Pandemic-Resilient Urban Centers: A New Way of Thinking for Industrial-Oriented Urbanization in Ethiopia

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Abstract: In Ethiopia, the flourishing of industrial parks in the suburbs of major urban centers is a recent phenomenon. The outbreak of COVID-19 has had an adverse impact on the emerging industrial parks and prospects of cluster cities. The aim of this article is to explore the different urban planning measures employed during the pandemic and to propose sound planning methods for the development of sustainable industrial-oriented urban centers. In Ethiopia, industrial-oriented urbanization started in the 1920s with the advent of the railway line. Currently, more than 25 industrial park-based cluster cities have flourished adjacent to cities. A number of initiatives have been undertaken by major stakeholders in these cluster cities to combat COVID-19. Their efforts, however, were made difficult because urban planners were not proactive and did not have foresight in the selection of sites that can mitigate the impact of COVID-19 or other similar pandemics. The researchers believe the problem could have been addressed if the planners used a science-based, human-focused, computer-aided decision-making approach, i.e., space syntax. Therefore, this article recommends that planners become proactive and work in collaboration with different stakeholders for the creation of resilient and livable industrial parks-oriented urban centers.

Keywords: cluster cities; COVID-19; industrialization; industrial parks; innovative planning; pandemic; railway line

1. Introduction

From the Black Death and the Spanish flu to COVID-19, pandemics wreak havoc on the human species [1]. They have the salient trait of being "perfect storms", bringing together a multitude of public health, economic, financial, social, and environmental crises in a single, rapid, and devastating blow to countries and societies [2]. The novel coronavirus (COVID-19) has posed unprecedented challenges to the nations of the world, irrespective of income status, race, or religion. As the novel COVID-19 spreads throughout the world, nations are facing major economic and social crises [1,3–5].

The COVID-19 crisis has, by halting demand and supply interactions and the production of goods and services [6], created adverse socio-economic impacts throughout the world. These are manifested in, for example, losses of life and income, the escalation of unemployment, disruptions to supply chains, the shutting down of businesses, etc.

One of the prominent sectors that is severely affected by COVID-19 is the manufacturing industry. With no viable cure, the crisis will likely continue to severely affect the development and industrialization of low- and middle-income countries.

The manufacturing industry is one of the pivotal economic sectors to achieve socio-economic transformation. In Ethiopia, the manufacturing industry was introduced during

the Imperial Government period, with the advent of the railway transport system. The manufacturing sector was paid due attention for the first time during this period, with the imperial regime promulgating a 10-year industrial strategy (1957–1967) [7]. The first five-year development plan (1957–1961), which emanated from the ten-year industrial strategy, focused on infrastructure development, human capital development, and resource mobilization. Following this, the second five-year development plan (1963–1967) gave priority to the industry sector. In the second five-year planning period, the Imperial Government played an active role in the manufacturing sector; as a result, the sector grew at an average annual rate of 16 percent, thus pushing the share of the industrial sector in the country's economy from 9 percent to 13 percent [7]. The Federal Democratic Republic of Ethiopia (FDRE) gives special emphasis to the manufacturing sector. To this effect, the government had designed and implemented Growth and Transformation Plans (GTP-I and GTP-II), which introduced a comprehensive industrial parks development approach [8,9]. Accordingly, the government has been engaged in the development of mega Industrial Parks projects. Almost all industrial parks are established on railway lines that are either completed or to be constructed [7]. The rate and scale of industrial parks development by the Federal Government, regional states, and private developers has had an affirmative effect on the urbanization processes. These industrial parks have, in turn, intensified the growth and development of already-existing urban centers, or have created cluster cities.

Urban areas are more vulnerable to COVID-19 due to the fact that they are exposed to travelers and congested settlement patterns [1]. Historically, pandemics also affected urban areas more severely than their rural counterparts [10]. This article explores the prevailing conditions of industrial-oriented urbanization in Ethiopia by giving special emphasis to industrial parks-based clustered urbanizations. The article is focused on answering the following three questions: (a) "how are industrial-oriented urban centers affected by COVID-19?", (b) "what kinds of measures have been taken by those urban centers to combat the impacts of COVID-19?", and (c) "what kind of policy and planning measures are best suited for the creation of resilient urban centers during times of crisis?"

2. Materials and Methods

2.1. Description of the Study Area

Ethiopia has been implementing industrial parks (IPs)-development programs since 2009 [5]. There are more than 25 IPs developed and operated by the federal government, regional states, and private developers [11] (see Figure 1). From these, more than half (13 or 52%) are owned by the Federal Government. The responsible government institution that is in charge of the federal government-owned IPs is the Industrial Parks Development Corporation (IPDC). The IPDC was established in 2014 as a public enterprise, with the intention of becoming an engine of rapid industrialization that nurtures manufacturing industries, accelerates economic transformation, promotes and attracts both domestic and foreign investors, as well as accelerates urbanization [12].

This article focuses on the role of IPs in accelerating urbanizations or creating cluster cities from the vantage point of the formation of resilient urban centers during the pandemic.

2.2. Methods

The article employs both exploratory and descriptive research designs to assess the overall impact of the novel COVID-19 pandemic on IPs, and its spillover effects on the nearby urban centers. Exploratory research methodology is used to review the available literature and to collect data from experts in the IPs planning departments [13]. The paper also uses a descriptive research method, as the study focuses mainly on the description of the state of affairs as it exists at present, and the researchers have no control over the variables; they can only report what has happened or what is happening [14].

The article employed document review and case study research methods because the case study method allows researchers to conduct a detailed investigation on a single instance of a phenomenon of interest, which, in this case, is the novel COVID-19 pandemic,

in the context of industrial-oriented urbanization, taking industrial parks owned by the Federal Government of Ethiopia as cases.

The study used both primary and secondary data. Primary data were collected from policy documents, relevant legislations, and authorized regulatory organs. On the other hand, secondary data were retrieved from published scientific journals, books, etc.
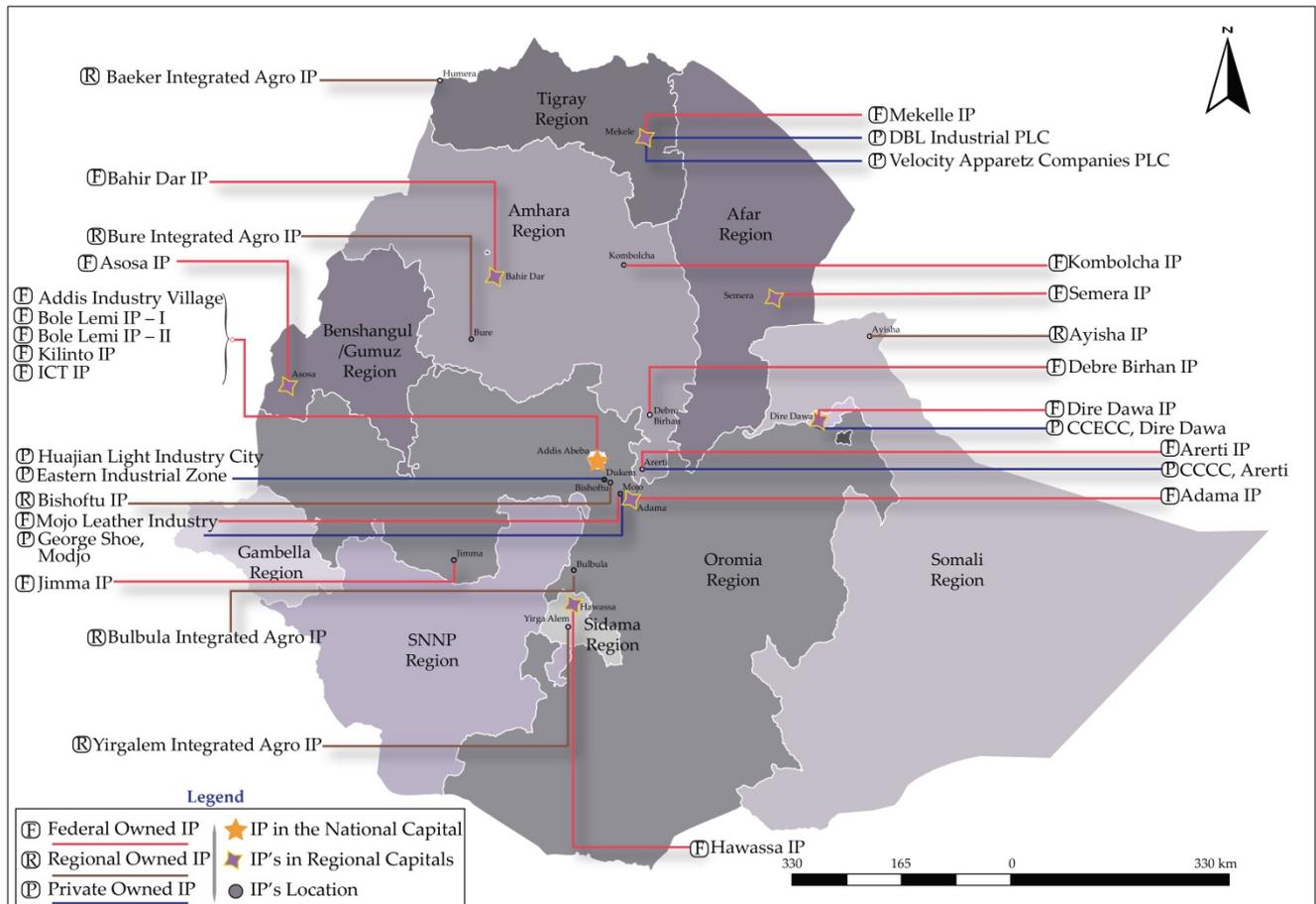
Figure 1. Industrial parks distribution map of Ethiopia; Source: EIC (2022). Computed by authors.

