

`Turning Industrial Area into an Eco –Industrial Park in South Africa: Case Study

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Abstract

This research work was done to study an existing industrial area in South Africa with the view to initiate work to develop it into an eco-industrial park. The scope of this work was to establish the current resource efficiency practices, challenges and opportunities as well as support and interest by operators in eco-industrial park development. The survey sought to also identify the need for capacity building in form of training interventions and government/municipal infrastructure facilitation. The resource efficiency and cleaner production (RECP) assessment of Alrode Industrial area was carried out in conjunction with National Cleaner Production Center (NCPC) in South Africa, hence prospects of implementing eco-parks across the country were explored.

Keywords

Eco-industrial, cleaner production, waste management, green industry, industrial symbiosis

1. Introduction

Organizations around the globe, particularly in developing countries, are experiencing challenges in dealing with waste that they generate during their production processes. In such manner, eco-industrial parks (EIP) offer a path for firms to end up plainly greener and in addition help support their industrial operations (Welle , 2015). It is common to see dumped waste disgracefully in most industrial areas around Johannesburg. This could be addressed by EIP introduction in converting existing industrial areas, which are over 30 years of age and home to several little and medium sized firms crosswise over the city, for example, chemicals, nourishment handling and building. The retrofit among others would incorporate including present day sewage frameworks, solar based lighting, green finishing and tempest water drains(Welle , 2015).

2. Justification

South Africa at present uses million tons of characteristic resources consistently and imports million tons from abroad. All things considered, there is a general developing worry that as resources and space for landfill turn out to be all the more rare and waste transfer costs increment, advance monetary development might be hampered by developing resource wasteful aspects. South Africa produces millions tons of waste every year. This is for the most part industrial waste from the handling of regular resources into modern items, and the rest is metropolitan waste. A colossal level of this waste is either burned or dumped in landfills. Regions and industry are therefore in a troublesome position, testing them to discover waste management contrasting option to cremation. Waste lessening and minimization endeavors should be expanded and the issue obviously calls for going above and beyond by

starting a industrial environment approach. Research is basic when one considers the ebb and flow worries on environmental change; the development of low carbon modern parks is underlined to support the advancement of low carbon economy in South Africa.

3. Eco-industrial park concept

Eco-industrial parks are developing as the essential field for testing and actualizing modern environment. Comparative in a few regards to standard business parks, eco-modern parks are intended to enable firms to share framework as a system for upgrading generation and limiting costs (Brilliant People group System, 2005). Eco-modern parks offer firms the chance to helpfully upgrade both monetary and ecological execution through expanded proficiency, waste minimization, advancement and innovation improvement, access to new markets, key arranging, and fascination of financing and speculation (Savvy People Group System, 2005). The eco-industrial park (EIP) idea was first formalized in 1992-93 by Indigo Improvement, a group of individuals from Dalhousie College in Nova Scotia, and Cornell College's Work and Condition Activity (Dartmouth College, 2006). Companies ought to have an industrial beneficial interaction whereby one waste of another is a raw material for the other. Figure 1 demonstrates the arrangement of conceivable operations at various firms giving each different resource as raw materials.

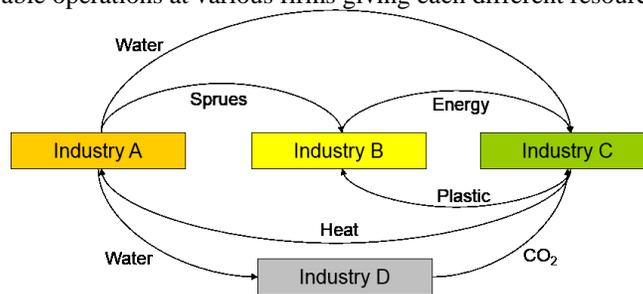


Figure1. Industrial symbiosis structure (Chertow, 2000)

