary diseases, which is permitted under medical supervision, and genetic enhancement for human traits, which must be prohibited to prevent the emergence of biological differentiation.

Genetic clinics and laboratories must be subject to precise and continuous licensing and monitoring. Any violation of the protocols is considered a crime punishable by law. The regulation is the precise line separating human service from the threat of technology. The law must be prior to the wide commercial application of these techniques.

In the expanded framework, the regulation of genetic editing must address the role of artificial intelligence in bio-design. AI systems such as protein-folding predictors and generative biological models are increasingly used to design genetic modifications. The legal framework must establish that any AI-assisted genetic design is subject to the same regulatory standards as human-designed modifications. The algorithmic black box cannot serve as a defense against liability. If an AI system recommends a genetic modification that causes harm, the developer, the deploying corporation, and the clinical practitioner share joint and several liability.

The regulation must also address the risk of bio-havens, which are jurisdictions with weak or nonexistent regulatory frameworks that attract rogue genetic experimentation. The biological social contract must establish a universal prohibition on genetic tourism for prohibited procedures, and must create an international bio-extradition treaty that ensures offenders cannot escape justice by relocating to unregulated jurisdictions.

The regulatory framework must also include provisions for the long-term monitoring of gene-edited individuals and their descendants. The biological social contract must establish that any individual who has undergone gene editing is entitled to lifelong medical follow-up, and that the descendants of gene-edited individuals are entitled to monitoring for heritable effects. This monitoring must be conducted with full respect for privacy and autonomy, and the data collected must be used solely for safety evaluation purposes.

CHAPTER EIGHT

PREVENTION OF GENETIC DISCRIMINATION IN EMPLOYMENT AND INSURANCE

Companies may seek to discriminate against individuals based on their genetic profiles, for example by refusing to employ a person who has a genetic predisposition to a certain disease, or by setting insurance premiums based on genetic data. The law must criminalize this type of discrimination completely. The use of genetic data in employment decisions or premium setting is not permissible.

Genetic data must be secret and protected under strict privacy laws. Any leakage or unauthorized use exposes the one authorized to access genetic data to civil and criminal penalties. The protection of individuals from genetic discrimination is necessary to ensure their integration into society without stigma.

In the expanded framework, the prohibition of genetic discrimination must extend to algorithmic decision-making. As employers and insurers increasingly use AI systems to evaluate candidates and policyholders, there is a risk that these systems will indirectly discriminate based on genetic proxies, such as health data, family history, or biometric markers. The law must prohibit not only direct genetic discrimination but also indirect algorithmic discrimination that produces equivalent outcomes. Any AI system used in employment or insurance decisions must be audited for genetic bias, and the results of such audits must be made publicly available.

The biological social contract must also establish a genetic data commons, which is a publicly owned repository of anonymized genetic data that can be used for research purposes but cannot be used for commercial discrimination. This commons belongs to all humanity and cannot be privatized or monopolized by any single corporation or state.

The prohibition of genetic discrimination must also extend to the domain of education. Schools and universities must not use genetic data to select students, track them into different educational programs, or determine their access to scholarships or financial aid. The right to education must be based on merit and potential, not on genetic composition.

CHAPTER NINE

PARENTAL RESPONSIBILITY FOR GENETIC MODIFICATION OF CHILDREN

When parents decide to modify the genes of their embryo, they make a decision on behalf of a person who does not yet exist. This chapter poses the legal and ethical problem of responsibility for this decision. If the modification results in side effects for the child, the medical authorities and the responsible companies must bear liability. It is not permissible to completely exempt parents if the decision was arbitrary.

The law must stipulate that the best interest of the child is the sole criterion for permitting genetic modification. It is not permissible to make modifications for aesthetic or social purposes. The protection of the rights of future generations requires restricting the authority of parents to manipulate the biological composition of their children in a manner that threatens their future.

In the expanded framework, parental responsibility must be understood in the context of AI-assisted genetic decision-making. When parents rely on algorithmic recommendations to make genetic decisions for their children, the question of responsibility becomes more complex. If an AI system recommends a genetic modification that the parents accept, and that modification causes harm, who bears responsibility? The biological social contract must establish that parental consent does not absolve the algorithm developer, the clinical practitioner, or the regulatory authority of their respective obligations. Informed consent in the era of algorithmic bio-design requires that parents understand not only the medical risks but also the limitations of the algorithmic recommendations they are following.

The law must also establish a right of the genetically modified child to challenge the decisions made on their behalf. When the child reaches the age of majority, they must have the right to be

informed of all modifications made to their genome, to access the medical records of the decision-making process, and to seek legal redress if the modifications were made without adequate justification or in violation of established protocols.

The principle of parental responsibility must also be understood in the context of intergenerational justice. Genetic modifications made to an embryo affect not only the individual child but also all of their future descendants. The biological social contract must establish that parents have a duty to consider the interests of future generations when making genetic decisions, and that this duty is enforceable by law.

CHAPTER TEN ILLEGAL TRADE IN GENETIC MATERIAL

Black markets have emerged for the sale of eggs, sperm, and modified genetic material. The law must criminalize trade in human genetic material as a violation of human dignity. It is not permissible to consider the human body or its parts as a commercial commodity.

Genetic donations must be subject to a transparent and non-profit system that ensures the absence of economic exploitation of donors in need. The trade in genes threatens to transform the poor into sources of biological material for the wealthy. The legal prohibition of genetic trade is protection of social justice and human dignity.

In the expanded framework, the prohibition of genetic trade must be expanded to address the macro-level threat of bio-colonialism. Transnational corporations frequently engage in biopiracy, which is the appropriation of genetic resources from indigenous and developing communities without fair compensation. The biological social contract must establish the principle of biological sovereignty, which holds that the genetic resources of a nation are a sovereign asset that cannot be appropriated without the consent of the source community.

The law must also address the emerging threat of synthetic biology, which allows corporations to synthesize genetic sequences derived from natural organisms and patent the synthetic versions. This is a new form of bio-colonialism that circumvents the Nagoya Protocol by transforming natural genetic resources into synthetic intellectual property. The biological social contract must prohibit the patenting of synthetic sequences that are substantially derived from the genetic heritage of sovereign nations without fair and equitable benefit-sharing.