3. Literature Review

3.1. The Notion of Pandemic and Resilience

3.1.1. Pandemic

The dictionary of epidemiology defines pandemic as "an epidemic occurring over a very wide area, crossing international boundaries and usually affecting a large number of people" [15]. This is a classical definition, because it excludes population immunity, virology, or disease severity. Based on this, pandemics can be said to occur everywhere without any hindrance of passing states' sovereignties, and to affect a large number of people irrespective of social status, religion, color, economic status, educational status, etc. Pandemics are the worst-case scenario, which happens when an epidemic outbreak occurs beyond a country's jurisdiction. For that matter, a pandemic that will occur on a smaller scale can have a fatal effect on millions of lives [1]. COVID-19 is now considered a pandemic because, from its first identification date of December 2019 in Wuhan, Hubei Provence of China, the virus has spread all over the world and has seriously affected both the economic and social aspects of life [1,4].

3.1.2. Resilience

The term "resilience" originated from the disciplines of physics and psychology. Initially, it was used to measure the capacity of systems, objects, or individuals to survive disruptions by maintaining acceptable levels of functionality and returning to a pre-disruption level of functioning in a timely manner [16].

UNISDR (2009) defines resilience as: "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" [17].

Resilience to the pandemic refers to the capacity of an urban environment to absorb shock without noticeable alteration to its function and structure [18]. Urban areas are responsible for the pandemic's higher transmission rate because urban centers served as nuclei for population agglomeration, are economic hubs, and have a high level of transportation usage [1].

Afrin et al. (2021) advocates for the importance of a "disaster risk management" framework (DRM) to make urban centers resilient to a pandemic [1]. The DRM is a global framework, formally known as the "Sendai Framework for Disaster Risk Reduction 2015–2030", that focuses on effective strategies for preparedness, response, and mitigation [19]. The DRM resilience concept has been developed using a wide ecological resilience approach [20].

According to Yamagata and Sharifi (2018), there are three theories of resilience, namely, engineering, ecological, and adaptive. Engineering resilience is also known as the "single-equilibrium approach", and gives special emphasis to minimizing vulnerability to disasters by enhancing the resistance and robustness of the physical infrastructure. This approach has prevailed for a long period; however, through time, two new approaches, namely, "ecological resilience" and "adaptive resilience", were introduced in the second half of the 20th century. Ecological resilience uses a multiple-equilibrium approach, while adaptive resilience uses non-equilibrium approaches to resilience [16]. Table 1 summarizes the salient features of the three resilience approaches.

"Adaptive resilience" recognizes system complexities and dynamics. It helps us to describe and understand the resilience of urban systems as complex and dynamic social-ecological systems. The adaptive concept defines resilience as:

> " . . . the ability of urban systems to continuously develop short-term coping and long-term adaptation strategies—considering, and in response to constantly changing system dynamics and complexities over a range of spatial and temporal scales—to mitigate hazards, withstand and absorb shocks, rapidly bounce back to baseline functioning, and more effectively adapt to disruptive events by bouncing forward to better system configurations." [16]

In order to achieve urban resilience, we should incorporate essential principles and characteristics such as robustness, stability, diversity, redundancy, flexibility, resourcefulness, coordination capacity, modularity, collaboration, agility, efficiency, creativity, equity, foresight capacity, self-organization, and adaptability into the urban system [16].

In general, resilience in an urban area focuses on removing uncertainties using vulnerability assessments, prevention, sound governance, and planning forms [21,22]. This entangles with both physical (providing efficient hygiene and ventilation systems in the design of a building and semi-public open spaces, flexible transit area planning for the realization of bike- and walk-friendly pathways, safe distancing, and handwashing or personal hygiene areas) and non-physical measures (technology-oriented planning and decision support systems, such as a geographic information system and space syntax) to combat pandemics effectively and efficiently [1].

Table 1. Theoretical approaches to resilience.

Resilience Approach	Description
Engineering	- It is also known as single-equilibrium; - It emphasizes minimizing vulnerability to disasters by enhancing the resistance and robustness of the physical infrastructure.
Ecological	- It is also known as multiple equilibrium; - It is a more dynamic and flexible approach that recognizes the inadequacy of resistance and robustness characteristics for building urban resilience; - It promotes building safety margins into the design of the system in order to absorb initial shocks, retain functionality, and minimize overall losses.
Adaptive	- It is also known as non-equilibrium; - It conceptualizes urban systems as complex and dynamic socio-ecological systems; - It can be used to model the performance of urban systems over time and across space; - It facilitates appropriate interactions between slow and fast variables. This allows the system to smoothly alternate between long periods of stability and short periods of chaotic change, without losing its integrity and functionality.

Source: Adapted from [16].

3.2. The Impact of Pandemics on the World Time Horizon

Pandemics are thought to be inevitable phenomena. Throughout history, there were several catastrophes caused by pandemics, which led to the loss of millions of lives, and that adversely affected the socio-economic situations of countries. Yet, the adverse socio-economic impacts' magnitude and the intensity of pandemics are usually severe in urban areas, compared to their rural counterparts. For that matter, some pandemics have taken cities' names, such as the London plague and the Hong Kong flu.

Figure 2 depicts that the first historical record of a pandemic was the Antonine Plague (165–180), which caused the loss of five million lives. Since then, different pandemics, such as smallpox, the Black Death, cholera, yellow fever, the flu, HIV/AIDS, SARS, Ebola, MERS, and COVID-19 have occurred, causing the losses of millions of lives. Of these pandemics, the Black Death (1347–1351) caused the highest loss of life. Lessons learned from the different pandemics helped people to better understand and deal with them, as well as design different prevention and coping strategies to reduce their impacts.

3.3. Planning Measures during the Time of Pandemic

Yamagata et al. (2018) stated that leaders and planners should take sound measures to combat pandemics and their adverse effects [16]. The different types of measures can be systematically categorized as spatial planning and engineering measures.

3.3.1. Spatial Planning Measures

(a)   Zoning

Zoning was introduced in the 14th century in the form of "quarantine" as a prominent mitigation measure for pandemics [26,27]. The term "quarantine" is derived from the Latin word "quaranta giorni", which means 40 days [26]. Urban centers in the Middle Ages applied quarantines to protect coastal cities from epidemics. For instance, ships arriving in Venice from infected ports were required to wait around at anchor on the seashore for

40 days before docking [26]. In Japan, the practice of quarantine was also applicable at the port of Deshima [27].