The advantages Eco-Industrial Parks give may fill in as motivating forces to organizations to enhance their ecological execution regarding administration of materials, energy and waste. The potential they offer as far as neighbourhood advancement is urging groups to put resources into ideas fusing this way to deal with modern improvement (Fleig, 2000). Exceedingly between subordinate connection between two firms, trading materials and energy in a commonly favourable way, each adding to the welfare of the other is called Industrial Symbiosis (IS). The worldwide monetary framework exists of item chains that together shape a system of businesses. The earth capacities as a source and sinks for the monetary framework; raw materials are extricated and waste is generated. In these systems of businesses there exist nearby opportunities for material trades past their standard item chains. This can convey monetary pick up and additionally diminished material extraction from and transfer to the earth (Nooij, 2014). The terms, for example, "Modern Advantageous Interaction", "Mechanical Biological community", "By-Item Trade System" and "Eco-Industrial Park" are synonymously alluded to as EIP in this paper. The advancement of industrial parks typifies passing advantages, natural advantages and societal advantages:

Money related advantages to organizations - Decreased generation costs because of the obtaining of undesirable results from different organizations at deal costs and offering of side-effects created. Diminished energy utilization in connection to less transportation utilized. Diminished waste administration in light of on location organizations having the capacity to offer what might be viewed as waste. Declines costs of consistence and cost of research and development as these expenses would be imparted to different organizations.

Ecological advantages - Decrease request on common assets, diminished waste in types of strong waste, air emanations, wastewater, and lessened odds of mishaps in transportation as channels would be utilized rather than trucks.

Societal advantages - The social advantages of eco-modern parks are cleaner air and cleaner water which would prompt better well being. Moreover the improvement of eco-industrial parks would prompt a diminished request on the sewer framework and less waste taken to landfills.

4. Why eco-industrial parks in South African industry

South Africa generated around 108 million tons of waste in 2011, of which 97 million was discarded to landfill. On analysis 59 million tons was general waste and 49 million tons was unclassified and dangerous waste. It was also found that only 10% of all waste produced in South Africa was reused in 2011 (CSIR and COWI, 2012). This is for the most part modern waste from the preparing of common resources into industrial products, and the rest is city waste. A large amount for this waste is either burned or dumped in landfills. Currently in South Africa, ecological assurance is overlooked to the detriment of financial improvement (Haggar, 2007). With manageable improvement and plan this does not need to be the situation. Feasible advancement hopes to bring down expenses and enhance nature simultaneously. Therefore, it can be presumed that practical improvement is not only an idea that ought to be pushed by preservationists and approach creators, yet ought to be grasped by firms, the business groups, and society as well (Haggar, 2007). Industrial parks are a cardinal unit of financial improvement; industrial parks have been assuming an imperative part in the national advancement systems of numerous nations and have been crucial where monetary improvement is concerned (Geng et al, 2009). There are various terms for modern parks, which differ contingent upon the degree and sort of operations, henceforth numerous modern kinds exist, this exploration will likewise help open up a chance to set up the most supportable or eco-proficient industrial systems in connection to these enterprises (Geng et al, 2009). EIP promotes the coordination of monetary advancement and natural security, and characterized as "a group of assembling and administration organizations found together on a typical property." Member organizations look for improved ecological, financial, and social execution through joint effort in overseeing natural and resource issues. By cooperating, the group of organizations looks for an aggregate advantage that is more noteworthy than the whole of individual advantages each organization would acknowledge by just improving its individual operations (Lowe, 2001).

EIP and low carbon industrial parks may offer multifaceted advantages to the clients; it normally takes after that any supportability evaluation of the modern park should embrace a multi criteria system. Henceforth, manageability evaluation of industrial parks ought to be represented thinking about the measurements of ecological, monetary, resource supportability. At the point when effectively run, South Africa's modern and innovation parks assume a key part in the urban economy, giving fundamental business and a place for big business and advancement to prosper. Tragically, they can likewise be troubling, threatening spots that experience the ill effects of issues, for example, poor ecological administration, activity clog and contamination. These issues negatively affect individuals who work in industrial operations and live close-by. In this way there is need to have to set out on very much financed inquire about tasks which try to give such territories a feasible future by giving town organizers the devices they have to grow more eco-accommodating modern parks (Research and Innovation, 2012).