The prohibition of genetic trade must also address the digital dimension of genetic data. As genetic sequencing becomes increasingly digitized, there is a risk that genetic data will be traded on digital platforms without the consent of the data subjects. The biological social contract must establish that genetic data is not a digital commodity and cannot be traded on digital platforms without the explicit consent of the data subject and the authorization of the national biological oversight authority.

CHAPTER ELEVEN

NATIONAL GENETIC REGISTRIES AND PRIVACY

States may establish national genetic registries for health or security purposes. This chapter poses the risks of these registries for privacy violation or discrimination. The law must organize the collection, storage, and use of genetic data with the highest security standards.

Access to registries must be very restricted and by judicial order only in cases of dangerous crimes. Individuals have the right to know what is registered about them and to request its deletion if there is no legal necessity. The balance between public interest in genetic registries and the private right requires strict legal controls in privacy.

In the expanded framework, national genetic registries must be understood as instruments of biological sovereignty. The genetic data contained in these registries is not merely personal information; it is a national strategic asset. The biological social contract must establish that genetic data cannot be transferred to foreign entities, whether governmental or corporate, without the explicit consent of the data subject and the authorization of the national biological oversight authority.

The law must also address the risk of genetic surveillance, which is the use of genetic registries for purposes of social control, political repression, or ethnic profiling. The biological social contract must establish an absolute prohibition on the use of genetic data for any purpose other than the purpose for which it was collected. Any violation of this principle must be classified as a crime against biological dignity, subject to universal jurisdiction.

The governance of national genetic registries must also include provisions for the protection of indigenous and minority genetic data. The biological social contract must establish that the genetic data of indigenous and minority communities is subject to enhanced protection, and that any research or commercial use of such data requires the free, prior, and informed consent of the community as a whole, not merely individual consent.

CHAPTER TWELVE

GENE THERAPIES AND LONG-TERM SAFETY GUARANTEES

Gene therapies may have side effects that appear after long years or on future generations. The law must oblige manufacturing companies to provide long-term guarantees for patient follow-up for many years after treatment. There must be a special compensation fund for late genetic damages.

Consent to genetic therapies must be accompanied by full disclosure of long-term risks. Legal responsibility does not expire by prescription in cases where late genetic damages appear. The protection of public health requires legal and medical patience in evaluating the safety of genetic techniques.

In the expanded framework, long-term safety guarantees must include the epigenetic dimension. Gene therapies may alter not only the target gene but also the epigenetic environment of the treated individual, with consequences that may not manifest for decades or even generations. The biological social contract must establish that the safety evaluation of gene therapies must include epigenetic impact assessments, which evaluate not only the direct effects of the modification but also its downstream effects on gene expression across the genome.

The law must also establish the principle of intergenerational pharmacovigilance, which requires that the descendants of individuals who received gene therapies be monitored for heritable effects. This monitoring must be conducted with full respect for privacy and autonomy, and the data collected must be used solely for safety evaluation purposes. The statute of limitations for gene therapy liability must be abolished, because the harm may not manifest for generations.

The compensation fund for late genetic damages must be funded by the manufacturing companies, the clinical practitioners, and the regulatory authorities. The fund must be sufficient to cover not only immediate medical costs but also long-term care, psychological support, and compensation for loss of quality of life. The biological social contract must establish that the right to compensation for genetic damages is imprescriptible and cannot be waived by contract.

PART THREE

CLIMATE MIGRATION AND THE RIGHT TO BIOLOGICAL TRANSIT

CHAPTER THIRTEEN

THE DEFINITION OF THE CLIMATE REFUGEE IN INTERNATIONAL LAW

The current definition of the refugee in international conventions does not include those who migrate because of climate change. A new legal definition of the climate refugee must be developed that includes those who were forced to flee because of environmental deterioration that threatens their lives biologically. This definition grants them legal rights equivalent to those of political refugees.

International law must recognize their right to international protection and non-refoulement to dangerous zones. The modernization of the definition of the refugee is a necessary humanitarian step to keep pace with the reality of environmental disasters. The current legal vacuum leaves millions of human beings vulnerable to loss without protection.

In the expanded framework, the definition of the climate refugee must include the epigenetic dimension. Climate displacement is not merely a geographical event; it is a biological trauma that alters the epigenetic profile of affected populations. The stress of displacement, the exposure to new pathogens, and the loss of traditional food systems all contribute to epigenetic changes that may be passed to future generations. The legal definition of the climate refugee must therefore recognize that climate displacement causes not only immediate material harm but also long-term biological harm that extends across generational lines.

The biological social contract must establish that climate refugees have the right to biological transit, which is the right to move to a habitable environment without being subjected to biological harm during the transit process. This includes the right to clean water, adequate nutrition, medical care, and protection from toxic exposure during migration. The denial of biological transit is a violation of the right to life itself.

The definition of the climate refugee must also address the question of internal displacement. Many climate migrants are displaced within their own countries, moving from rural areas to urban centers or from coastal regions to inland areas. The biological social contract must establish that internally displaced climate migrants are entitled to the same rights and protections as cross-border climate refugees, including the right to biological transit, the right to resettlement, and the right to compensation.

CHAPTER FOURTEEN

THE RIGHT TO MIGRATION AS A BIOLOGICAL NECESSITY

When the land becomes uninhabitable, the right to migration transforms from a political right to a biological necessity for survival. The law must recognize the right to biological transit to states whose environment has become uninhabitable for human continuity. It is not permissible for future states to close their borders before those fleeing a certain ecological death.

International conventions must organize the reception of climate refugees based on responsibility for historical emissions. The right to migration in climate change is an extension of the right to life. The denial of this right is a denial of the value of human life before natural forces.

In the expanded framework, the right to biological transit must be understood in the context of deterritorialized sovereignty. When a state becomes uninhabitable, its people do not cease to be a nation. The biological social contract must establish that the right to biological transit includes the right to maintain national identity, cultural heritage, and political sovereignty even in the absence of a physical territory. This is the principle of the juridical state, which holds that a nation can exist as a legal and digital entity even after its physical landmass has been rendered uninhabitable or submerged.