(b)   Walkable Streets and Open Space Planning

During the Black Death, European planners advocated for the opening of larger public spaces, which provided a greater opportunity to connect with nature and reduce the feeling of isolation. This phenomenon helped planners improve the settlement and resettlement patterns of Renaissance cities, with the strategy of expanding their cities to prevent overcrowding [28,29].
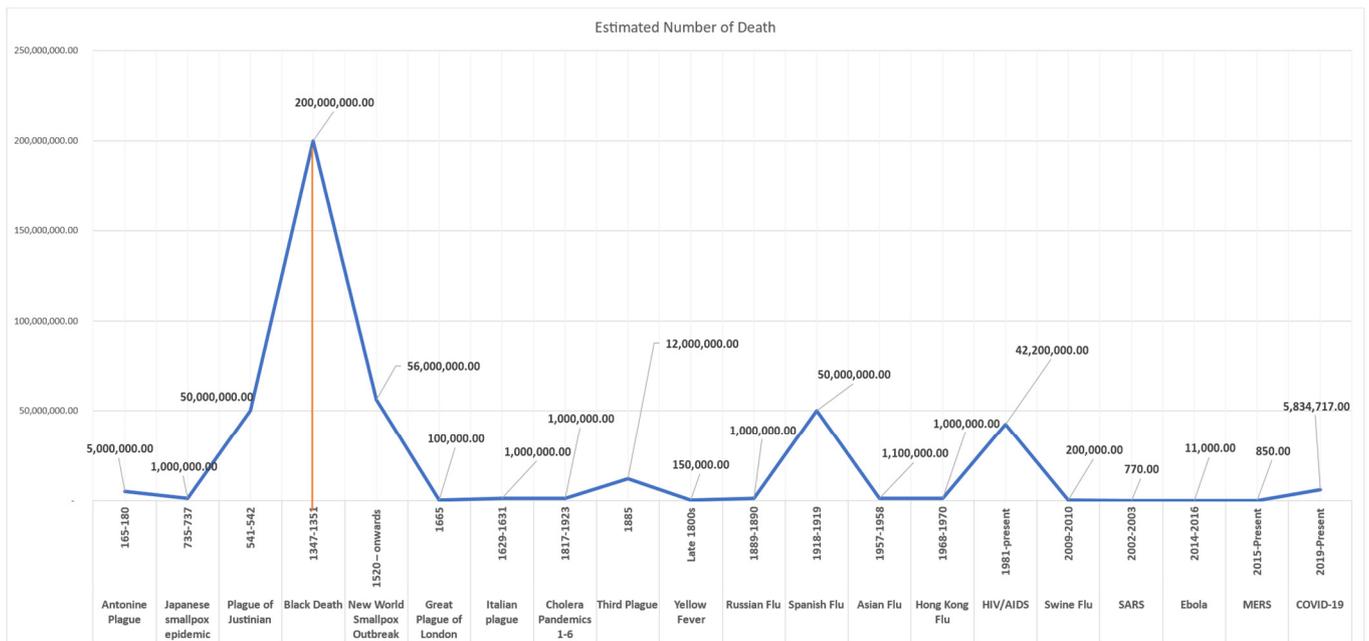
Figure 2. The Occurrence of Pandemics in the World Time Horizon; Source: [23–25].

3.3.2. Engineering Measures

The industrial revolution is considered as a prominent pandemic period, with a series of cholera outbreaks [16,24,29]. The period was known to have been a terrible time for living in urban centers. One of the main reasons for the outbreak of cholera was related to hygiene, i.e., the mixing of clean tap water with wastewater [16,24,29]. The cholera outbreaks created the opportunity for urban planners to manage waste in the streets. The crisis also necessitated the design of ventilations and designs that let in daylight and featured open spaces, as well as an infrastructure design that managed the cholera crisis through the development of a sewage system downriver, which safely separated wastewater from the clean water supply.

3.3.3. Mixed Approach

Looking back on the historical events of the 19th century, the second industrial revolution, also known as the technological revolution, which peaked between 1870–1914, was an important case of unprecedented urbanization. During these periods, cities became densely populated, full of high-rise buildings, railway transportation, and public spaces for entertainment and welfare [30]. Between 1918–1919, the deadliest respiratory virus pandemic in history, the "Spanish Flu pandemic", killed more than 50 million people worldwide. The pandemic slowed down urbanization and limited public life. As a preventive measure, people stayed at home and chose to walk instead of using crowded public transport. Like the Spanish flu, COVID-19 is a rapidly spreading infectious disease in the contemporary world, and is a challenge for urban centers. So far, nations have been implementing different prevention and mitigation measures, such as restrictions in the

form of quarantines, travel bans, and school closures, and moral persuasions or obligations, such as social distancing, staying at home, and the use of personal protection equipment [3]. In addition, using existing technology, such as infrared technologies with facial recognition, to detect a person with a high temperature even if she/he is wearing a mask, helps to control and predict the spread of COVID-19 [1,3,4].

In order to combat pandemics, innovative spatial planning, engineering, and design has been developed and implemented in different parts of the urban areas of the world [3,31].

4. Results

4.1. The Advent of Industrialization on the Railway Line in Ethiopia

The origin of modern industrial-oriented urban centers can be traced back to the beginning of the 20th century, with the advent of the railway transport system [32]. Emperor Menelike II is credited for championing the construction of a railway line for the transportation of passengers and freight from the center to the ports of Ethiopia [33]. The construction and installation of railway transport, with its intrinsic element of the telegram, was started after Emperor Menelik II gave a written concession to Alfred Ilg (a Swiss national who arrived in Ethiopia in 1877) [32,34], which officially empowered him to study the project and to set up a company for the construction of a railway line on the 11th of February 1893 [33,34]. The construction of the railway line started at the port of Djibouti and reached the Ethiopian border, specifically called Dewele or Douale, in 1901 [33]. This railway was a single-gauge (950 mm) line, which had a 781-km length with more than 30 stations [33].

Initially, the stations were two to three buildings that served limited railway service-related functions, such as ticket selling, administration, residences for staff, and warehousing, also serving as a space for passengers to wait. The buildings, which were constructed in the courtyards of the railway stations, attracted different kinds of urban service providers and traders to lead sedentary lives in and around the stations. These stations also attracted investors to engage in the manufacturing sector. Then, station areas gradually evolved into urban villages and urban centers. Some of these station-based urban centers, such as Kaliti, Akaki Beseka, Mojo, Awash Sebat Kilo, and Dire Dawa, specialized in light manufacturing [35].

Therefore, there is a direct nexus between the railway transport → industrialization → urbanization in Ethiopia. It was in the 1920s, with the advent of the railway transport system, that the manufacturing sector evolved in the eastern corridor, along which the Ethio–Djibouti railway line stretched. Since then, the country followed different approaches for the industry sector.

4.2. Historical Insights of Industrialization and Urbanization in Ethiopia

Ethiopia followed different development approaches, depending on the government's ideology. Since the end of the WWII, Ethiopia has witnessed three regimes: the Imperial (1950s–1974), the Dergue (1974–1991), and EPRDF (since 1991) [7,35,36].

(a)   The Imperial Era

The construction of a modern railway line that runs from the port of Djibouti to the central parts of Ethiopia ended in 1917 [32,33]. The advent of this railway line had a spillover effect on the development of modern manufacturing enterprises, demographic changes, and urbanization [32,35]. The imperial regime witnessed mostly private-led import substitute industrialization (ISI) development strategies. The ISI strategy attracted foreign investors to engage in the production of consumable goods. This act had a positive impact on the growth and development of urban centers and laid the base for the eastern economic corridor, such as Addis Ababa, Kaliti, Akaki, Mojo, Metehara, Awash, and Dire Dawa [33].

