Greening or greenwashing dirty laundry?

Tracing sustainability in the Tirupur textile cluster.

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Abstract

The contemporary world landscape is epitomised by a highly globalised world economy, where neo-liberal agendas push for ultimate competitiveness and much of the manufacturing and production processes have been relocated from core to semi-peripheral countries. To be able to compete in the global arena, many developing nations and newly emerging economies have sacrificed an approach to sustainable development by neglecting social and ecological aspects. A showcase of such unsustainable growth in recent years can be observed in Tirupur, South India. Tirupur’s heavy export orientation of ready-knitted garments transformed it into a major textiles cluster for fashion retailers and buyer groups worldwide. However, the substantial pollution of water resources due to the discharge of raw effluents by processing units into the Noyyal river and the overexploitation of groundwater cast a shadow on the city’s economic expansion. In order to tackle these challenges, a number of regulatory directives were issued from the mid 1990’s onwards, leading to the enforcement of strict Zero Liquid Discharge norms in the cluster. This study investigates whether intervention efforts directed at Tirupur’s textiles sector have been able to address inherent challenges impacting the local environment and population. The findings gathered from an extensive literature review and a field study to Tirupur suggest that while some problems of the past have been attended to, major sustainability issues remain. Serious concerns such as a shift in pollution and economical uncertainty in the cluster have been identified as consequences from the policy interventions.

Keywords: Intervention, Pollution, Sustainability, Textiles industry, Zero Liquid Discharge

List of abbreviations

BOD  Biochemical Oxygen Demand
CETP  Common Effluent Treatment Plant
COD  Chemical Oxygen Demand
CPCB  Central Pollution Control Board
DAT  Dyers Association Tirupur
ETP  Effluent Treatment Plant
IETP  Individual Effluent Treatment Plant
MLD  Million Litres per Day
MLR  Material to Liquid Ratio
NTADCL  New Tirupur Area Development Corporation Limited
Rs.  Indian Rupees
SD  Sustainable Development
SSI  Small Scale Industry
TADP  Tirupur Area Development Program
TDS  Total Dissolved Solids
TEA  Tirupur Exporters Association
TSS  Total Suspended Solids
TNPCB  Tamil Nadu Pollution Control Board
TWAD  Tamil Nadu Water Supply and Drainage Board
ZLD  Zero Liquid Discharge
1. Introduction

Today’s world picture is characterised by a highly globalised world economy, where neoliberal agendas campaign for ultimate competitiveness in order to satisfy the growing demand for commodities and increased productivity (Dicken, 2007). However, this scenario of capital-driven policy orientation also encourages approaches to accelerated growth that inherently neglect social and ecological aspects. As a consequence, many developing countries striving to compete in the global arena often sacrifice a balanced approach to sustainable development in order to partake in international trade and rapid economic expansion (Chaturvedi, 2012; Fernando, 2003; Rogers et al., 2008).

Over the last decades a number of developing countries have transitioned into emerging economies, showcasing rates of unprecedented growth. Within these newly industrialised states, export clusters are sprawling, attracting foreign capital and providing new opportunities for a myriad of local, national and international actors (Dicken, 2007). One prominent example is India, which has become increasingly attractive for a wide array of industries. As one of the top garment exporters in the world, India’s textiles sector plays a significant role not only with regards to foreign earnings but also as major source of employment (Baskaram et al., 2012). However, besides the high labour intensity of production activities, fabric processing also requires large quantities of freshwater and energy, while generating substantial amounts of wastewater (Rajaram & Das, 2011). Hence, in the wake of challenges such as rapid population growth, urbanisation and changing consumption patterns, pressures on resource availability and ecosystems are surging (Rajaram & Das, 2008). According to various scholars (Chaturvedi, 2012; Saravanan, 2007) India’s precarious freshwater situation, partly due to scarcity and partly due to pollution, is further intensified by the increasing competition for the resource caused by rising demand among industrial and domestic users.

A showcase of extreme water depletion and environmental degradation of the past can be observed in the town of Tirupur, located in the state of Tamil Nadu in South India. The town’s extensive export orientation made it one of the leading global suppliers of ready-knitted garments for fashion retailers and buyer groups worldwide (Banerjee & Munshi, 2004; Carswell, 2012; De Neve, 2009; Heyer, 2013). However, the days of unparalleled growth and industrial expansion were obscured in the mid 1990’s when the substantial pollution of water resources due to the discharge of raw effluents by processing units into the Noyyal river and the overexploitation of groundwater impacting the livelihoods of local people made global headlines (Geetha et al., 2008; Prabha et al., 2013). In addition to the detrimental environmental situation and the threatening consequences for Tirupur and downstream regions, attention also diverted towards social adversities such as child labour, discrimination practices and inhumane working conditions encountered in the sector (Carswell & De Neve, 2013; 2014; Heyer, 2013).