Focal and neighbouring firms throughout South Africa have started to grasp the modern nature approach as the way to practical improvement of the nation. There is a developing agreement among approach creators that ecologically friendlier and more economical generation homes should be found if the economy is to continue developing in a way that enhances the personal satisfaction for society.

5. Case study industrial area

This industrial area is a medium site situated in the town of Alberton, with an assortment of light to substantial heavy industrial operations. Alberton is a town located on the East Rand of the Gauteng Region in South Africa which celebrated its centennial year in 2005. In 2007, it had a populace of 202,202 tenants. It is known as a run of the mill room group, a group basically private in character, with the greater part of its specialists driving to work in adjacent rural areas or urban areas. The town has different access streets to all major turnpikes in Gauteng, most eminently the R59, N3 and N12. Alberton is arranged on the banks of the Natal Spruit near the major urban focuses of Johannesburg (15 kilometers south east) and Pretoria (76 kilometers).

6. Research Methodology

Both essential and tertiary information was utilized for investigation. The essential was gathered in a type of review surveys, perceptions and meetings. The surveys were given to industry administrators, interviews were directed on a

few organizations, and various key perceptions noted by the group of analysts on this task. The questionnaires were sent to more than 4000 organizations on email from the database on the organizations working in the area. The optional information was primarily on writing, past reports and database. The thought behind meetings was to discover what administrators and chiefs of businesses think about EIP, taking a gander at the directors' discernments and states of mind towards the thought. The appropriate responses given are more comparative in a way that the examination infers that the chiefs require more learning through preparing and workshops on EIPs to understand the win-win circumstance for the two situations and their own ventures. The study survey were examined utilizing the excel spreadsheet, the perceptions and meetings are utilized for the most part on the proposals. The auxiliary information of this investigation comprise of auditing the writing, given database for the businesses that have just been gone to and the past research report that in a similar research field. The significance of optional information was to give the heading of the exploration, what has been done as such far and would could it be that still should be finished.

7. Results and discussion

7.1 Overview of Alrode industrial area

Essentially all the examination and results were taken from Alrode Industrial area demonstrate that it is still in infancy of eco-industrialization and much waste is being lost without being reused or recycled. The industrial area has an open arrangement and right now all operations are individualized, without much being partaken as far as accessible city infrastructural facilities. The area is still in the conventional plan and a superior course of action must be executed for ceaseless change in waste sharing.

7.2 Waste management

Waste in types released included glass and scrap metal as given in Figure 2. Some waste is as yet an issue and organizations are thinking that it is hard to dispose. There is need to have to organize with particular clients so that this waste can be made useful.



Figure 2. Zinc dipping scrap in Alrode Park

7.3 Industry composition

Metal industries are dominant as shown in Figure 3 and hence control of waste metals need to be attended to. Maintenance industries are following up and hence analysis of the products they do should also be found out in terms of the harm in environment since it involves maintenance of cars, refrigeration mechanics, etc. which have some gases that are released to the environment. Car maintenance disposes carbon monoxide (CO) and panel beating disrupts environment indeed.