With the three consecutive five-year plans (1957–1973) of the Imperial era, the government aimed to accelerate agricultural development through the promotion of commercial agricultural ventures, investing in the development of various social infrastructures such

as transportation, construction, and communications, and introducing and developing commercial agriculture [7].

With regard to industrial development, light industries, mainly food and beverages and textile manufacturing, were dominant in the sector [35]. These labor-intensive types of manufacturing caused an agglomeration of people and growth and the development of urban centers. As a result, the total output reached ETB 81.8 million. In the second five-year plan (1963–1967), the emperor declared investment law, which stated profit tax exemption for five years, remittance, duty-free machine imports, and equity participation in local firms for foreign national investors.

Between 1962 and 1969, cotton's share in employment and output reached 40 percent and 33 percent, respectively, with the number of people employed doubling from 10,100 to 21,610 [35]. Though urbanization at that time was below 5%, the manufacturing sector played a significant role in the agglomeration of people in the flourishing industries at the newly emerging station-based urban centers.

(b)   The Dergue Regime (1974–1991)

After the revolution, the military controlled the political power and adopted socialism as the leading political economic ideology. In this period, the Dergue designed and implemented two development plans: the five- and ten-year development plans. The first five-year plan was largely about advocating for the role of the state in the economy. Accordingly, the military government nationalized all private enterprises. On the other hand, the ten-year perspective plan, like the prior economic policies of the country, underlined the importance of agriculture for the country's economy, while the industrial sector was the other priority of the government. This plan was anticipated to bring an annual growth rate of 6.5% in real GDP, 4.3% growth in agricultural GDP, 10.8% in industrial GDP growth, and 6.9% in services. However, due to various challenges such as civil war, the government failed to realize its goals.

(c)   Ethiopian People Revolutionary Democratic Front (EPRDF)—(Since 1991)

Following the downfall of the military government, the EPRDF controlled the political power. At the initial stage, the Transitional Government of Ethiopia (TGE) adopted an agricultural-led economic policy, i.e., the "Agricultural Development-Led Industrialization" (ADLI). This was followed by two subsequent strategies that focused on agricultural development: the Sustainable Development and Poverty Reduction Program (SDPRP) and the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06–2009/10). However, these neoliberal-oriented policies and strategies did not bring the intended economic growth for the country. The failure of these plans forced the government to adopt another model. The EPRDF Government produced the "Democratic Developmental State" political economy ideology by merging the developmental state from East Asian countries with democracy from the West. Following this, the government issued two consecutive five-year development plans: the Growth and Transformation Plan (GTP), i.e., GTP I (2009/10–2014/15) and GTP II (2014/15–2019/20).

The new industrial policy that was enshrined in the two strategic plans (GTP I and GTP II) boldly declared the need for transforming the economy from agriculture to the manufacturing industry [8,9]. During this period, industrialization and industry-oriented urbanization were revived. These two strategic plans propagated a cluster-based "special economic zone" or "industrial parks development" approach. For the realization of industrial parks development, different legislations were promulgated, and the Industrial Parks Development Corporation (IPDC) was established by the virtue of the Council of Ministers Regulation No. 326/2014. This structural transformation policy direction and the associated strategic plans paved the way for the revival of industrial-oriented urbanization with a new model technically known as industrial parks. For the first time, the concept of IPs was introduced in the Investment Proclamation 769/2012, in the form of an industrial development zone.

However, the phrase "industrial park" encompasses a wide variety of related concepts, such as free-trade zones, export processing zones, special economic zones, high-tech zones, free ports, enterprise zones, etc. [37–41].

UNIDO (2020) gives a common definition for industrial park (IP), defining it as:

> "a tract of land developed and subdivided into plots according to a comprehensive plan with the provision of roads, transportation and public utilities, sometimes also with common facilities, for use by a group of manufacturers" [40].

This definition used a broader and comprehensive approach.

The Ethiopian legal system also defines IP using a broad and comprehensive definition, namely, as:

> "area with distinct boundary . . . to develop comprehensive, integrated, multiple or selected functions of industries, based on a planned fulfilment of infrastructure and various services such as road, electric power and water, one-stop-shop and have special incentive schemes, with a broad view to achieving planned and systematic, development of industries, mitigation of impacts of pollution on environment and human being and development of urban centers, and includes special economic zones, technology parks, export processing zones, agro-processing zone, free trade zones and the like . . . " [42].

Presently, the Government of Ethiopia has given special emphasis to sectoral transformation. The "Ten-Year Development Plan of Ethiopia (2021–2030)" discussed the issue of industrial-oriented urbanization under the economic sectors development plan [42]. This "homegrown" economic reform document stated "sustainable urban development" as one of the key priority areas at the macroeconomic and sectoral levels [43]. The current national policy enshrined the development of the manufacturing industry as one of the primary pillars for the ten-year homegrown economy [43]. This transformation, among others, will be promoted by pursuing aggressive measures towards rapid industrialization and structural transformation [43].

As a summary, the different industrial development approaches of Ethiopia, which were intended to bring sectoral transformation and urbanization, since the end of WWII are presented on Table 2.

For the realization of sectoral transformation, the government of Ethiopia has been investing massively in enabling infrastructures and setting up a series of special economic zones or industrial parks. Before the pandemic, the Federal Government developed 12 industrial parks throughout the country.

4.3. The Nexus of Urbanization and IPs

Global experience reveals that urbanization and structural transformation are interconnected; however, this situation is less applicable in African countries [7,44]. Like many other African countries, the Ethiopian urbanization process has its own path and is weakly tied to structural transformation; it has not been driven by improved agricultural products [44].

However, with the recent underpinning growth, there is a remarkable urbanization process envisaged in Ethiopia. There are different driving forces for the prevailing fast urban population growth. Of these executed mega projects, railways, roads, hydro-electric power infrastructure, telecommunication infrastructure, industrial parks development, and real estate development by the Ethiopian government are worth mentioning.

The prevailing experience depicts that, in Ethiopia, industrial parks development has a direct nexus for the emergence of new urban agglomerations in the periphery of existing cities and towns through clustered development approaches. Figure 3 illustrates industrial parks oriented urbanization using a cluster development approach.

Table 2. Summary of industrialization and urbanization in time horizon.

Period	Description
Imperial (1950s–1974)	- Modern types of industrialization emerged during the 1920s with the advent of Ethio–Djibouti railway transport; - Strategy: private-led import substitute; - The first industrial development strategy introduced (1957–1967); - The three consecutive five-year plans (1957–1973) implemented; - Share of manufacturing: 2.6 % (1963–67) and 4.4% (1973–74);Labor-intensive manufacturing led to the agglomeration of people tantamount to urbanization.
Dergue (1974–1991)	- Nationalization of all privately owned manufacturing; - Strategy: public-led import substitution; - Designed and attempted to implement five-year and ten-year strategic plans.
FDRE (Since 1991)	- Strategy: initially, the government followed private-led import substitution using neoliberal policies and strategies (ADLI, SDPRP, and PASDEP); - Then, the "Democratic Developmental State" (GTP I and II) were introduced—aiming to bring sectoral transformation through cluster-based "special economic zone" development approaches; - The current "homegrown economy" propagates the role of the manufacturing sector to achieve sectoral transformation.