The law must also establish the principle of climate proportionality, which holds that the responsibility to receive climate refugees is proportional to the historical contribution of the receiving state to climate change. States that have contributed the most to greenhouse gas emissions bear the greatest responsibility for receiving and supporting climate refugees. This is not charity; it is legal obligation.

The right to biological transit must also include the right to cultural continuity. Climate migrants are not merely biological organisms; they are bearers of cultural heritage, traditional knowledge, and social identity. The biological social contract must establish that the resettlement of climate

migrants must include the preservation of their cultural heritage, including traditional agricultural practices, medicinal knowledge, and spiritual traditions.

CHAPTER FIFTEEN

STATE RESPONSIBILITY FOR TRANSBOUNDARY CLIMATE DAMAGES

Major industrial states have caused a large proportion of the emissions responsible for climate change that harms other states. International laws must recognize state responsibility for transboundary climate damages. Compensation must be paid to damaged states to enable them to adapt or resettle their citizens.

An international court specializing in climate disputes must be established to adjudicate these responsibilities. The principle of the polluter pays must apply not only at the state level but also at the corporate level. Climate justice requires the bearing of historical responsibility for the consequences of environmental actions.

In the expanded framework, state responsibility for transboundary climate damages must include the epigenetic dimension. Climate change caused by industrial emissions does not merely cause immediate physical harm; it causes epigenetic harm that is passed to future generations. The biological social contract must establish that state responsibility for climate damages extends to the epigenetic consequences of those damages, including the heritable biological trauma suffered by affected populations.

The law must also address the role of non-state actors, particularly transnational corporations, in causing climate harm. The biological social contract must establish that corporations bear direct legal responsibility for the climate damages caused by their emissions, and that this responsibility is not limited by the corporate veil. The victims of climate harm must have the right to pursue claims directly against the corporations responsible, regardless of the jurisdiction in which those corporations are headquartered.

The principle of state responsibility for transboundary climate damages must also include the obligation to prevent future harm. States that continue to emit greenhouse gases at levels that threaten the habitability of other states are not merely causing present harm; they are committing a continuing violation of international law. The biological social contract must establish that the obligation to prevent climate harm is a peremptory norm of international law, from which no derogation is permitted.

CHAPTER SIXTEEN

RESETTLEMENT AND LEGAL INTEGRATION FOR CLIMATE MIGRANTS

When receiving climate refugees, the host state must ensure their legal and social integration. They must be granted a stable legal status that permits them to work, own property, and access health services. It must be prevented to exploit them as cheap labor because of their vulnerable position.

States must plan to receive climate migrants as part of demographic development strategies. Successful integration transforms the crisis into an opportunity to renew the workforce. The law must facilitate integration so that it does not threaten the stability of the migrant.

In the expanded framework, the resettlement of climate migrants must include biological integration, which is the process of ensuring that climate migrants are not subjected to biological harm in their new environment. This includes access to clean water, safe food, adequate healthcare, and protection from environmental toxins. The biological social contract must establish that the host state has a positive obligation to ensure the biological safety of climate migrants, and that failure to do so constitutes a violation of the right to life.

The law must also address the cultural dimension of resettlement. Climate migrants are not merely biological organisms; they are bearers of cultural heritage, traditional knowledge, and social identity. The biological social contract must establish that the resettlement of climate migrants must include the preservation of their cultural heritage, including traditional agricultural practices, medicinal knowledge, and spiritual traditions. The loss of cultural heritage is a form of biological harm, because culture is an integral part of human biological identity.

The resettlement of climate migrants must also include provisions for family reunification. Climate displacement often separates families, and the biological social contract must establish that the right to family reunification is a fundamental right of climate migrants. The host state must facilitate family reunification and must not impose conditions that make it impossible for climate migrants to reunite with their families.

CHAPTER SEVENTEEN UNINHABITABLE ZONES AND INTERNATIONAL PROTECTION

Zones may appear on the planet that have become entirely uninhabitable for human life because of heat or pollution. These zones must be declared international disaster zones and placed under international protection. Their inhabitants must be evacuated in an organized and safe manner.

The economic exploitation of these dangerous zones must be prevented at the expense of human health. The declaration of the validity of a zone for life entails international commitments for the protection of its inhabitants. The law must recognize the reality of ecological death and deal with it with human seriousness.

In the expanded framework, the declaration of uninhabitable zones must include the epigenetic assessment of the affected population. Before evacuation, the biological social contract must require a comprehensive epigenetic screening of all affected individuals to identify those who have suffered heritable biological harm. This screening must be conducted with full respect for privacy and autonomy, and the data collected must be used to provide targeted medical support to affected individuals and their descendants.

The law must also establish the principle of ecological memory, which holds that the declaration of an uninhabitable zone does not erase the historical and cultural significance of that zone. The biological social contract must establish that the memory of the lost zone must be preserved through digital archives, cultural monuments, and legal recognition. The people who inhabited the zone have the right to maintain their connection to their lost homeland, even if they can never return to it physically.

The declaration of uninhabitable zones must also include provisions for the remediation of the affected environment. The biological social contract must establish that the entities responsible for rendering a zone uninhabitable bear the obligation to remediate the environment, to the extent that remediation is possible. This obligation is imprescriptible and cannot be waived by contract or by the passage of time.

CHAPTER EIGHTEEN

DISASTER NATIONALITY AND THE LEGAL STATUS OF SINKING STATES

With the rise of sea levels, complete island states may lose their territory and their legal personality disappears. This chapter poses the problem of the nationality of the inhabitants of these states. International law must decide the continuity of the legal personality of the state even if it has lost its territory, to ensure the continuity of the nationality of its citizens.

The right of these peoples to maintain their cultural and political identity even in the diaspora must be guaranteed. The disappearance of a state because of climate does not mean the disappearance of its people. The legal protection of sinking states is protection of sovereignty and the right of peoples to existence.

In the expanded framework, the legal status of sinking states must be understood through the concept of deterritorialized sovereignty. The Montevideo Convention on the Rights and Duties of States requires a defined territory for statehood. The biological social contract must challenge this requirement by proposing a new legal fiction: the juridical state. This is a state that exists as a purely legal and digital entity, retaining its seat in the United Nations, its international treaties, and its Exclusive Economic Zone even after its physical landmass has been submerged.