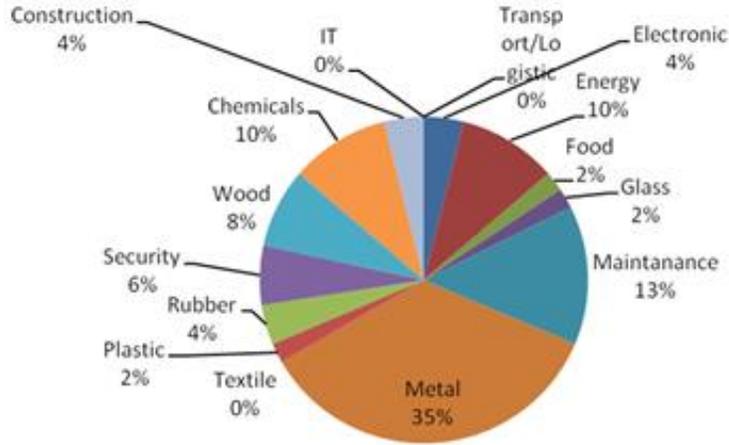


Figure 9. Industry composition

7.4 Willingness to reduce resource consumption

There are Resource Efficiency and Cleaner Production scaling up challenges. Keeping in mind the end goal to survey these and think of greener handling the questionnaire requested that the organizations determine measures they can take. From the 14 organizations that reacted to this Table 4 demonstrates that half can reuse their water while around 30% can recycle the water and another 30% can lessen the measure of water they utilize. This demonstrates for some of these organizations that it is useful to utilize one of these strategies all the while. To spare energy just 14% are willing/ready to join with different organizations to save on energy. Only half can utilize elective wellsprings of vitality that is inexhaustible while around 36% can diminish their utilization of energy. A nearer evaluation is required to perceive how more organizations can be joined to spare energy utilization.

Table 1. Resource consumption responses

| Resource consumption (Water) | | Resource consumption (energy) | |
|-------------------------------|-----|--|-----|
| 1. Recycle | 50% | 1. Combine with other companies to save energy | 14% |
| 2. Reuse | 30% | 2. Reduce usage of energy | 36% |
| 3. Reduce | 30% | 3. Using alternative energy (solar) | 50% |

7.5 Ability of companies to exchange waste and by-products

Table 2. Waste exchange and by-products responses

| Aspect | Customer | Supplier |
|--------------------|----------|----------|
| 1. Goods /services | 7% | 64% |
| 2. By products | 35% | 7% |
| 3. Waste products | 35% | |

One way that is pivotal to reduce waste and enhance asset effectiveness is having organizations in this Industrial Park supply their waste or by items to different organizations to use as raw materials. Table 2 demonstrates that 64% of the organizations can supply their merchandise/benefits as raw materials for others. 35% are conceivable shoppers of other organizations' byproducts and another 35% of waste products.

7.6 Prevalence of recycling, resource conservation and industry collaborations(symbiosis)

The findings indicate that not much on the symbiosis is taking place at the moment as shown by the responses of the questionnaire aspects in Table 3 below due o lack of collaborations amongst the industry operators in the park.

Table 3 Current situation on symbiosis of companies responses

| Questionnaire aspect | Never | Rarely | Often | Always |
|----------------------|-------|--------|-------|--------|
| | | | | |

| | | | | |
|--|-----|-----|-----|-----|
| In this industry is your company benefitting from energy efficiency through collaboration of other companies | 35% | | 21% | 7% |
| The company re-use water | 29% | 21% | 7% | 7% |
| The company recycle water | 35% | 14% | 7% | 14% |
| The company reduced the use of water | 7% | 1 | 14% | 43% |
| The company re-use, recycle and reduce waste products and by-products | 7% | 14% | 14% | 29% |
| The company physically change materials with other companies | 14% | 1 | 21% | 21% |
| The company reuse of by-products from one company (or sector) by other companies (or sectors). | 21% | 21% | 0% | 21% |
| The company sell by products to other company for re-use | 21% | 0% | 7% | 35% |

7.7 Measures recommended to reduce water and energy consumption

The industrial area was particularly examined in the utilization of water and energy, and further on the measures that could be utilized to diminish these resource utilizations. It was discovered that as far as water utilization, half prescribed reusing of water as an option, while 28.57% suggested the reusing of water and 21.43% expressed that they could lessen water utilization as a fitting option. On energy utilization, 14.29% of respondents expressed that joining energy use with different organizations would be the best methods for saving energy. 35.71% suggested lessening energy use and half expressed that an alternative energy source option, for example, solar based would enable the saving of energy in industrial park organizations. In the exploration of this segment an examination of the South Africa bills of installments of power and water, was done and it discovered that the cost of power is USD 0.0897 per kWh, while water USD 0.003.59 per kilo liter.