Source: computed by authors; 2022.
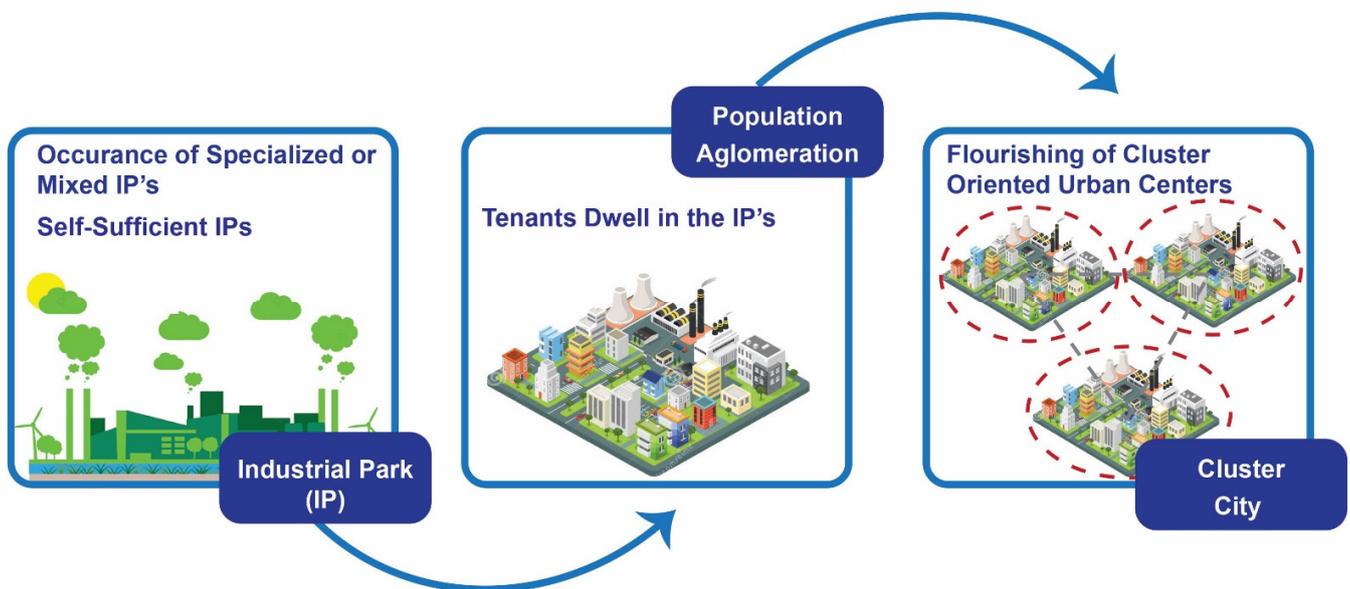
Figure 3. Illustrations of IPs-oriented urban centers' development; Source: authors, 2022.

4.4. The Prospects of Industrial Parks for Cluster Cities' Formation in Ethiopia

Industrial parks have played an indispensable role in the flourishing of clustered cities. Marshall (1890) has mentioned three benefits of clusters for firms: knowledge and technology spillovers, labor pooling, and market access [45]. For the government, clusters will help to reduce infrastructure cost and enable experimentation with policy changes before they are rolled out to the broader economy. The prevailing mode of industrial parks

development is considered as a policy-driven industrial clustering around a supply source or a pool of workers [45]. Well-designed, planned, and implemented industrial parks often lead to urban development in the vicinity of the park. For instance, Shenzhen Industrial Park, which exists in China, has grown from a small village to a mega city of 10 million people [46].

In this section, we examined the IPDC or Federal Government-owned functional industrial parks, considering them as potential clustered cities, from location and population vantage points.

So far, there are 114 tenant companies which have working premises in the 12 government-owned IPs. (See Figure 4). These IPs create job opportunities for more than 83,000 people, mainly for women, and generate USD 735 million in revenue for the country [47]. The existing 12 IPs are functional throughout the country based on their proximity to market outlets, infrastructure, economic potential, and regional balance in development [7]. As Figure 4 indicates, the majority (8 or 66.67%) of industrial parks are established along the railway line of the eastern economic corridors [7].
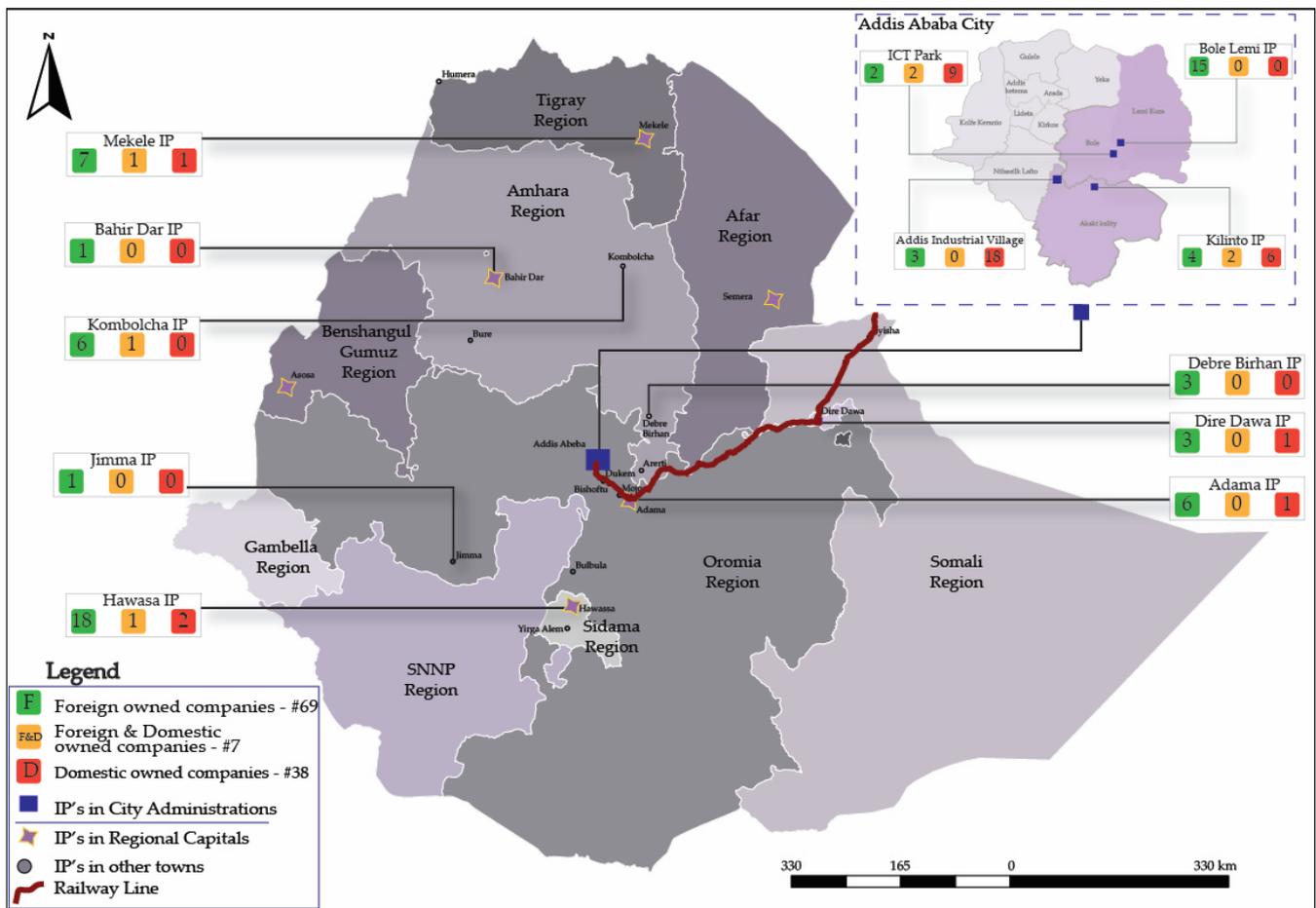
Figure 4. Distribution of federal-owned IPs; source: [48], Prepared by the authors.

4.4.1. Location

Almost all of the existing functional industrial parks are located on the outskirts of pre-established cities. As Table 3 indicates, with the exception of Hawassa, all IPs are located in suburban areas, within a range of 3 km to 20 km away from the central business district (CBD).

Table 3. Location of federal-owned functional IPs.

S/N	IP Name	Location (Region)	Total Area (Ha)	Developed Area (Ha)	Adjacent Urban Center	Distance from the Nearest CBD
1	Bole Lemi	Addis Ababa	353	172	Addis Ababa	15.4
2	ICT Park	Addis Ababa	200	200	Addis Ababa	14
3	Kilinto	Addis Ababa	279	279	Addis Ababa	20
4	Hawassa	Sidama	300	140	Hawassa	3.1
5	Mekele	Tigray	1000	75	Mekele	7.1
6	Kombolcha	Amhara	800	75	Kombolcha	4
7	Adama	Oromia	2000	120	Adama	8
8	Dire Dawa	Dire Dawa	4186	150	Dire Dawa	15.4
9	Jimma	Oromia	1000	75	Jimma	7.4
10	Bahir Dar	Amhara	2000	75	Bahir Dar	9.9
11	Debre Birhan	Amhara	1100	100	Debre Birhan	8.2

Source: [11,48].

