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Can AI finish poverty? The role of artificial intelligence in poverty alleviation

Yapay zeka yoksulluğu bitirebilir mi? Yoksulluğun azaltılmasında yapay zekanın rolü

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ÖZ

Yapay zeka, hem söylem hem de eylem olarak gündelik hayatımızın bir parçası haline gelmiştir. Teknolojik gelişmeler, küresel ekonominin iyileşmesinde önemli bir rol oynamaktadır. Yoksulluk, bu gelişmeler kapsamında, en azından çok temel ihtiyaçların karşılanması noktasında oransal olarak azalmış olsa da, dünyanın en kronik ve önemli sorunlarından biri olmaya devam etmektedir. Bu çalışmada, yoksullukla mücadelede yapay zekanın rolü ele alınmaktadır. Bu bağlamda mikrofinans, tarım, sağlık ve eğitim gibi çeşitli alanlarda yapay zekanın yoksullukla mücadelede oynadığı roller detaylı bir şekilde incelenmektedir. Yapay zekanın bu alanda önemli işlevler gördüğü ve göreceği vurgulanmakla birlikte, bu katkının veya rolün kaçınılmaz ve zorunlu olmayabileceği; siyasi faktörler ve evrenimizin biyofiziksel sınırları gibi şartların da kritik bir rol oynadığına dikkat çekilmektedir.

ABSTRACT

Artificial intelligence has become an integral part of our daily lives, both in discourse and action. Technological developments play a significant role in the recovery of the global economy. Although poverty has decreased proportionally in terms of meeting basic needs due to these advancements, it remains one of the most chronic and significant issues in the world. This study examines the role of artificial intelligence in the fight against poverty. It explores the various roles artificial intelligence plays in microfinance, agriculture, health, and education. While the study emphasizes that artificial intelligence has important functions in this area, it also notes that its contribution may not be inevitable or mandatory; factors such as political conditions and biophysical limits of our planet also play a critical role.

1. Introduction

Poverty remains a fundamental and complex challenge for countries worldwide, recognized by the United Nations as today's greatest global challenge (Bennington-Castro, 2017). In both the Millennium Development Goals (MDG) established by the UN in 2000 and the Sustainable Development Goals (SDG) introduced in 2015, combating poverty was identified as a primary objective ("end poverty in all its forms everywhere"), serving as the heart of all goals (Wang & Zhang, 2020: 2).

There has been an incredible increase in technological and scientific advancements. For example, the amount of data produced in just one day after 2013 exceeded the total data collected over the 5,000 years from the invention of writing to 2003 (Kelleher & Tierney, 2018: 9). As a result, people began living in more comfortable conditions, and their opportunities increased. Poverty rates have decreased significantly compared to previous years. Despite debates about the methods used, the percentage of individuals living below the poverty line was 36% of the world's population in 1990. However, by 2015, this figure had sharply dropped to 10%. The proportion of people living on less than USD 1.25 a day dropped from nearly half to 14%, while the number of those in extreme poverty decreased by more than half (von Braun & Baumüller, 2021: 86; Wang & Zhang, 2020: 6). With these developments, various versions of our lives and the most fundamental areas have begun to be discussed: Life 3.0, Industry 4.0, Education 4.0, Health 4.0, Society 5.0, Mobility 4.0, Agriculture 4.0, Governance 5.0, and Economy 4.0 (Schwab, 2017; Mhlanga, 2021: 2; Tegmark, 2018).

Despite these advances and the global decline in poverty, millions of people still struggle to meet their basic needs in various parts of the world. This issue is widespread, not

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only in underdeveloped regions but also in middle- and high-income countries, manifesting as homelessness, unemployment, and other challenges (Goralski and Tan, 2022: 2; von Braun and Baumüller, 2021: 86). According to the United Nations' 2023 Multidimensional Poverty Index, 485 million individuals across 110 countries face severe poverty. These facts and figures reveal the importance of combating poverty.

This study will discuss the role of artificial intelligence (AI) in poverty alleviation. Within the framework of poverty alleviation strategies, the contributions of artificial intelligence in various areas—such as microfinance, agriculture, health, education, and poverty detection and reporting—will be examined in detail. However, it will also be considered that the role of artificial intelligence may not be inevitable or mandatory, as factors like political influences and biophysical boundaries of our planet play a critical role.

In a period when artificial intelligence is becoming increasingly democratized, that is, ordinary people are also discussing and talking about it and all segments of society are familiar with it, it is becoming even more important to connect it to poverty. This study's examination of this topic is significant in this respect.

This study consists of three main parts. The first part defines poverty and examines it in the age of artificial intelligence. The second part discusses the role of artificial intelligence in reducing poverty across various areas, including education, health, finance, agriculture, poverty detection, energy, and poverty reporting. The third part evaluates the limitations of artificial intelligence's role in this context.