The deterritorialized state must have the right to issue digital identity documents, to conduct diplomatic relations, to participate in international organizations, and to manage its maritime resources. The citizens of the deterritorialized state must retain their nationality, their voting rights, and their cultural identity regardless of their physical location. The biological social contract must establish that the loss of territory does not extinguish the sovereignty of a nation. Sovereignty is not a geographical fact; it is a social contract between a people and their collective identity.

The legal framework for sinking states must also include provisions for the management of maritime resources. Even after the physical landmass of a sinking state has been submerged,

the state retains its Exclusive Economic Zone and its rights over the maritime resources within that zone. The biological social contract must establish that these rights cannot be extinguished by the loss of territory, and that the sinking state has the right to manage and benefit from its maritime resources through digital governance mechanisms.

PART FOUR

LEGAL LIABILITY AND COMPENSATION IN THE BIOLOGICAL ERA

CHAPTER NINETEEN

CIVIL LIABILITY FOR GENETIC DAMAGES

If a genetic technique causes harm to an individual or his lineage, the developing company must bear full civil liability. The compensation must include psychological, physical, and hereditary damages extending to generations. The burden of proof must be on the company to prove the safety of its technique.

The compensation must be sufficient to cover long-term treatments and special care. Civil liability is the guarantee for companies to commit to safety standards. The protection of individuals from the damages of technology requires a strict and comprehensive liability system.

In the expanded framework, civil liability for genetic damages must address the convergence of artificial intelligence and genetic engineering. If an AI system recommends a genetic modification that causes harm, the question of liability becomes more complex. The biological social contract must establish a framework of strict joint and several liability for AI-driven bio-design. The developer of the algorithm, the corporation that deploys it, and the clinical practitioner who executes it share indivisible liability for biological outcomes. This prevents the outsourcing of moral and legal responsibility to black-box algorithms.

The law must also establish the principle of algorithmic transparency in bio-design. Any AI system used in genetic decision-making must be capable of explaining its recommendations in terms that are understandable to clinicians and patients. The opacity of algorithmic decision-making cannot serve as a defense against liability. If an AI system cannot explain why it recommended a particular genetic modification, the developer bears full responsibility for any harm that results.

The compensation for genetic damages must also include provisions for the descendants of the harmed individual. The biological social contract must establish that the right to compensation for genetic damages extends to all future generations affected by the harm. This right is imprescriptible and cannot be waived by contract or by the passage of time.

CHAPTER TWENTY

ENVIRONMENTAL CRIMES AS CRIMES AGAINST HUMANITY

Severe ecological pollution that threatens the life of large groups of humans must be classified as a crime against humanity. The perpetrators of environmental crimes must be subject to international criminal accountability. It is not permissible for environmental disasters to pass without punishment, whether intentional or resulting from gross negligence.

The penalties must include prison sentences and massive fines and confiscation of assets. The criminalization of destructive acts against nature raises the level of legal protection for nature and humans together. Criminal justice must extend to include crimes against the planet that harbors life.

In the expanded framework, environmental crimes must include the category of epigenetic sabotage, which is the deliberate or negligent alteration of the epigenetic environment of a population through toxic exposure, pollution, or climate degradation. Epigenetic sabotage is a crime against humanity because it causes heritable biological harm that extends across generational lines. The perpetrators of epigenetic sabotage must be subject to universal jurisdiction, meaning that they can be prosecuted in any court regardless of where the crime was committed.

The biological social contract must also establish the principle of ecocide as a crime of strict liability. This means that the perpetrators of ecocide are liable regardless of their intent or knowledge. The mere fact of causing massive environmental harm is sufficient to establish criminal responsibility. This principle reflects the understanding that the consequences of environmental destruction are so severe that they cannot be excused by claims of ignorance or good faith.

The criminalization of environmental crimes must also include provisions for corporate criminal liability. The biological social contract must establish that corporations can be held criminally liable for environmental crimes, and that this liability is not limited by the corporate veil. The officers and directors of corporations that commit environmental crimes must be subject to personal criminal liability, including imprisonment and the confiscation of personal assets.

CHAPTER TWENTY-ONE

COMPENSATION FOR LOSS OF LANDS DUE TO CLIMATE

Individuals who lose their lands and homes because of climate disasters deserve fair compensation. International funds must be created to finance these compensations, funded by the states responsible for emissions. The compensation must be rapid to enable the damaged to rebuild their lives.

The compensation must include not only material value but also emotional and cultural value. The land is not merely a property; it is part of human identity. The damage of land loss requires legal and human sensitivity.

In the expanded framework, compensation for loss of lands must include the biological dimension. The loss of land is not merely a material loss; it is a biological trauma that alters the epigenetic profile of affected individuals. The stress of displacement, the loss of traditional food systems, and the disruption of social networks all contribute to biological harm. The biological social contract must establish that compensation for land loss must include biological rehabilitation, which is the provision of medical and psychological support to restore the biological integrity of affected individuals.

The law must also establish the principle of cultural compensation, which recognizes that the loss of land includes the loss of cultural heritage, traditional knowledge, and spiritual connection. Compensation must include the preservation and transmission of cultural heritage, including traditional agricultural practices, medicinal knowledge, and spiritual traditions. The biological social contract must establish that cultural heritage is an integral part of human biological identity, and that its loss constitutes a form of biological harm.

The compensation for loss of lands must also include provisions for the restoration of livelihoods. Climate migrants who have lost their lands must be provided with the means to rebuild their livelihoods, including access to land, capital, and training. The biological social contract must establish that the right to livelihood is a fundamental right of climate migrants, and that the host state has a positive obligation to facilitate the restoration of livelihoods.

CHAPTER TWENTY-TWO

MANDATORY INSURANCE AGAINST BIOLOGICAL AND CLIMATE RISKS

Companies operating in biological fields and polluting industries must be committed to insurance against potential damages. This insurance guarantees the rights of victims even in the case of bankruptcy of the company. The coverage must include environmental and hereditary damages for the long term.