4.4.2. Population Agglomeration

The feasibility study of each functional park indicates that there is a significant agglomeration of people in IPs in the form of workers. The potential agglomeration of workers varies from park to park. By taking a projection of potential workers, each industrial park has the potential for the formation of a clustered city.

MOUDH [48] categorized the different urban centers into seven categories based on population size (See Figure 5).
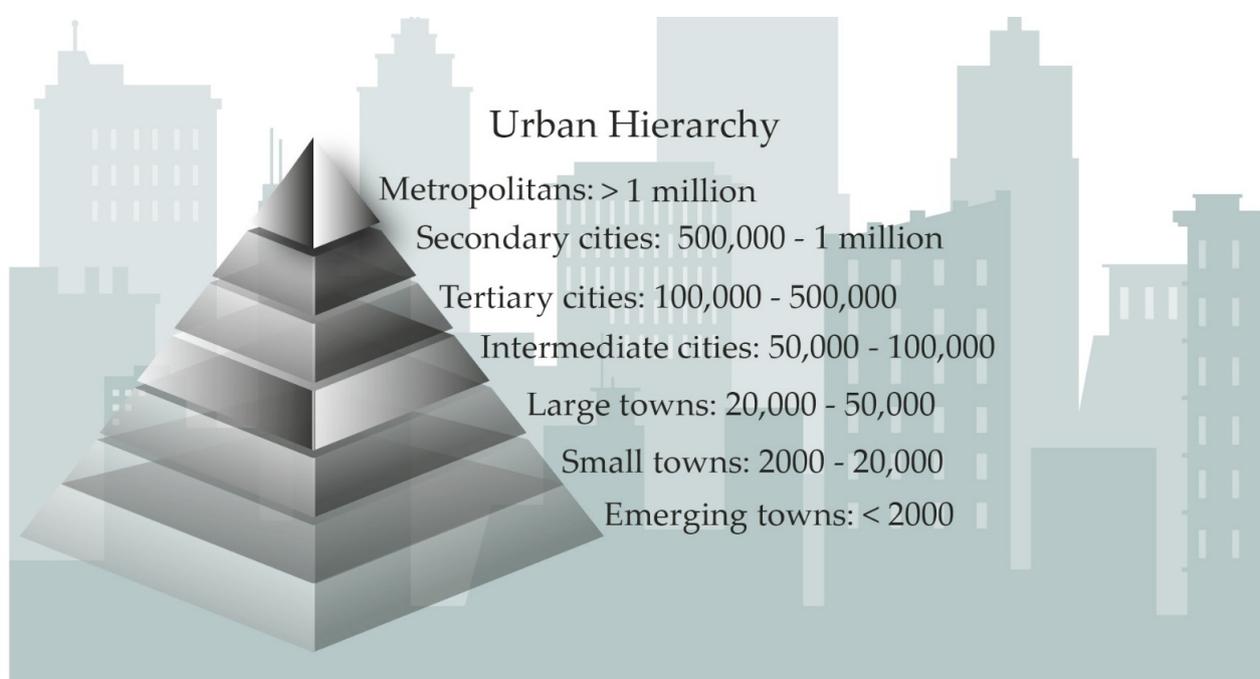
Figure 5. Hierarchy of urban centers in Ethiopia; Source: [48] Computed by authors.

Based on this MOUDC [49] population size classification, the existing functional IPDC-owned IPs can be labeled as follows: the Bole Lemi, Kilinto, and Hawassa IPs are intermediate cities; the ICT park is a tertiary city; the Mekele, Adama, and Dire Dawa IPs are large towns; and the remaining IPs are small towns. (See Table 4).

Table 4. Potential IPs-based cluster cities with urban hierarchy.

S/N	IP Name	Location (Region)	Population	Urban Hierarchy
1	Bole Lemi	Addis Ababa	50,000	Intermediate city
3	ICT park	Addis Ababa	240,000	Tertiary city
4	Kilinto	Addis Ababa	50,000	Intermediate city
5	Hawassa	Sidama	60,000	Intermediate city
6	Mekele	Tigray	20,000	Large town
7	Kombolcha	Amhara	13,000	Small town
8	Adama	Oromia	20,000	Large town
9	Dire Dawa	Dire Dawa	20,000	Large town
10	Jimma	Oromia	13,000	Small town
11	Bahir Dar	Amhara	13,000	Small town
12	Debre Birhan	Amhara	13,000	Small town
	Total		462,000	

Source: IPDC, computed by authors; 2021.

4.5. The Impact of COVID-19 on IPs-Oriented Clustered Cities

The novel COVID-19 pandemic has had a direct impact on the Ethiopian economy and the country's ambitious industrialization agenda of becoming a "light manufacturing hub in Africa". This subsection discussed the economic and social impacts of COVID-19 on the IPDC-owned IPs.

4.5.1. Economic Impacts

(A)   Investment Attraction

The impact of COVID-19 has dwindled foreign direct investment. Since IPDC's establishment, the inflow of the number of investors has been affirmative, with an average of 32 investors per annum. However, the outbreak of COVID-19 has had an adverse impact on the inflow of investors to the IPs. For instance, the annual growth rate between the year 2019/20 and 2020/21 is the least (0.02), compared to the other previous years. (See Table 5).

(B)   Financial Impact

Table 5. Number of investors in IPDC-owned IPs (2014/15–2020/21).

Year EFY (Gregorian)	Number of Investors	Annual Growth Rate
2007 (2014/15)	10	
2008 (2015/16)	11	0.10
2009 (2016/17)	26	1.36
2010 (2017/18)	36	0.38
2011 (2018/19)	47	0.31
2012 (2019/20)	62	0.32
2013 (July 2020–December 2021)	63	0.02

Source: IPDC, computed by authors; 2021.

COVID-19 has also created a financial dwindling on companies' revenue. As Figure 6 depicts, the annual export amount was increasing significantly until the outbreak of COVID-19. However, since the onset of the COVID-19 pandemic, the annual export has declined rapidly.
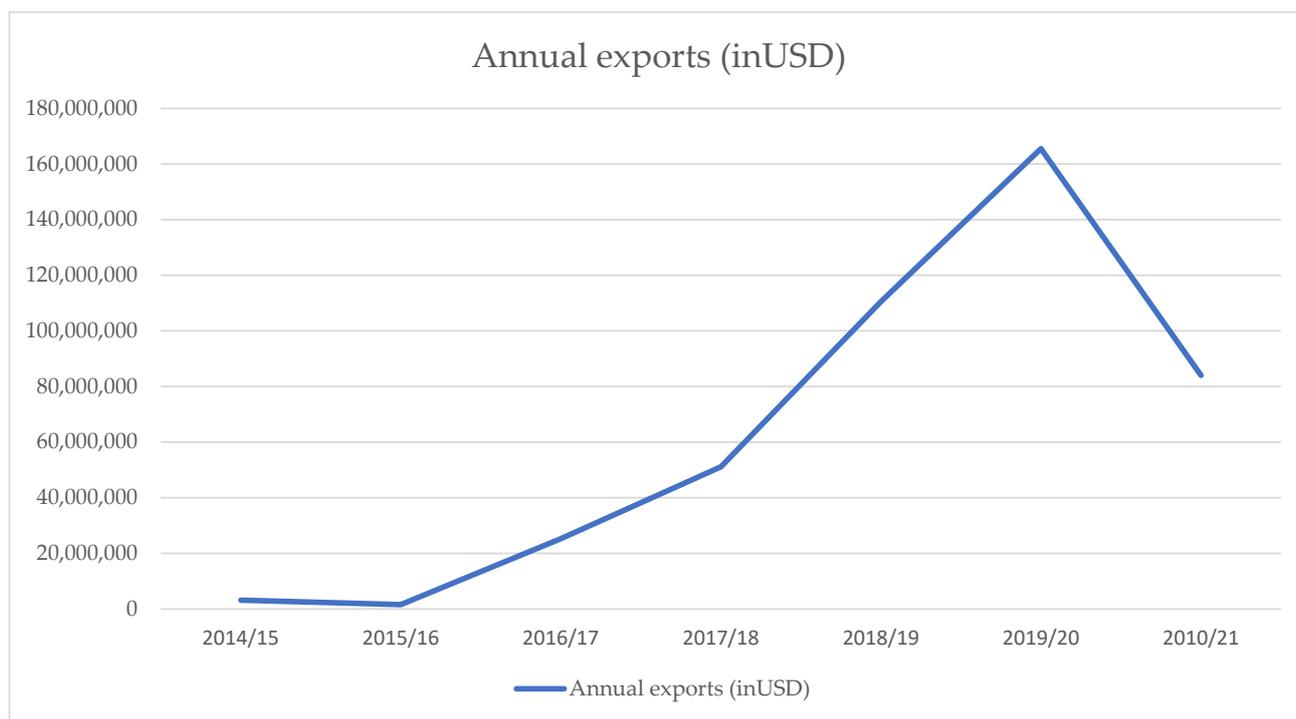
Figure 6. The export amount of IPDC-owned IPs (2014/15–2020/21); Source: IPDC, computed by authors; 2020.