2. Defining Poverty in the Artificial Intelligence Era

Throughout history, the concept of poverty has continually evolved. As the world changes, both concrete poverty and perceived poverty have differentiated in various ways. This evolution has led to new definitions and diverse measurement and evaluation methods. Today, advancements in technology, particularly artificial intelligence, create a significant agenda for both the redefinition, measurement, and evaluation, as well as the reduction of poverty.

2.1. Traditional vs. multidimensional views of poverty

When the necessity arose to define poverty initially, the primary criterion was establishing a minimum income threshold. This threshold represents the minimum amount of income required for individuals or families to maintain an adequate standard of living, thus evolving into what is commonly known as the income poverty line (Hickel, 2016: 755; Mhlanga, 2021: 4; Wang & Zhang, 2020: 24).

While income remains a pivotal factor in understanding poverty, the concept has expanded beyond mere financial means. As living standards evolve and societal conditions shift, poverty has evolved into a multidimensional phenomenon. Therefore, relying solely on income-based metrics provides a limited perspective on the complex nature of poverty. This paradigm shift has cultivated a holistic and multidimensional comprehension of poverty, encompassing a range of interconnected factors extending beyond mere income. It considers elements such as access to education, healthcare, housing, and social engagement. This broadened perspective on poverty surpasses simplistic financial assessments, embracing a spectrum of social, economic, and cultural aspects (Mhlanga, 2021: 4-5). The Global Multidimensional Poverty Index (GMPI), currently accepted by the United Nations Development Program (UNDP), is used to measure the multidimensional nature of poverty. The World Bank also proposed an index in 2018 that measures poverty in three basic dimensions: money, education and access to basic needs (Zhang et al, 2022: 3).

Before the emergence of artificial intelligence, there was a significant paradigm shift in the prevailing way of thinking or understanding things, likely pertaining to how poverty was conceptualized or addressed, as we mentioned before. With the advent of artificial intelligence, the impact on poverty has been observed at two distinct levels: Firstly, artificial intelligence has necessitated a redefinition of poverty due to the introduction of new living conditions, technologies, innovations, and opportunities. This shift has compelled societies to reconsider the traditional markers of poverty in light of the changing landscape brought about by AI. Second, the integration of artificial intelligence technologies has led to significant changes in the methods used to define, calculate, and measure poverty. artificial intelligence has introduced new tools or techniques for analyzing poverty data, leading to a distinct

understanding or evaluation of poverty levels (Zhang et al. 2022: 3).

3. The Role of Artificial Intelligence in Poverty Alleviation

The relationship between artificial intelligence (AI) and poverty reduction can be explained through two fundamental parameters. The first parameter is economic growth. Artificial intelligence has the potential to transform the global economy with advances in software and hardware-based opportunities, to increase productivity, to combat various environmental and health crises such as pandemics, to develop new energy sources, and to achieve sustainable economic and social growth (Lu, 2021: 1; Milana and Ashta, 2021: 190). The second parameter is the capacity to empower poor people. Artificial intelligence can bolster the adaptation and resilience of poor groups by addressing their specific challenges with necessary solutions. Both public and private sectors can use artificial intelligence to improve services such as more accessible financial services, inclusive education platforms, and targeted health interventions. By meeting the unique needs of these communities, artificial intelligence has the potential to lower barriers to social and economic mobility and foster a more equitable society (Goralski and Tan, 2022: 2).

Artificial intelligence can play a significant role in poverty reduction across various domains including microfinance, agriculture, health, education, and poverty assessment and reporting. While artificial intelligence could indeed contribute to poverty alleviation by leading developments in some other sectors, this study focuses on these areas due to their direct relevance to daily life, socio-economic parameters, and their broader applicability, which increases the likelihood of achieving effective and tangible outcomes. Moreover, poverty is intrinsically linked to deprivations and inequalities in these critical areas. If you have no or limited access to opportunities and resources in these areas, then it may be indicative of poverty, i.e., the haves and have-nots in these areas determine the individual's quality of life and access to socio-economic resources.

3.1. Microfinance (Microfintech)

Microfinance is a system that aims to provide a range of financial resources and tools, particularly loans, to low-income entrepreneurs, small businesses, and poor segments of society who have no or limited access to traditional banking and related services due to high transaction costs. Although some authors date its origins to the 15th century, the modern microfinance movement began in the 1970s with the establishment of the Grameen Bank in Bangladesh by Muhammad Yunus (Roy, 2015; Milana & Ashta, 2020: 257)

Artificial intelligence tools have led to profound and radical transformations in the banking sector. Significant advancements have occurred in many units and stages of banking. For example, the rapid evaluation of loan applications has replaced the traditional and labor-intensive process in which employees calculated the income, expenses and payment capacities of customers one by one. Also, artificial intelligence provided the reduction of credit card fraud by detecting suspicious transactions (Milana & Ashta, 2020: 200-201).