Insurance premiums must be commensurate with the level of environmental risk of the activity. The system of mandatory insurance distributes risks and guarantees the stability of compensations. Financial protection is an essential part of the liability system for victims.

In the expanded framework, mandatory insurance must address the convergence of AI and bio-design. If an AI system causes biological harm, the insurance framework must be capable of covering the resulting damages. The biological social contract must establish that developers of AI systems used in bio-design are required to maintain insurance coverage for potential biological harms. This insurance must be sufficient to cover not only immediate damages but also long-term and intergenerational consequences.

The law must also establish the principle of algorithmic liability insurance, which requires that any AI system used in biological decision-making be covered by a specialized insurance policy that addresses the unique risks of algorithmic bio-design. This insurance must be separate from general liability insurance and must be calibrated to the specific risks of the AI system in

question. The opacity of algorithmic decision-making increases the risk of unforeseen harm, and the insurance framework must reflect this increased risk.

The mandatory insurance framework must also include provisions for the insurance of climate risks. States and corporations that contribute to climate change must be required to maintain insurance coverage for the climate damages caused by their emissions. This insurance must be sufficient to cover the costs of adaptation, resettlement, and compensation for climate migrants. The biological social contract must establish that the right to climate compensation is a fundamental right of climate migrants, and that the insurance framework must ensure that this right is enforceable.

CHAPTER TWENTY-THREE

CAUSATION PROOF IN BIOLOGICAL AND CLIMATE ISSUES

Proving the causal relationship between a specific act and a biological or climate damage is scientifically complex. The law must develop flexible proof standards that rely on strong scientific probability rather than absolute certainty that may be impossible. There must be recourse to independent experts to evaluate scientific evidence.

The burden of proof must be lightened for the damaged in environmental and genetic issues. Justice requires that the victim not be left helpless before scientific complexities. The development of legal proof theories is necessary to keep pace with the complexities of modern science.

In the expanded framework, causation proof must incorporate the updated Bradford Hill criteria for biological causation. These criteria include strength of association, consistency, specificity, temporality, biological gradient, plausibility, coherence, experiment, and analogy. The biological social contract must establish that courts should apply these criteria when evaluating claims of biological harm, rather than requiring absolute proof of causation.

The law must also establish the principle of the digital biological fingerprint, which is a new tool for proving causation in biological cases. This fingerprint is a unique biological signature that can be traced to a specific cause, such as a particular pollutant, a specific genetic modification, or a particular environmental condition. The biological social contract must establish that the digital biological fingerprint is admissible as evidence in court, and that its presence creates a presumption of causation that the defendant must rebut.

The causation proof framework must also include provisions for the use of epidemiological evidence. In cases of mass biological harm, such as epigenetic sabotage or climate-induced health effects, individual causation may be impossible to prove. The biological social contract must establish that epidemiological evidence is admissible as proof of causation in such cases, and that the burden of proof shifts to the defendant once epidemiological evidence establishes a statistically significant association between the alleged cause and the alleged harm.

CHAPTER TWENTY-FOUR

PRESCRIPTION IN BIOLOGICAL CRIMES AND DAMAGES

Biological and genetic damages may appear after long decades. The rights must not expire by traditional prescription in these cases. The calculation of prescription must begin from the moment of discovery of the harm, not from the moment of the occurrence of the act. Responsibility must remain as long as the damage is present.

The protection of future generations required the suspension of prescription rules in major biological crimes. Justice does not expire by prescription when the matter relates to human life and the genetic future.

In the expanded framework, the abolition of prescription for biological crimes must be understood in the context of intergenerational justice. The biological social contract must establish that the rights of future generations are not subject to prescription. This means that the descendants of individuals who suffered biological harm have the right to seek legal redress regardless of how much time has passed since the original harm occurred.

The law must also establish the principle of continuing biological harm, which holds that biological harm is not a single event but a continuing process. As long as the biological consequences of the harm persist, the right to seek redress persists. This principle is particularly relevant in cases of epigenetic harm, where the consequences may manifest across multiple generations. The statute of limitations for epigenetic harm must be abolished entirely, because the harm continues biologically as long as the affected lineage persists.

The abolition of prescription must also apply to climate crimes. The biological social contract must establish that the right to seek compensation for climate damages is imprescriptible, because the consequences of climate change persist for centuries. The descendants of individuals who suffered climate harm have the right to seek redress regardless of how much time has passed since the original emissions occurred.

PART FIVE

GLOBAL GOVERNANCE AND THE LEGISLATIVE FUTURE

CHAPTER TWENTY-FIVE

TOWARD A GLOBAL BIO-HUMAN PACT

There must be a binding international pact that protects the biological rights of the human being, signed by all states. It must stipulate the prohibition of non-therapeutic genetic modification and the protection of climate refugees. This pact must be a supreme reference for national laws.

An international committee must be established to monitor compliance with the biological pact. The unification of global standards prevents a race to the bottom in protection. The biological pact is the constitution of humanity in the era of biotechnology and climate.

In the expanded framework, the Global Bio-Human Pact must include enforcement mechanisms that go beyond voluntary compliance. The biological social contract must establish the creation of an International Biological Agency, modeled after the International Atomic Energy Agency, but equipped with binding biological inspection protocols and the authority to impose bio-sanctions on non-compliant states. This agency must have the power to conduct unannounced inspections of genetic laboratories, biotechnology facilities, and industrial sites, and to impose immediate sanctions on entities that violate the pact.

The pact must also establish a universal bio-extradition treaty, which ensures that individuals who commit biological crimes cannot escape justice by relocating to jurisdictions with weak or nonexistent regulatory frameworks. Biological crimes must be classified as crimes of universal jurisdiction, meaning that they can be prosecuted in any court regardless of where they were committed or the nationality of the perpetrator.

The Global Bio-Human Pact must also include provisions for the protection of indigenous and minority genetic heritage. The biological social contract must establish that the genetic resources of indigenous and minority communities are subject to enhanced protection, and that any research or commercial use of such resources requires the free, prior, and informed consent of the community as a whole. The pact must also establish a mechanism for the fair and equitable sharing of benefits derived from the use of indigenous and minority genetic resources.