7.8 Types of waste generated and recyclability

The most experienced type of waste in Alrode industries could be easily exchanged waste and other waste that could go to the landfill. A large portion of the waste produced is arranged in a solitary receptacle and is not isolated, subsequently it is for the most part considered as recyclable waste. This is credited to numbness among organizations as they do not know where to take their waste and how it could be helpful to different businesses and in addition their own particular ventures.

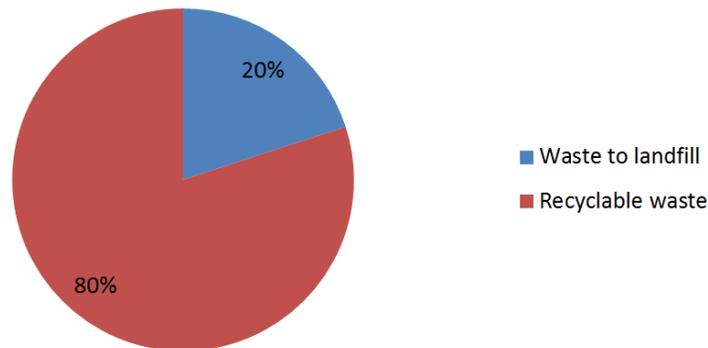


Figure 4. Waste generated by weight per month and recyclability

Enterprises where for the most part reacting on waste to landfill and recyclable waste, while none identified with air contamination and other waste that these ventures are creating each month. This is on account of the landfill and recyclable waste can be effortlessly recognized. Despite the fact that the enterprises happen not to reuse those wastes that can be reused yet these businesses realize that a portion of the waste can be reused as delineated in Figure 4.

of the organizations that figured out how to give back the reaction of the surveys, half expressed that they are reusing at least 75% of their recyclable waste, while just 10% of respondents are reusing 100% .

7.8 Water effluent discharge and pre-treatment

The reaction consequences of the in Figure 13, 43% of the respondent ventures express that they were utilizing constant technique to release water while 28% utilized the cluster strategy. Furthermore, 28% did not react to this inquiry which proposed that the business did not know the sort of the strategy used to release water from their operations. 28.57% of the industrial administrators met expressed that pre-treatment of waste water of gushing happened before it was released. It was however likewise discovered that 42.86% of the administrators met did not know whether any treatment was done to the waste water and effluents before release. The absence of information here demonstrates a lack of instruction and preparing with respect to waste administration. In light of the 15.79% of the industrialists who direct pre-treatment of waste and effluents delivered, assist examination was led to break down the procedure class utilized as a part of the pre-treatment process. It was found that 21.05% of the respondents that direct pretreatment before waste water and effluents release utilize the physical procedures, for example, screening, floatation and skimming. While 73.68% are uninformed of the pretreatment procedure utilized, while 15.79% utilize the synthetic procedure known as balance. It was additionally discovered that none of the respondents utilized any of the organic procedures, for example, streaming, filtration, anaerobic assimilation or septic tanks.

7.9 Waste management

It was discovered that the respondents knew about the different methods that could be utilized to oversee waste. 57% of the respondents proposed that reusing the waste created would be a reasonable methodology, it was however distinguished that the administrators were not learned on the way toward reusing, while 28.57% recommended reusing and 14.29% proposed lessening the waste delivered, as demonstrated in Figure 5. None of the respondents recommended consuming or covering of the waste created.