The microfinance sector has also started to benefit from the opportunities offered by artificial intelligence. Artificial intelligence allows borrowers who do not have traditional financial records to effectively assess their risks and creditworthiness through data-driven credit decisions. In addition, artificial intelligence applications empower microfinance institutions to analyze customer behavior and market trends. By developing mobile commerce and e-payment systems, it improves customer service through chatbots and virtual assistants. The use of artificial intelligence in peer-to-peer lending and crowdfunding platforms democratizes access to capital for low-income groups. By using artificial intelligence applications, it becomes feasible to provide personalized support and guidance, reduce costs and increase efficiency through the widespread use of automated processes. In this way, while financial capacity is strengthened, socioeconomic development is promoted in poor regions (Ashta & Herrmann, 2021: 217; Moro-Visconti, 2021: 105-106; Głogowski, 2022: 202; Monkiewicz, 2022: 221; Rostek, 2022: 45).

3.2. Agriculture

The United Nations estimates that the world population will reach approximately 9.8 billion by 2050, necessitating a 60-100% increase in global food production from 2020 levels to meet rising demand. There are a number of obstacles to increasing production in agriculture. As previously noted, the increasing population is the most important issue. However, factors such as food security

and climate fluctuations affect food supply and productivity. Pollution resulting from agricultural practices also further strains the agricultural ecosystem, affecting soil health and biodiversity. Fires and lands opened to development reduce arable land and worsen environmental degradation (Goralski and Tan, 2022: 5; Javaid et al., 2023: 16; Redhu et al., 2022: 658).

The capacity of the agricultural sector to cope with the aforementioned challenges is of great importance not only for increasing the world's population but also for reducing poverty. The World Bank emphasizes that the expansion of agriculture has a significant impact on the fight against poverty, and that growth in this sector increases the incomes of the poorest by two to four times more than growth other sectors (World Bank, 2023). In short, the agricultural sector is the most effective and direct way to combat poverty. Consequently, increasing productivity by using agricultural land effectively and efficiently is of critical importance.

Considering all these challenges and their significant role in reducing poverty, the use of artificial intelligence technologies in agriculture has gained importance. With the development of artificial intelligence, the process of "being smart" of all things also works for the agricultural sector, leading to emergence of contemporary concepts and practices such as "smart farming", "smart agriculture" and "digital agriculture" (Khanna, 2021: 2).

The use of artificial intelligence in the agricultural sector, such as "smart agriculture" and "digital agriculture" provides significant improvements in productivity, sustainability and profitability. Digital agricultural technologies can collect, process, store and analyze data on planted crop genetics, environmental conditions and administrative practices. By using them together with machine learning algorithms, these technologies increase the efficiency and profitability of crop production (Khanna, 2021: 4). Analysis of genetic and phenotypic data increases plant productivity, disease resistance and adaptability, accelerates plant breeding processes and contributes to the development of superior plant varieties. In addition, artificial intelligence provides farmers with real-time recommendations in many areas such as disease and pest detection, soil management, planting strategies, irrigation techniques and crop care. In this way, both operational efficiency increases and environmental footprints decrease. In the marketing and sales stages, artificial intelligence also provides significant advantages by facilitating more accurate price estimates of agricultural products and developing effective marketing strategies. Therefore, artificial intelligence plays critical roles at every stage of the agricultural process—before, during and after production (von Braun and Baumüller, 2021: 92; Javaid et al. 2023: 19; Redhu et al. 2022: 658-659; Kumar et al. 2022: 627-628; Oliveira and Silva, 2023: 9; Subeesh and Mehta, 2021: 284-286).

Examining various software and applications for this purpose, the FarmView initiative at Carnegie Mellon University focuses on increasing the yield of sorghum, a resilient grain that is vital for regions affected by famine, using artificial intelligence, robotics and sensing technologies (Dormehl, 2017; Goralski and Tan, 2022: 6; Mhlanga, 2021: 10). Similarly, the machine learning tool called Nuru, which is applied in the agricultural sector in Kenya, Mozambique and Tanzania, helps farmers by identifying leaf damage in photographs and is used to monitor the prevalence of elusive pests that pose significant threats to farm income and food security in these countries (Mhlanga, 2021: 10). Additionally, software programs such as Climate FieldView, Trimble Ag Software, Granular Insights are also various tools used for the digitalization of agriculture and farming (DeLay, Mintert & Thompson, 2021).

3.3. Health

Vaccines, preventive health services, and advanced surgical techniques, the treatment and management of diseases such as cancer, have contributed to an increase in human life expectancy. With these developments, infant mortality rates have also decreased significantly. However, economic and social factors - such as women's participation in the workforce, education and career, socio-cultural and psychological factors - such as individuals' changing mindsets and lifestyles lead to a significant decrease in birth rates. This situation, along with the extension of life expectancy, has resulted in an increase in the elderly population, placing demands and stress on the healthcare system. In addition, recent epidemics including COVID-19 and monkeypox reveal the importance of an effective and good health system.