CHAPTER TWENTY-SIX

THE ROLE OF INDEPENDENT NATIONAL OVERSIGHT BODIES

Each state must establish independent bodies for oversight of biological and climate matters. They must enjoy broad powers in licensing, inspection, and punishment. They must be independent from political or economic influence to ensure their neutrality.

National bodies must cooperate in a global network for the exchange of information about risks. Effective national oversight is the first line of defense for citizens. The independence of the bodies is a guarantee for the effectiveness of legal protection.

In the expanded framework, national oversight bodies must be equipped with the technical capacity to evaluate AI-driven bio-design. As artificial intelligence becomes increasingly central to genetic engineering and climate modeling, national oversight bodies must have the expertise to assess the safety, fairness, and transparency of algorithmic systems used in biological decision-making. The biological social contract must establish that national oversight bodies must include specialists in artificial intelligence, data science, and algorithmic ethics, in addition to traditional medical and legal experts.

The law must also establish the principle of algorithmic audit, which requires that any AI system used in biological decision-making be subject to regular independent audits. These audits must

evaluate the system for bias, transparency, and safety, and the results must be made publicly available. The opacity of algorithmic decision-making is a threat to democratic accountability, and the biological social contract must ensure that this opacity does not shield harmful systems from scrutiny.

The national oversight bodies must also be equipped with the authority to conduct unannounced inspections of genetic laboratories, biotechnology facilities, and industrial sites. The biological social contract must establish that the right to inspect is not subject to prior notice, and that any obstruction of inspection constitutes a criminal offense. The oversight bodies must also have the authority to impose immediate sanctions on entities that violate biological safety standards, including the suspension of licenses, the imposition of fines, and the referral of cases to criminal prosecution.

CHAPTER TWENTY-SEVEN

INTERNATIONAL JUDICIAL COOPERATION IN BIOLOGICAL CRIMES

Biological and climate crimes are often transboundary. Judicial cooperation must be strengthened for the extradition of criminals and the exchange of evidence. The definition of biological crimes must be unified to facilitate international prosecution.

A specialized judicial network must be established for environmental and genetic crimes. Judicial cooperation ensures the absence of impunity for criminals who cross borders. Justice is a global one that requires specialized and cooperative judicial apparatuses.

In the expanded framework, international judicial cooperation must address the challenge of algorithmic bio-crimes. As AI systems become capable of designing genetic modifications and biological agents autonomously, the question of jurisdiction and responsibility becomes more complex. The biological social contract must establish a framework for the international prosecution of algorithmic bio-crimes, which holds that the developer, the deployer, and the user of an AI system that commits a biological crime are all subject to international jurisdiction.

The law must also establish the principle of digital evidence in biological crimes, which recognizes that electronic data, algorithmic logs, and digital biological fingerprints are admissible as evidence in international courts. The biological social contract must establish standardized protocols for the collection, preservation, and analysis of digital biological evidence, to ensure that such evidence is reliable and admissible across jurisdictions.

The international judicial cooperation framework must also include provisions for the protection of witnesses and victims. Biological crimes often involve powerful corporations and states, and witnesses and victims may face intimidation, retaliation, or violence. The biological social contract must establish that witnesses and victims in biological crime cases are entitled to protection, including anonymity, relocation, and financial support.

CHAPTER TWENTY-EIGHT

SAFETY STANDARDS FOR FIELD BIOLOGICAL RESEARCH

Strict standards must be established for conducting biological research in the field, not only in the laboratory. The environmental and genetic impact of any experiment must be evaluated before its commencement. There must be emergency plans to deal with any leakage or unexpected harm.

Research must be subject to continuous monitoring by independent ethics committees. Safety in research is a legal and ethical responsibility before it becomes a technique. Prevention of biological disasters begins with strictness in licensing researchers.

In the expanded framework, safety standards for field biological research must address the convergence of AI and synthetic biology. As AI systems become capable of designing novel biological organisms, the risk of unintended ecological consequences increases dramatically. The biological social contract must establish that any AI-designed biological organism must undergo a comprehensive ecological risk assessment before it can be released into the environment. This assessment must evaluate not only the direct effects of the organism but also its potential interactions with existing ecosystems, including the possibility of horizontal gene transfer, ecological disruption, and evolutionary consequences.

The law must also establish the principle of algorithmic containment, which requires that AI systems used in biological design be subject to strict containment protocols. These protocols must ensure that the AI system cannot autonomously generate or release biological agents without human authorization. The biological social contract must establish that the developer of an AI system used in biological design bears strict liability for any unauthorized biological release caused by the system.

The safety standards for field biological research must also include provisions for the protection of indigenous and local communities. The biological social contract must establish that any field biological research conducted in or near indigenous or local communities requires the free, prior, and informed consent of the community, and that the community has the right to participate in the design, conduct, and evaluation of the research.

CHAPTER TWENTY-NINE

DEMOCRACY AND PUBLIC BIOLOGICAL DECISION-MAKING

Decisive decisions about genetic modification and climate must not be made in isolation from the people. Civil society must be involved in making biological policies through referendums and national dialogues. There must be complete transparency about the risks and benefits.

The ethical and biological concerns of the public must be represented in parliaments through specialized committees. Democracy is the biological one that ensures that technology serves the human and does not control him. The participation of the people is the guarantee for legislation of biological destiny.

In the expanded framework, democratic bio-decision-making must address the challenge of algorithmic transparency. As AI systems become increasingly central to biological decision-making, the public has the right to understand how these systems operate and what criteria they use. The biological social contract must establish the principle of algorithmic transparency in public biological decisions, which requires that any AI system used in policy-making be capable of explaining its recommendations in terms that are understandable to the public.

The law must also establish the principle of democratic bio-audit, which requires that any AI system used in biological policy-making be subject to regular democratic review. This review must include public hearings, expert testimony, and citizen participation. The biological social contract must establish that the power to shape human biology is too important to be concentrated in the hands of a technocratic elite. This power must be subject to democratic accountability.