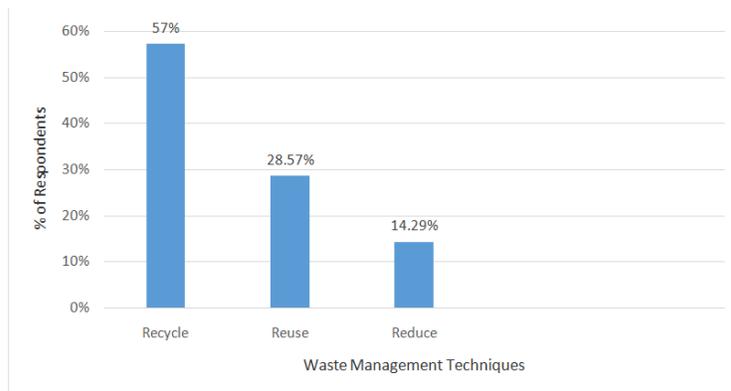


Figure 5. Waste management techniques used

7.10 Government or local authority intervention

It was discovered that the local authorities did not sufficiently offer help to industrial administrators in connection to the waste administration in the area. 64.29% of the talked with respondents expressed that they had never been helped by the local government in managing their waste. 21.43% demonstrated that local authority had once in a while aided the administration of waste, while just 14.29% had regularly received help from local government in the administration of their waste. These figures show that administration intercessions had not been perceived, and in this way industrial parks depend on their business capacities in taking care of waste created.

7.11 Identified improvement opportunities

To recognize opportunities members were requested to give their feeling on the level of change from being an industrial area to Eco-Industrial Park (EIP) and on the presence of advantageous interaction. These outcomes above demonstrated that there was a considerable measure of opportunity to get better. Every one of the regions featured should have been investigated to get every one of the organizations included. More work still should have been finished including usage of strategies where important to encourage the accomplishment of the required change.

After such an overview has been done it is critical to have a complimentary workshop keeping in mind the end goal to network and offer consequences of the examination and guide the route forward. Of the example under thought, 21% of the respondents showed eagerness to go to the expected complimentary evaluation workshop. A proposal could be possibly be made to make it necessary for every one of the organizations in this Industrial Park to partake in this program.

8. Recommendations

8.1 Industrial symbiosis

Modern beneficial interaction is one of the principle attributes of an eco-industrial park. There are various ways that this beneficial interaction can be accomplished. Table 1 demonstrates that 35% of reviewed organizations can offer their by-products to different organizations to re-utilize. This demonstrates a great deal of potential in this regard for advantageous interaction. As more learning is made accessible to the organizations the reaction will progress. Cooperation with different organizations for energy efficiency utilization is a tremendous move. 35% of the organizations have not investigated it. There is need to have to get to why this is the situation and think of methods for urging these organizations to give this a shot. Lessening the measure of and reusing water that each organization is utilizing can be effortlessly done from the review. Around half are doing these two. In a perfect eco-industrial park, organizations that can exchange materials with others or trade, waste and by-products in one place. The nearest the circumstance can get to this the more effective a industrial park will be.

8.2 Transforming into eco-industrial park infrastructure

The improvement to change the area into an eco-industrial park should focus on making a closed loop of material flow cycles and upgrading energy utilisation generated from the industrial area by recognizing the previously mentioned advantageous industrial connections among existing associations. New eco-modern parks can be developed around officially existing operations or worked sans preparation with exercises. Collaboration that creates after some time is expected to actualize and keep eco-industrial parks running; along these lines a developmental approach ought to be embraced. It can be valuable to begin building eco-industrial parks around officially existing materials and existing processes.

8.3 Waste material recovery facility

The establishment of a waste material recuperation establishment can empower the modern parks to change over waste into energy. Changing over waste into energy is a possible answer for the issue of environmental change, since it substitutes petroleum product and controls methane emanations. The methodology involves dynamic help of waste-to-energy activities to create energy inflammable waste and biogas from natural waste. This depends on the waste isolation establishment. To augment the waste-to-energy impact later on, the arrangement to extend and incorporate waste-to-energy establishments and to make an ecological energy park stop would need to be started. A complex with normal power and a bio-energy town outfitted with RDF generator and evaporator, a biogas converter for risky sewage, a energy converter for sewage slime, and a landfill gas preparing area ought to be built in the industrial park. It is normal that 43% of waste can be changed over to energy utilizing this innovation. Moreover, there is a requirement for enhancing arrangements and changes laws expected to elevate waste-to energy exercises, for example, through implementing the Wastes Control Act.