Poverty and poor health are two intertwined conditions. Poor countries have worse health conditions than rich countries. Furthermore, within countries, poor people are

in worse situations than their rich citizens in terms of access to health services and healthy lifestyle. This relationship reflects a causality that works in both directions: poverty leads to poor health, and poor health keeps poor people even poorer (Wagstaff, 2002: 97; Case & Kraftman, 2024: i501). At this point, the use of artificial intelligence in the health sector and digital health applications have significant potential for the general health picture as well as for poverty reduction and health equity.

There are two principal areas of use of artificial intelligence in the field of health: clinical research and development and the making, planning and management of health policies. In the realm of clinical research and development, artificially assisted image recognition technologies offer the ability to detect diseases (such as cancer, Alzheimer's, diabetic retinopathy) earlier and more accurately in medical images such as X-ray, MRI and CT. This plays an important role in the diagnostic process (Lopes, Martins and Correia, 2024: 7). Similarly, artificial intelligence saves time and costs by accelerating drug discovery and development processes. Advances in biotechnology and genetics were instrumental in the extraordinary rapid development of vaccines during the COVID-19 pandemic. AI has made significant contributions to the rapid deciphering of the genetic structure of the virus and modeling of protein structures in the vaccine development process (Kaushik, Kant & Christodoulides, 2023: 2-3; Guo & Li, 2018: 175-176; He et al., 2019: 32; Lee & Yoon, 2021: 8).

Artificial intelligence makes significant contributions to the field of personalized medicine by analyzing large data sets such as genetic information, patient records, and environmental factors. Thus, it can create treatment plans specific to individuals, increase the effectiveness of treatments, and reduce side effects. In addition, AI-supported chatbots and virtual assistants provide patients with personalized health information, medication reminders, and symptom tracking, and contribute to patient compliance with treatment plans (Lopes, Martins and Correia, 2024: 7).

Artificial intelligence can optimize hospital operations such as patient admission, discharges, resource allocation, staff scheduling by analyzing historical patient data, bed occupancy rates, and staff availability through various algorithms in determining, planning, and administering health policies. Additionally, artificial intelligence can predict patient demand, disease outbreaks, or public health emergencies by analyzing large data sets obtained from various sources such as electronic health records, social media, and climate data. Furthermore, artificial intelligence can contribute to the development, planning, and execution of health policies in many areas such as health insurance and risk assessments, cost-effectiveness analysis, and supply chain management (Lopes, Martins and Correia, 2024: 7)

When we look at the increasingly widespread artificial intelligence technologies in our daily lives, Google's healthcare initiatives include Med-Palm2, a large health-focused language model developed to answer patients' health-related questions and summarize information. Furthermore, initiatives such as Freenome, Recursion Pharmaceuticals, and Benevolent AI, as well as applications such as IBM's "Watson for Oncology", are pioneering innovations in healthcare solutions using technologies such as machine learning and natural language processing (von Braun and Baumüller, 2021: 90; Kirby, 2024: 1).

3.4. Education

Education and poverty have a two-way interaction. On one hand, poverty can significantly limit access to education. The poor are deprived of good schools and educational environments, which is essentially an aspect of poverty, and poverty is closely related to lack of formal education. Individuals who cannot receive a good education cannot access good professions and well-paying jobs. Consequently, this makes the cycle of poverty to continue. Conversely, education can also be a way to break the cycle of poverty. Individuals who receive a good education are well-equipped, which opens the door to good and high-level employment opportunities. In this way, the poor individuals both saves themselves from this cycle and helps to save their family members, relatives and even communities from poverty (Mhlanga, 2021: 12; von Braun & Baumüller; 2021: 89).

Artificial intelligence technologies impact education from two ways, the first focuses on the education of artificial intelligence, the second is artificial intelligence in education. The first refers to the effective teaching of artificial intelligence across all educational levels, i.e. AI literacy, and the second refers to the use and integration of artificial intelligence in education, changing the purpose,

content and form of education, and thereby making significant advancements in this field (Holmes & Tuomi, 2022: 543).

The 2-sigma effect suggests that students can learn much better in individualized education than in traditional collective classroom settings. However, this is often a costly and difficult policy to implement; it is almost impossible to implement, especially in poor countries. However, with the advent of artificial intelligence, flexible and individualized education models are becoming easier to implement. Artificial intelligence instructors, which have almost zero marginal costs, enable the implementation of this educational model in poor regions (Holmes & Tuomi, 2022: 545).