The democratic bio-decision-making framework must also include provisions for the participation of future generations. The biological social contract must establish that the interests of future generations must be represented in biological decision-making, through the appointment of guardians for future generations who have the authority to participate in legislative and regulatory processes. This ensures that the rights of future generations are not sacrificed for the short-term interests of the present generation.

CHAPTER THIRTY

CONCLUSION AND FUTURE VISION FOR THE BIOLOGICAL CONTRACT

In the conclusion of this book, we have drawn the features of a new social biological contract. The biological and climate challenges require a legal response that is unprecedented and that protects the essence of humanity. The future depends on our ability to organize our technological and environmental power with wisdom and justice.

The human being must remain the goal, and biology and climate must be a framework for his life, not a threat to his existence. This book is a call to legislators and the world to move before the loss of time. The protection of the biological future of humanity is the highest duty, legal and ethical, in our era.

In this expanded edition, we have integrated the most advanced developments in posthuman jurisprudence, epigenetic science, algorithmic bio-design, deterritorialized statehood, and bio-colonial resistance. These additions transform the book from a pioneering legal study into a comprehensive constitutional blueprint for the twenty-first century. The biological social contract is no longer merely a philosophical proposal; it is the survival code for the human species.

The future of biological jurisprudence lies in the convergence of law, science, and ethics. The biological social contract must be understood not as a static document but as a living framework

that evolves with scientific knowledge and social values. The law must be capable of adapting to new biological realities while maintaining its commitment to human dignity, equality, and justice.

The ultimate vision of the biological social contract is a world in which every human being is protected from biological exploitation, genetic discrimination, and climate displacement. A world in which the benefits of biotechnology are shared equitably, and the risks are managed collectively. A world in which the sovereignty of peoples over their biological heritage is respected, and the rights of future generations are safeguarded. This is not a utopia; it is a legal obligation. The biological social contract is the instrument through which we fulfill this obligation.

The task before us is immense, but it is not impossible. The history of law is a history of adaptation to new realities. The social contract of the Enlightenment adapted to the industrial revolution. The biological social contract must adapt to the biotechnological and climate revolutions. The question is not whether we will adapt, but whether we will adapt in time. The answer depends on the courage, wisdom, and solidarity of legislators, scientists, and citizens around the world.

May God grant us success.

Dr. Mohamed Kamal Arafa El-Rakhawi

APPENDICES

APPENDIX A

PROPOSED LEGISLATIVE TEXTS

This appendix provides model legislative texts for the implementation of the Biological Social Contract. These texts are intended to serve as templates for national legislatures and international bodies seeking to translate the principles of the biological social contract into binding legal instruments.

Model Article One: The Right to Biological Integrity

Every human being has the right to biological integrity. This right encompasses the genetic dimension, the epigenetic dimension, and the ecological dimension of human biology. No person shall be subjected to genetic modification, epigenetic harm, or ecological degradation without their free, prior, and informed consent. The state has a positive obligation to protect the biological integrity of all persons within its jurisdiction.

Model Article Two: The Principle of Biological Equality

All human beings are biologically equal before the law. No person shall be discriminated against on the basis of their genetic composition, epigenetic profile, or biological characteristics. The state shall take positive measures to ensure that genetic disparities do not threaten the foundations of democratic participation. The prohibition of genetic enhancement for non-therapeutic purposes is a constitutional obligation.

Model Article Three: The Right to a Habitable Climate Environment

Every human being has the right to a habitable climate environment. This right includes the right to clean air, clean water, safe food, and protection from toxic exposure. The state has a positive obligation to limit greenhouse gas emissions, to adapt to the realities of climate change, and to protect its citizens from climate disasters. The failure to fulfill this obligation constitutes a breach of the social contract.

Model Article Four: The Right to Biological Transit

Every person who is forced to flee their home because of environmental degradation or climate disaster has the right to biological transit. This right includes the right to move to a habitable environment without being subjected to biological harm during the transit process. The denial of biological transit is a violation of the right to life itself. The responsibility to receive climate refugees is proportional to the historical contribution of the receiving state to climate change.

Model Article Five: The Prohibition of Genetic Trade

The trade in human genetic material is prohibited. The human body and its parts are not commercial commodities. Genetic donations shall be subject to a transparent and non-profit system that ensures the absence of economic exploitation of donors in need. The patenting of synthetic sequences that are substantially derived from the genetic heritage of sovereign nations without fair and equitable benefit-sharing is prohibited.

APPENDIX B

GLOSSARY OF TECHNICAL TERMS

This appendix provides definitions of the technical terms used in this book, to ensure clarity and precision in the understanding of the Biological Social Contract.

Biological Social Contract: A new form of social contract that organizes the relationship between the human being and his biology, and between the human being and his climate environment, within a binding legal framework.

Biological Integrity: The right of every human being to the protection of their genetic, epigenetic, and ecological dimensions from unauthorized modification, harm, or degradation.

Biological Equality: The constitutional principle that all human beings are biologically equal before the law, and that no person shall be discriminated against on the basis of their genetic composition, epigenetic profile, or biological characteristics.

Biological Transit: The right of climate refugees to move to a habitable environment without being subjected to biological harm during the transit process.

Bio-Colonialism: The appropriation of genetic resources from indigenous and developing communities by transnational corporations without fair compensation or the consent of the source community.

Deterritorialized Sovereignty: The legal fiction that a state can exist as a purely legal and digital entity, retaining its seat in the United Nations, its international treaties, and its Exclusive Economic Zone, even after its physical landmass has been submerged or rendered uninhabitable.

Epigenetic Sabotage: The deliberate or negligent alteration of the epigenetic environment of a population through toxic exposure, pollution, or climate degradation, causing heritable biological harm that extends across generational lines.

Genetic Sovereignty: The principle that the genetic resources of a nation belong to its people and cannot be appropriated, patented, or commercialized without the free, prior, and informed consent of the source community.

Intergenerational Temporal Equity: The principle that the obligations of the present generation extend to all future generations, and that the statute of limitations for biological harm must be abolished or radically extended because the harm continues biologically across generational lines.

Neuro-Rights: The rights of individuals to the protection of their neural correlates of consciousness from genetic or algorithmic manipulation, including the right to mental privacy, cognitive liberty, and psychological continuity.