The annual growth rate of IPDC-owned IPs' export amount also affirmed the fact that the outbreak of COVID-19 has made the annual growth negative. (See Figure 7).

4.5.2. Social Impact

One of the prominent purposes of IPs is serving as a catalyst for the urbanization process through attracting foreign direct investments (FDI), and generating employment. It is known that the success of IPs relies on their strategic location that links the IPs to a source of labor. In the IPDC-owned IPs, the number of workers has increased from time to time since 2014, and the number of available jobs created by IPs for the past six years is 30,095.5 per year; however, the growth depicts a decline with in time of COVID-19. (See Table 6).

Table 6. IPDC-owned IPs' job creation (2014/15–2020/21).

Year EFY (Gregorian)	Number of Jobs	Annual Growth Rate
2007 (2014/15)	9119	
2008 (2015/16)	9900	0.09
2009 (2016/17)	21,250	1.15
2010 (2017/18)	33,944	0.60
2011 (2018/19)	50,125	0.48
2012 (2019/20)	56,223	0.12
2013 (July 2020–December 2021)	61,368	0.09

Source: IPDC, computed by authors; 2020.
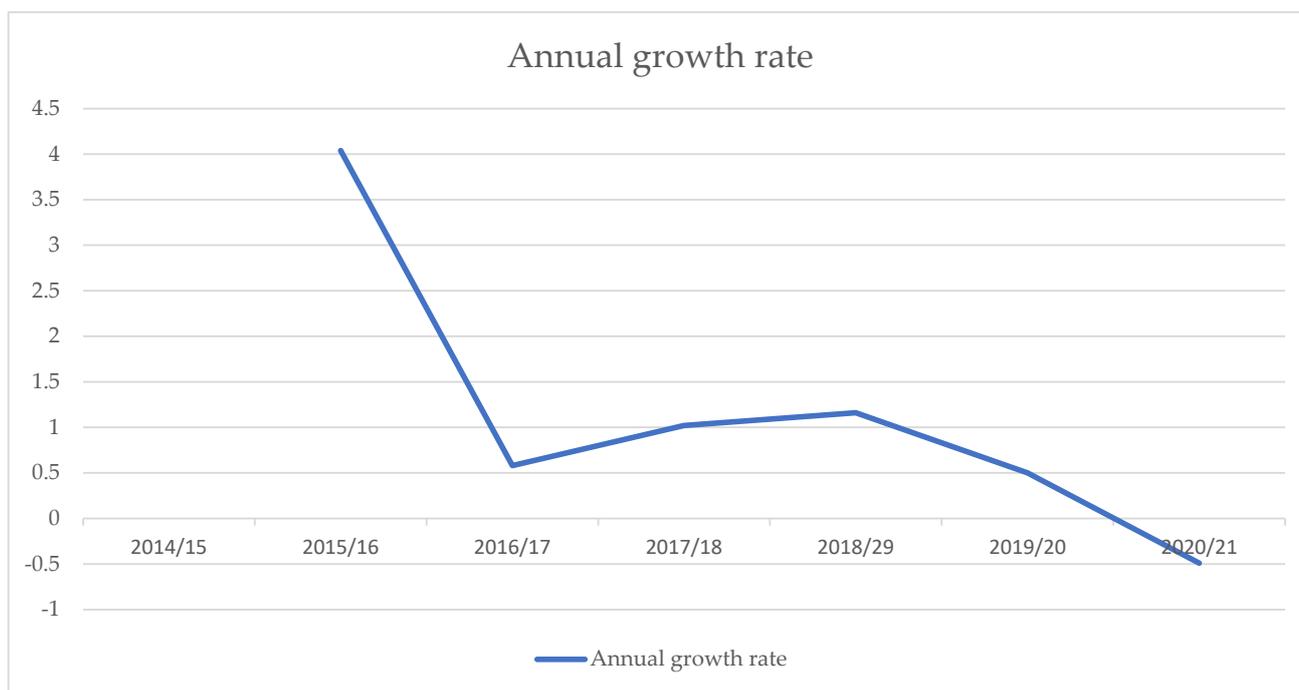
Figure 7. IPDC-owned IPs' annual export growth rate (2014/15–2020/21); Source: IPDC, computed by authors; 2021.

4.6. Measures to Combat the Impact of COVID-19

4.6.1. Government Measures

(A)　Restriction Measures

　　The government of Ethiopia has put into place several essential measures to combat the outbreak of the COVID-19 pandemic, such as mandatory quarantine periods for all travelers, restrictions on public gatherings, school closures, mandatory facemasks in public places, and fewer passengers using public transport. Risk communication, on measures such as physical distancing, wearing face masks, and hygiene, including through media and cell-phone ringtone reminders, are also critical interventions.

(B)　Design and Implementation of Norms and Standards

　　The government has also issued several legislations and strategic guidelines, such as:

- 　National Comprehensive COVID-19 Management Handbook [50];
- 　COVID-19 Workplace Response Protocol [51];
- 　Financial Administration Framework to regulate COVID-19 pandemic control and prevention fund [52].

　　The Ministry of Labor and Social Affairs issued a COVID-19 Workplace Response Protocol outlining and encouraging employers and workers to take preventive measures to reduce the risk of COVID-19 exposure. The protocol also put forth various legal and administrative measures to curb the economic consequences on industry and the workers.

(C)　Incentives

　　The government has availed three major incentives for investors operating inside the industrial parks, with a view to ease the impact that the COVID-19 pandemic imposes on their investment [11]. These are:

(a)　Incentives targeted at encouraging investors with no order from abroad for the past two months and those who lost procurement agreements from their clients abroad. They are allowed to sell their products within the local market;

(b)　Free transport of goods from Modjo dry port up to Djibouti port is available for all IPs investors;

(c)   A six-month discount cargo service is offered for the Ethiopian Airline cargo service's customers.

Apart from providing investors with a range of initiatives to promote the exports sector, the IPDC has been implementing various measures in coordination with the Ministry of Transport to resolve investors' continuous logistics complaints.

(D)   Repurposing

In order to protect companies from total lockdown, the government allowed investors to produce personal safety equipment (PPE), such as face masks. Accordingly, different companies that are existing in the IPs are actively engaging in the production of face masks, aiming at fulfilling local demand, and there is a plan to supply masks for African countries.