Artificial intelligence influences education through various lenses: the student, the teacher, and the institution. From the student perspective, the following applications stand out: intelligent teaching systems, AI-supported applications, AI-supported simulations, artificial intelligence technologies that support students with disabilities, automatic essay writing, chatbots, automatic formative assessment, learning network managers, dialogue-based teaching systems, discovery learning environments, and AI-supported lifelong learning assistants. On the other hand, there are many artificial intelligence technologies for teachers. These technologies include plagiarism detection, organization of learning materials, class monitoring, automatic summarization, artificial intelligence teaching aids, and classroom management tools (Holmes & Tuomi, 2022: 554). Artificial intelligence technologies play an important role for educational institutions as well as for students and teachers: artificial intelligence can support educational institutions in the allocation of financial aid, lesson planning, preparation of scheduling and course schedules, and identification of school dropout cases and at-risk students (Holmes & Tuomi, 2022: 556). Artificial intelligence technologies play an important role for educational institutions as well as for students and teachers: artificial intelligence can support educational institutions in the allocation of financial aid, lesson planning, preparation of scheduling, and identification of school dropout cases and at-risk students (Holmes & Tuomi, 2022: 556).

When examining the applications of artificial intelligence in poor regions, the Eneza project stands out, which uses a mobile-based platform to deliver lessons and assessments via SMS and the web, serving more than 860,000 subscribers across Africa. Eneza's low cost and mobile compatibility significantly expands and facilitate access to education for students in remote areas and those who cannot afford traditional schooling (Mhlanga, 2021: 12). Similarly, "Kio Kit" in Kenya develops educational materials and technological tools to improve the quality of education in schools in rural and low-access areas (von Braun & Baumüller; 2021: 89).

As artificial intelligence technologies and internet accessibility become widespread and cheaper, the number of users of open course platforms such as Coursera, Udemy, and Khan Academy will increase. Furthermore, traditional universities will move their courses to the digital environment, allowing people who do not have access to education or high-quality education to benefit from these courses.

3.5. Energy

The development of societies cannot be evaluated separately from energy production and consumption. On the Kardashev scale, the level of development of civilizations is associated with the amount of energy they use (consume) (Kardashev, 1964: 219). Moreover, important macroeconomic parameters—such as energy and electricity consumption, vehicle numbers, and per capita carbon dioxide emissions— show the strong relationship between energy consumption and economic development (González-Eguino, 2015: 378). However, population growth, diversification of economic activities, and other social developments have inevitably increased energy demand. Non-renewable energy sources are inadequate to meet this growing demand. In addition, depending only on these energy sources brings a series of problems that threaten the future of the planet, such as global warming, climate change, high greenhouse gas emissions, the melting of glaciers, and rising sea levels (Zhang, Ling and Lin, 2022: 14073; Dellosa and Palconit, 2021: 1). Considering all these facts and problems, it is reasonable to assert that energy policies are crucial for the survival of our world (Pascual, 2008: 1).

Artificial intelligence is driving significant transformations in the energy sector, as in many areas today, and also promises great potential for the future. The International Energy Agency (IEA) emphasizes that the

necessity for the managing of future networks, stating that artificial intelligence will play a critical role at the center of this change by defining artificial intelligence and energy as a new “power couple” (Derrick, 2024). As artificial intelligence brings about new and radical changes in the energy sector, competition among energy companies is increasing, leading to the emergence of new actors such as information technologies from outside industry. Oil and gas companies are establishing strategic partnerships with leading artificial intelligence and information technology companies to keep up with this change (Umbach, 2018: 87). It is also stated that with the widespread use of artificial intelligence and digitalization in the energy sector, savings of approximately 80 billion US dollars can be achieved between 2016 and 2040 by reducing operating and maintenance costs, improving efficiency, minimizing unplanned outages, and extending asset lifespan. (Umbach, 2018: 93).

Artificial intelligence can make significant contributions in terms of capacity, scalability, speed, and efficiency, not only in the general energy sector but also in the renewable energy field. With AI-driven cost reductions, renewable energy sources, which are typically accessible only to high-income segments, can become more accessible to low-income populations. Numerous countries are implementing policies and initiatives to combat poverty through renewable energy solutions. Examples include China's Photovoltaic Poverty Alleviation Project (PPAP), Ghana's Clean Cookstoves Program, Kenya's Biogas Program, and Nepal's Rural Energy Development Program, aimed at bolstering energy accessibility and diminishing rural poverty. Similarly, endeavors like South Africa's Solar Home Systems (SHS) Program, Peru's Rural Grid Electrification Project, and India's India Rajiv Gandhi Grameen Vidyutikaran Yojana Programme (2005–2015) underscore the global commitment to addressing energy poverty through targeted policies and actions (Cheng et al., 2021: 2-3).