8.4 Development of waste management software

Modern material stream administration can be utilized to build the resource proficiency by methodically advancing the reuse of materials and segments. Such waste supervised programming can be executed to meet both the individual organization's internal needs with respect to waste related data investigation and additionally the necessities for between organization trade and coordination with external players. The product is made out of an arrangement of associated platforms comprising of fundamental information sections, and would help industrial operations as far as recognizing and overseeing data on substances, waste and places engaged with the transfer procedure and also bookkeeping information in this regard (Krause et al, 2012).

8.5 Creation of waste sinks

Waste should never again be viewed as something that is harmful, but as a potential resource for use by the industry processes. The centralization of waste, with the exception of landfill and cremation locales, has been extremely limited by anticipating well being and on security grounds. Nonetheless, similarly as most ventures pick up advantage from the area externalities, there are chances to be picked up from waste recycling. The production of waste sinks or focus on industrial parks makes economies of scale, progression of supply and basic stream mass of waste materials or energy. Waste reprocessing and energy recovery ventures can be invigorated to create savings in dealing with waste. The businesses change over waste into materials and administrations that are sold to makers and processors in a similar area or somewhere else.

8.6 Incentives for industrial ecology

Utilizing industrial nature as the premise of streamlining or advancing material or energy streams, cyclic conduct inside the assembling hubs (administrators) can be accomplished by outlining procedures to advance materials reuse inside same modern parks. Particular examinations should be possible to connect different conceivable activities or cooperative energies accessible in the current in SA modern zones. A multi-disciplinary and incorporated way to deal with the arranging and administration of assembling regions is required to encourage modern environment. It must be key and long haul. Industrial biology advancements take numerous years to sustain, however the key components of foundation must be set down ahead of schedule in the vital arranging procedure to support the brooding of new firms.

8.7 Way forward

There should first be an expansive city or locale wide practicality focus to survey waste streams, markets, transport costs, foundation, open dispositions, social and monetary effects and dangers. Second, there ought to be point by point making arrangements for the plan, advancement and administration of the site. This arranging ought to incorporate various factors, for example, advancement designs, hierarchical courses of action, consolidating an industry impetus to inspire and pull players together, money related and hazard restriction systems venture groups, site plan and tenure agreements. To this end, new uses and imaginative procedures for abusing waste materials should be distinguished in South Africa. This is the area of modern biology that draws on some vision of a natural system of interconnected on-screen characters trading materials and energy. The environmental representation prompts the use of specific apparatuses, for example, material stream investigation (MFA), and life-cycle appraisal (LCA). Frameworks can in this manner be determined that better utilize the discharges and waste streams of industry and local utilization. Waste could be limited by applying a transfer framework for industry by means of an environmental system, whereby results are changed over into re-usable items or resources, for instance, scrap metal could be utilized for assembling processing balls for the mines in South Africa. The change in perspective underway and utilization is expected to reuse and trade side-effect materials and catch and trade waste energy in an economical way.

9. Conclusion

Various challenges have been identified that should be overcome to encourage the promotion of industrial park establishments in South African. In light of a legitimate concern for monetary savings, strategies that advance the recuperation of industrial wastes, must be started through instructing people in general and private to energize modern beneficial interaction. More accentuation ought to be on the improvement of components that would all the more adequately urge singular organizations to oversee waste streams successfully while permitting them the essential opportunity to grow new and beneficial utilization for the same. Mindfulness preparing on eco-frameworks is required as a few organizations do not recognize what is required and what they should do. Working through public private partnerships between nearby experts who are involved with waste treatment and landfill locales, ventures that release issue waste to these destinations, waste organizations that have practical experience in waste re-utilize and reusing, and national government that is in charge of authoritative rules ought to set up a platform to lead the EIP improvement activity on existing framework. For future industrial parks, they ought to be organized in a roundabout or U-shape arrangement to make sharing of resources and facilities simple.

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Biography

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