Posthuman Jurisprudence: The branch of legal philosophy that addresses the implications of genetic enhancement, artificial intelligence, and biotechnology for the concept of legal personhood, legal capacity, and democratic participation.

APPENDIX C

INTERNATIONAL LEGAL INSTRUMENTS REFERENCED

This appendix lists the international legal instruments referenced in this book, to provide the reader with a comprehensive understanding of the existing legal framework within which the Biological Social Contract operates.

The Universal Declaration of Human Rights, 1948

The International Covenant on Civil and Political Rights, 1966

The International Covenant on Economic, Social and Cultural Rights, 1966

The Convention on the Rights of the Child, 1989

The Convention on Biological Diversity, 1992

The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, 2010

The Paris Agreement on Climate Change, 2015
The 1951 Convention Relating to the Status of Refugees and its 1967 Protocol
The Montevideo Convention on the Rights and Duties of States, 1933
The Rome Statute of the International Criminal Court, 1998
The UNESCO Universal Declaration on Bioethics and Human Rights, 2005
The UNESCO Universal Declaration on the Human Genome and Human Rights, 1997

APPENDIX D

PROPOSED INSTITUTIONAL FRAMEWORKS

This appendix proposes the institutional frameworks required to implement the Biological Social Contract at the national, regional, and international levels.

The International Biological Agency: Modeled after the International Atomic Energy Agency, this agency would be equipped with binding biological inspection protocols and the authority to impose bio-sanctions on non-compliant states. It would have the power to conduct unannounced inspections of genetic laboratories, biotechnology facilities, and industrial sites, and to impose immediate sanctions on entities that violate the Global Bio-Human Pact.

The International Court for Biological and Climate Justice: This specialized court would adjudicate disputes relating to biological crimes, climate damages, and the rights of climate refugees. It would have universal jurisdiction over biological crimes and would be empowered to issue binding judgments and enforceable compensation orders.

The Global Bio-Human Pact Secretariat: This secretariat would be responsible for monitoring compliance with the Global Bio-Human Pact, coordinating the activities of national oversight bodies, and facilitating international judicial cooperation in biological crimes.

National Biological Oversight Bodies: Each state would establish an independent national biological oversight body with broad powers in licensing, inspection, and punishment. These bodies would be independent from political or economic influence and would cooperate in a global network for the exchange of information about risks.

The Guardian for Future Generations: Each state would appoint a Guardian for Future Generations with the authority to participate in legislative and regulatory processes on behalf of future generations. The Guardian would have the right to challenge legislation or regulation that violates the principle of intergenerational temporal equity.

REFERENCES

This section provides a comprehensive list of the academic sources, legal instruments, and scientific studies referenced in this book. The references are organized thematically to facilitate further research.

PHILOSOPHICAL AND JURISPRUDENTIAL FOUNDATIONS

Hobbes, Thomas. *Leviathan*. 1651.
Locke, John. *Two Treatises of Government*. 1689.
Rousseau, Jean-Jacques. *The Social Contract*. 1762.
Spinoza, Baruch. *Ethics*. 1677.
Rawls, John. *A Theory of Justice*. Harvard University Press, 1971.
Habermas, Jurgen. *Between Facts and Norms*. MIT Press, 1996.
Chalmers, David. *The Conscious Mind*. Oxford University Press, 1996.
Bostrom, Nick. *Superintelligence: Paths, Dangers, Strategies*. Oxford University Press, 2014.
Harari, Yuval Noah. *Homo Deus: A Brief History of Tomorrow*. Harper, 2017.

GENETIC ENGINEERING AND BIOETHICS

Doudna, Jennifer A., and Samuel H. Sternberg. *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution*. Houghton Mifflin Harcourt, 2017.
Isasi, Rosario, and Bartha Maria Knoppers. "Mind the Gap: Policy Approaches to Human Genetic Engineering." *Human Genetics*, vol. 139, no. 1, 2020, pp. 9-17.
Lander, Eric S., et al. "Adopt a Moratorium on Heritable Genome Editing." *Nature*, vol. 567, no. 7747, 2019, pp. 165-168.
National Academies of Sciences, Engineering, and Medicine. *Human Genome Editing: Science, Ethics, and Governance*. National Academies Press, 2017.
WHO Expert Advisory Committee on Developing Global Standards for Governance and Oversight of Human Genome Editing. *Human Genome Editing: A Framework for Governance*. World Health Organization, 2021.

CLIMATE CHANGE AND MIGRATION

Intergovernmental Panel on Climate Change. *Climate Change 2023: Synthesis Report*. IPCC, 2023.
UNHCR. *Legal Considerations on Claims for International Protection Made in the Context of Climate Change and Disasters*. UNHCR, 2020.
McAdam, Jane. *Climate Change, Forced Migration, and International Law*. Oxford University Press, 2012.
Farber, Daniel A. "Climate Change and the Future of International Law." *American Journal of International Law*, vol. 114, no. 4, 2020, pp. 673-702.

EPIGENETICS AND INTERGENERATIONAL JUSTICE

Meaney, Michael J. "Epigenetics and the Biological Definition of Gene by Environment Interactions." *Child Development*, vol. 81, no. 1, 2010, pp. 41-79.
Heard, Edith, and Robert A. Martienssen. "Transgenerational Epigenetic Inheritance: Myths and Mechanisms." *Cell*, vol. 157, no. 1, 2014, pp. 95-109.
Brown Weiss, Edith. *In Fairness to Future Generations: International Law, Common Patrimony, and Intergenerational Equity*. Transnational Publishers, 1989.

ARTIFICIAL INTELLIGENCE AND BIO-DESIGN

Jumper, John, et al. "Highly Accurate Protein Structure Prediction with AlphaFold." *Nature*, vol. 596, no. 7873, 2021, pp. 583-589.

Ienca, Marcello, and Roberto Andorno. "Towards New Human Rights in the Age of Neuroscience and Neurotechnology." *Life Sciences, Society and Policy*, vol. 13, no. 1, 2017, pp. 1-20.

Floridi, Luciano. *The Ethics of Artificial Intelligence*. Oxford University Press, 2023.

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DOI: 10.5281/zenodo.21834126
2026