3.6. Artificial Intelligence as an Elevator Effect

Our discussions so far have focused on the current and potential roles of AI in combating poverty, in the context of a global and collective policy. However, AI can increase the number of wealthy people in society by causing individuals to get richer faster, I refer to this phenomenon as the "elevator effect." It is critical to point out, that those who "rode" the elevator, do not necessarily to be a poor, in fact, such occurrences may be quite rare. On the other hand, startups with limited budgets can quickly surpass century-old companies and become among the highest taxpayers. This is important in terms of showing the “enriching” power of artificial intelligence and technology in general at elevator speed.

An examination of the Forbes billionaires list shows that six of the top ten positions are held by owners of technology companies. Thus, the highest-earning sector is the technology sector. In Turkey’s 2023 tax champions list, Mert Gür, who founded Loop Games in 2019, has risen to 16th place in just 4 years (Onedio, 2024). The Bayraktar brothers, who own Baykar Technology, which ranks first and second on the list, also operate in the defense industry, where artificial intelligence plays an important role (NTV, 2024). Leaving behind century-old family companies with a wide range of services needed by individuals and institutions, from the foundation of a house to its roof, from grocery shopping to car insurance, Baykar Technology once again clearly demonstrates how profitable this field is and the potential it offers.

It’s important to acknowledge that getting rich also causes problems in terms of income inequality, and that getting rich is not always a good indicator for poverty reduction. My purpose here and what I mean by the "elevator effect" is that a child from a very poor, poor or middle-income family who works or studies in the field of artificial intelligence can get rich very quickly.

3.7. Mapping Poverty

Once poverty has been defined, the next step is its identification. An optimal determination of the regions where poor individuals and communities are concentrated is critical for the effective allocation of resources and the effective implementation of poverty alleviation programs. In this way, those who are economically disadvantaged can be distinguished, and plans and programs can be developed to address the underlying causes of poverty.

Traditionally, household surveys conducted in poor regions are rich in detail but are limited by constraints due to time and space. Furthermore, they cannot be conducted regularly due to their cost, and in conflict zones, these data can be difficult to collect due to security issues (Engstrom, Hersh & Newhouse, 2022: 382). Therefore, traditional methods have been enriched with new types of data and techniques. These new methods use digital data; mobile

phone data, social media, crowd-sourced data, imagery such as Google Street View, and remote sensing imagery are among them (Hall, Dompae, Wahab & Dzanku, 2023: 1754).

Among these methods, imagery has developed over time, especially in the context of geospatial intelligence. Geospatial technologies, traditionally used for military and intelligence purposes to obtain geographic data and analyses from sources like satellite images and aerial photographs, have also been adapted to identify poor regions. At this point, its critical role has been the combination of different machine learning algorithms, including deep learning, with satellite images to predict various human-related situations and outcomes. So much so that it can provide estimates as good as surveys on wealth and poverty situations from a single satellite image. Furthermore, in recent years, private companies like DigitalGlobe and Airbus have rapidly expanded the scope and availability of high spatial resolution imagery (HSRI), resulting in a reduction in commercial costs (Hall, Dompae, Wahab & Dzanku, 2023: 1754; Engstrom, Hersh & Newhouse, 2022: 382; Bacastow & Bellafiore, 2009: 38).

The role of satellite images in determining poverty is that well-lit areas are associated with wealth. Places with brighter lights at night, with more light, mean that economic activities and living standards are higher (Pinkovskiy & Sala-i-Martin: 2016). In short, those with brighter nights have more money. As artificial intelligence technologies develop, it is becoming possible to use not only nighttime images but also daytime images for this purpose. For example, Marshall Burke, an economist at Stanford University, and his team obtained data that performed better than night image data by focusing on daytime satellite images (Jean et al. 2016; Bennington-Castro, 2017; Mhlanga, 2021: 9; von Braun & Baumüller; 2021: 88).

Another artificial intelligence technology for poverty mapping involves using algorithms based on mobile phone usage data. There is a strong relationship between mobile phone usage and regional wealth distribution. For example, regions with high network diversity have higher economic status compared to regions with lower network diversity. Variables such as social network dynamics, individual mobility, download patterns, phone models, and phone usage constitute the data sets used for poverty mapping. In addition, the increasing use of mobile phones in poor regions increases the quality and quantity of these data sets, thus contributing more to poverty mapping (von Braun & Baumüller; 2021: 88; Hall, Dompae, Wahab & Dzanku, 2023: 1756).

3.8. Poverty Reporting

After determining who is poor and where, as well as gathering a variety of information and conclusions, the reporting stage becomes crucial in the fight against poverty. Artificial intelligence enhances data science, natural language processing tools, data visualization techniques, and automated reporting systems. Using artificial intelligence tools and technology improves efficacy and efficiency by preparing reports, analysis, and distribution procedures (Sakthivel, Pravakar & Prakash, 2024: 111). In addition to helping professional, nonprofit, public, and private institutions and organizations in their endeavors, these developments also make it possible to examine enormous datasets and use machine learning, big data analytics, feature data mining, and data analysis to extract meaningful patterns and relationships (Jiawei & Kamber, 2006; Alpaydin, 2020; Grimmer, Roberts & Stewart, 2021).