4.6.2. Company Owners

Company owners have been taking different measures to minimize the impact of COVID-19, such as awareness creation among workers, reducing the number of workers by half to ensure social distancing, or providing additional buses for transportation services to and from work. See Figure 8). Temperature measurements and handwashing mandates for workers upon entry and departure from their workplace, as well as the distribution of personal safety equipment (PPE), are also being carried out by some factories. Concerns were raised among factory owners about the nature of the garment operational structure. Maintaining social distancing in a factory setting is proving to be difficult for many factories, as the operational structure of production lines requires a certain level of proximity among each machinery line.
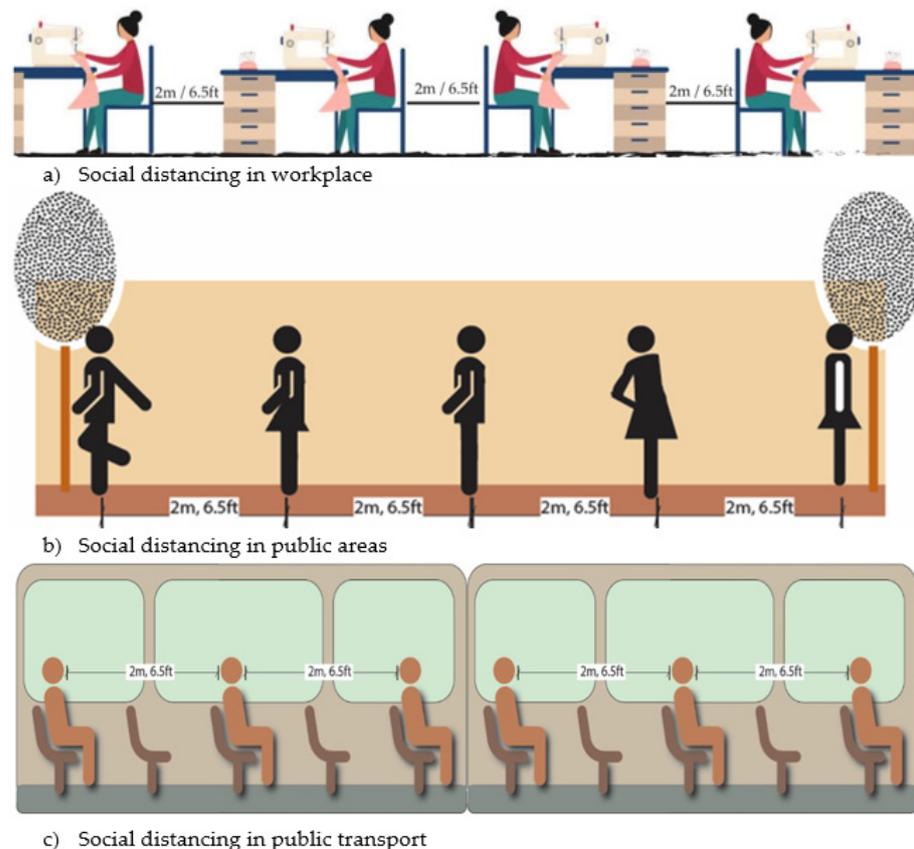
Figure 8. Illustrations of some practical measures to combat COVID-19; Social distancing is one of the pivotal strategies to prevent and mitigate the spread of COVID-19. Figure 8 depicts the different ways of social distancing in Industrial Park Oriented Urban Centers: (**a**) Social distancing in the textile manufacturing workplace (**b**) Social distancing in public places (**c**) Social distancing while using public transport. Source: authors, 2022.

5. Innovative Planning Measures

In the time of pandemics, urban and regional planners should be proactive in combating the prevailing problems through an innovative planning approach. Of the three resilience approaches, the adaptive resilience planning approach is recommendable for combatting the prevailing pandemic through the following measures:

(i) understanding the nature of the pandemic;
(ii) developing in-depth knowledge of prevention and curative methods;
(iii) designing an innovative planning measure;
(iv) implementing it accordingly, in collaboration with stakeholders.

As Figure 9 demonstrates, this process will help planners to play an indispensable role in the absorption of shocks, to rapidly bounce back to baseline functioning, and to adapt to disruptive events more effectively by moving forward to better urban dynamic social-ecological system configurations.

Figure 9. Adaptive resilient planning process; Source: authors, 2022.

Taking the current novel COVID-19 pandemic, urban planners should:

(a) understand the salient features of COVID-19, such as the type of disease it is (viral or bacterial). In this case, COVID-19 is an infectious disease caused by a newly discovered coronavirus. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes;

(b) collect relevant information to know the way to prevent the spread of the disease, as well as curative methods. Planners should collect relevant information from responsible entities. The World Health Organization (WHO) and the Ethiopian Ministry of Health, as well as the Public Health Institute, provides relevant information on the different prevention methods. Accordingly, some of the simple precaution measures advocated by relevant public health organizations are: physical distancing, wearing a mask, keeping rooms well ventilated, avoiding crowds, cleaning your hands, and coughing into a bent elbow or tissue;

(c) develop science-based human-focused planning models. Once planners have sufficient knowledge of the cause and dissemination of the disease, they should develop simple, realistic, and implementable planning models that indicate the roles of different stakeholders.

In general, to create a resilient industrial oriented urban center; policymakers and city planners should be proactive to have adequate knowledge and understanding about the nature of the pandemic. In addition, the socio-economic impact on the urban dwellers should be critically scrutinized. Using their scientific knowledge about the nature and impact of the pandemic on urban areas, planners and policymakers should design implementable preventive and mitigation strategies. (See Figure 10).

Figure 10. Ways of integration to combat pandemics; source: authors, 2022.

Innovative, science-based, and human-focused planning methods, and environmentally safe preventive models, should be designed and adopted. Some of the recommended designing approaches to prevent the impact of the COVID-19 pandemic in IPs-based clustered cities are manifested in transportation, manufacturing, and public places. One of the prevention methods is zoning or quarantines. In order to select quarantine sites, urban planners can employ computer-aided decision-making approaches, such as space syntax. Here, planners might develop an axil map or segment map that depicts local and global integration and selects areas with dark blue street layouts. These areas are isolated or segregated and they are ideal for quarantine. On the other hand, planners can also indicate red street layouts on an axil or segment map to designate the area for the installation of notices or sign boards, set up public hygiene sites in order to post images or messages that create awareness for the general public, and install handwash materials, respectively. This also helps to regularly disinfect the areas that are identified as high-movement areas.

6. Conclusions

In Ethiopia, industrial-oriented urbanization flourished in the 1920s, with the advent of the railway transport system. This railway line, which stretches from the central part of Ethiopia to the port of Djibouti, attracts investors to open their factory around railway stations. These factories, in turn, attract workers and different kinds of service-providing firms. This phenomenon causes the realization of industrial-oriented cluster cities. However, the current industrial-oriented cluster cities are triggered by government-led gigantic development projects, i.e., industrial parks developments. The novel COVID-19 pandemic has an adverse effect on the growth and development of clustered cities.

During the time of a pandemic, the adaptive resilience planning approach is recommended to absorb shocks, to rapidly bounce back to baseline functioning, and to adapt more effectively to disruptive events by bouncing forward to better urban dynamic socio-ecological system configurations.

In the Federal Government-owned industrial parks, the impact of COVID-19 was revealed mainly on foreign direct investments and the labor market. The study identified that COVID-19 dwindled foreign direct investments and labor forces in the clustered cities. In order to mitigate the impact of COVID-19 in the clustered cities, different stakeholders, including the government and company owners, have been taking a variety of measures; however, the pandemic's impact is significant. On the other hand, the role of planners in designing innovative, science-based, and human-focused planning methods, and implementing them in collaboration with other stakeholders, is almost null.

Therefore, planners should be proactive in combating pandemics such as COVID-19 through developing implementable, innovative, science-based, and human-focused preventive and curative models, and they should work in collaboration with other stakeholders. In the future, the authors hope that this article will provoke the development of pandemic-preventive models that will be applicable in the industrial park-oriented clustered urban centers.

Author Contributions: D.T.M., writing; E.G., advising and consulting; X.W., advising and funding acquisition; S.Z., editing and funding acquisition. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the China Association for Science and Technology (CAST) Program of International Collaboration Platform for Science and Technology Organizations in Belt and Road Countries (No.2022ZZGJB041422).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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