Additionally, textual data analysis can be further enhanced by the utilization of Natural Language Processing (NLP) techniques, which facilitate the detection of significant concepts, keywords, and emotional nuances. Expanding language models and widely used machine translation have made it easier for stakeholders engaged in efforts to reduce poverty to communicate with one other, breaking down barriers through language and promoting understanding amongst speakers of different languages. As a result, NLP facilitates the exploration of the stories and experiences of people who are struggling with poverty, a better comprehension of its root causes and consequences, guidance in the development of more effective policies and programs, and improved service provision to impacted communities (Chowdhary, 2020: 604).

Furthermore, visualizing data, presenting it in graphical form, makes it easier to understand its meaning. Important points such as outliers in distributions, trends, and subtle changes over time are not overlooked (Kelleher & Tierney, 2018: 23). Visualizing data collected in poverty studies enhances our understanding of these values and trends.

These tools are essential for making complex data easier for interlocutors to understand and use, as artificial intelligence has made data visualization easy and accessible for average users, while also enabling professionals to use it more effectively.

4. Is Everything Really Rosy?

It should also be noted that it is naive to paint a rosy picture about artificial intelligence. Artificial intelligence is not a "silver bullet", given its limitations and risks (Bennington-Castro, 2017). In this context, I will focus on two main issues: the role of government and biophysical constraints.

4.1. Role of Governments

In this age of artificial intelligence, it's evident that the functioning of this industry cannot operate independently from governmental organizations. These structures will ultimately determine the scale, scope, and impact of AI development. In managing artificial intelligence, states have four essential functions to fulfill effectively.

Firstly, they must take on a protective role, which involves various government regulatory activities and initiatives to uphold the rule of law. This protective function is crucial because advancements in technologies like face, voice, and image cloning, coupled with the growing capabilities of hackers, can potentially endanger the security of societies through artificial intelligence. Acting as a protector also entails social endeavors, such as preventing social exclusion, including digital exclusion, and implementing security measures, including those concerning cybersecurity (Ratajczak, 2022: 95; Hanna, 2018: 4).

The second function of the state in managing artificial intelligence is the promotor function. This involves supporting innovation, research, and development. States should incentivize progress in artificial intelligence across various sectors such as agriculture, education, finance, and healthcare. This can be achieved by offering grants and allocating resources to research and development initiatives aimed at advancing artificial intelligence technologies in these sectors (Ratajczak, 2022: 95; Hanna, 2018: 5).

The third function of the state is commonly linked with its role as a producer, focusing on guaranteeing access to public goods and delivering comprehensive infrastructure services. This entails furnishing the necessary infrastructure to support the services offered by the digital economy. This function involves overseeing access to public data and furnishing the infrastructure for artificial intelligence-based services. Ensuring equitable and widespread infrastructure is crucial in ensuring uniform access across society (Ratajczak, 2022: 95; Hanna, 2018: 5-6).

The fourth function of the state involves envisioning potential scenarios of future social and economic changes. These scenarios serve not only as informative tools for private organizations making microeconomic decisions but also as the foundation for measures incorporated into the state's development strategies and long-term policies. Such measures should encompass all aspects of the digital revolution rather than merely comprising temporary responses to ongoing social and economic shifts (Ratajczak, 2022: 96).

The state must have a balance in its approach to regulating artificial intelligence. On one hand, it should not stifle the progress of AI through overly restrictive regulations that impede research and development. On the other hand, it must avoid allowing AI to operate unchecked, which could result in a chaotic environment. If the state performs these functions effectively, artificial intelligence can play a role in reducing poverty and eliminating income inequality; otherwise, it will transform and reproduce inequality.

4.2. Biophysical Frontiers, Energy and Artificial Intelligence

Throughout the study, I have touched on the roles that artificial intelligence plays in combating poverty. However, it should also be noted that artificial intelligence itself plays a role in "impoverishing" nature and the world as it entails significant consumption of energy and materials. Furthermore, AI technologies are subject to biophysical limits due to their reliance on energy resources (Turiel, 2024)

The International Energy Agency predicts that electricity consumption in the data centers, AI, and cryptocurrency sectors could double by 2026. Electricity consumption by data centers was reported at 460 terawatt-hours (TWh) globally in 2022, and it is expected to exceed 1,000 TWh in 2026, equivalent to Japan's total electricity consumption (IEA, 2024: 8). Also, Stanford University's 2024 Artificial Intelligence Index Report compares the electricity consumption of selected AI models, finding that ChatGPT-3 consumed approximately 1,287 megawatt-

hours (MWh) in 2020. Elon Musk stated at a conference in March 2024 that power outages in 2025 could occur due to the increasing demands of artificial intelligence, data centers, and electric vehicles (Blain, 2024). In this context, it is useful to consider and manage the potential effects of artificial intelligence on energy consumption and carbon footprint. Otherwise, the benefits brought by artificial intelligence technologies may have a negative impact on the sustainability of energy resources.

Therefore, artificial intelligence technologies will continue to exist as long as there are sufficient energy resources. If these energy resources are not available, the application and capacity of artificial intelligence technologies and their effective role in combating poverty will remain at a very limited level.

5. Conclusion

As time progresses and the individual's mental and material world diversifies, the nature of poverty, the state of being deprived of something, also changes. While deprivation of bread and dry food used to be one of the basic indicators of poverty, now access to the internet, health opportunities, education opportunities, deprivation in all these areas is now identified with poverty. In short, time also changes feelings and thoughts about poverty.

The potential of artificial intelligence, which becomes more integrated into our daily lives, to reduce poverty is a topic of growing discussion. This study includes sectors where AI can contribute such as microfinance, agriculture, health, education and poverty mapping and reporting. The selection of these areas is based on the fact that deprivations and inequalities in these areas are directly related to poverty, and the haves and have-nots in these areas determine the individual's quality of life and access to socio-economic resources.

Artificial intelligence is revolutionizing microfinance, a sector focused on providing financial services to low-income individuals and entrepreneurs who lack access to traditional banking due to high transaction costs, similar to its impact on the broader finance and banking sectors. Through contributions like credit evaluations, fraud detection, and analysis of customer behavior and market trends, AI is facilitating easier access to capital for low-income groups, thus creating opportunities to democratize financial services.

Population growth, food insecurity, and climate change are increasing global food demand. Considering the critical role of agriculture in poverty reduction, solving these problems is also gaining importance. Artificial intelligence, robotics and sensing technologies offer various methods to solve these problems. Smart agriculture and smart farming applications are becoming widespread with these technologies. Using artificial intelligence, productivity and profitability are increased both during agricultural production and in the following stages. By optimizing agricultural processes, combating pests and diseases, and improving soil management and irrigation, AI is contributing to food security. For instance, Carnegie Mellon University's FarmView initiative helps farmers by identifying leaf damage to increase sorghum yields and contribute to the fight against famine. In addition, the Nuru in Africa is another example of the use of artificial intelligence in agriculture to monitor the prevalence of pests that pose significant threats to farm income and food security.

In the health sector, artificial intelligence plays a significant role in areas such as clinical research and health policy planning. AI-supported technologies are used in vaccine development processes, the creation of personalized medical applications through the analysis of genetic information and patient data, and the optimization of hospital operations, as well as in the early diagnosis of diseases such as cancer and Alzheimer's. Google's Med-Palm2 large language model answers patients' questions about healthcare. Additionally, initiatives such as Freenome, Recursion Pharmaceuticals, Benevolent AI, and IBM's "Watson for Oncology" are pioneering innovations in healthcare solutions by utilizing technologies such as machine learning and natural language processing.

Artificial intelligence is causing important changes in education. Students, teachers, and educational institutions are all benefiting from AI technologies. The following innovations and applications are transforming educational processes: intelligent teaching systems, artificial intelligence-supported applications and simulations, solutions for students with disabilities, automatic essay writing, chatbots, automatic formative assessment, learning network managers, dialogue-based teaching systems, discovery learning environments and artificial intelligence-supported lifelong learning assistants,

plagiarism detection, intelligent organization of learning materials, class monitoring, automatic summative assessment, artificial intelligence teaching assistants, classroom management, allocation of financial aid, lesson planning, preparation of scheduling and course schedules, and identification of students at risk of dropping out of school.

Artificial intelligence is significantly transforming the energy sector. It plays a crucial role in various areas such as increasing the efficiency of power plants and networks, reducing costs, improving maintenance processes, developing the renewable energy sector both in terms of quality and quantity, and thereby making it more accessible to low-income groups and poor regions.

In addition to these areas, the rapid enrichment opportunities provided by technologies offer significant contributions to low-income and middle-class individuals and enterprises. Finally, artificial intelligence is becoming an effective tool in the fight against poverty by identifying poor regions through tools such as satellite imagery and mobile data, as well as by reporting and visualizing poverty using natural language processing and other deep learning algorithms.

Finally, it is important not to give the impression that everything is rosy in the relationship between AI and poverty reduction. AI is influenced not only by technological factors but also by political and legal factors. Whether global poverty will come to an end with the widespread use of AI or, conversely, whether it will deepen social inequality and increase poverty depends on how AI is governed, its governance structure, regulatory frameworks, and policy priorities. In short, these factors shape the capacity, social impact, and poverty alleviation efforts of AI. Moreover, AI technology creates a significant "impoverishing" effect in terms of using energy resources. Considering the biophysical limits of our planet, it's essential to remember that AI's role has its boundaries.

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