In order to tackle these challenges, a number of regulatory directives were issued from the mid 1990’s onwards, while stricter controls on processing units were enforced over the years. Furthermore, authorities imposed new methods and best practice standards of effluent treatment in order to restore water bodies (Prabha et al., 2013), while new water schemes were inaugurated to counteract acute scarcity and address the increasing demand for freshwater (Srinivasan et al., 2014).
1.1 Research aim and questions

The overall aim of this study is to investigate whether intervention efforts directed at Tirupur’s textiles sector have been able to address inherent challenges impacting the local environment and population. More specifically, the project is concerned with evaluating the sustainability implications resulting from the policy program imposed in the cluster. In order to achieve this objective the following research questions have been devised:

- What key interventions have been instituted and how have the effects been perceived?
- What changes have been triggered by the intervention? How has the policy affected the textiles industry, workers and the local environment?
- Has the policy intervention led to fundamental changes in the industry that inherently contribute to the cluster’s sustainable development in the long run?

1.2 Research justification

The rapid growth of Tirupur’s knitwear industry from the 1980’s onwards, turning a little town into a bustling city that supplies the global market with ready-knitted garments, has been the focus of many studies. Researchers from various disciplines have examined different aspects of Tirupur’s development and its impacts in the region. While some have directed their attention to socio-economical matters such as labour agency, production networks and capital allocation (Banerjee & Munshi, 2004; Baskaran et al., 2012; Carswell, 2012; Carswell & De Neve, 2014; 2013a; 2013b; Cawthrone, 1995; De Neve, 2012; 2009; Heyer, 2013; Vijayabaskar, 2011) others have also focused on environmental aspects concerned with pollution, resource management and water affairs (Arumugam & Elangovan, 2009; Appasamy et al., 2000; Blomqvist, 1996; Geetha et al, 2008; Prabha et al, 2013; Rajaram & Das, 2011; Rajkumar & Nagan, 2011; Ranganathan et al., 2007; Saravanan 2007; Saravana et al, 2011; Senthilnathan & Azzez; 1999). Although a fair amount of research has examined ecological negativities resulting from industrial effluent discharge practices and abatement efforts, the majority of literature does not cover, or fully attend to, occurrences presented in recent years (viz. the Zero Liquid Discharge directive and closure of the dyeing industries). Moreover, there seems to be an inherent lack of studies investigating the contemporary situation using an interdisciplinary approach.

This study aims to address this gap by briefly outlining Tirupur’s environmental situation with regards to development efforts since the mid 1990s until now and, more importantly, by evaluating the sustainability implications of recent intervention directives imposed on the cluster’s textiles sector. To do so, an interdisciplinary approach, pooling natural and social sciences literature has been pursued, while a field study to Tirupur was conducted in order to collect first hand empirical evidence. Furthermore, this paper intends to convey a more intimate and holistic picture to its readers, by incorporating accounts gathered through interactions and interviews with local people recounting their perceptions of developments, so to better comprehend the state of affairs in Tirupur and trace a possible course of augmented sustainability.
2. Background

2.1 India’s challenges to development

Since the liberalisation of India’s economy in the 1990’s, the country has transformed into an attractive destination for industrial manufacturing due to its cheap labour and access to raw materials (Dicken, 2007). However, India’s rapid industrialisation in recent years has led to considerable pressures on the ecosystems. The adverse effects of industrial pollution and depletion of resources have led to scenarios of severe environmental degradation threatening public health and the existence of local populations (Rajaram & Das, 2008). Moreover, as India’s population grows and migration flows to urban areas surge, stress on infrastructure- and ecosystem services further intensify.

According to Chaturvedi (2012) one of the most critical challenges faced by India is concerned with its water resources. On one hand, the rising demand for water poses serious problems for adequate allocation, while on the other hand severe pollution and overexploitation have resulted in the qualitative and quantitative deterioration of water bodies, leading to acute shortages in some regions. India’s economy strongly depends on agriculture for crop production and consequently 80% of water withdrawals are confined to that sector and irrigation purposes. In comparison, domestic and industrial water consumption is relatively low with 5% and 6% respectively. However, water requirements for all three sectors, as well as the energy sector (currently consuming around 1%) are projected to increase significantly in the near future, thus complicating the already volatile situation with regards to supply and management issues (Chaturvedi, 2012; Ranade & Bhandari, 2014).

Furthermore, the widespread problem of untreated wastewaters being discharged into water bodies has ultimately led to serious contamination of surface- and ground waters in various areas, turning “several rivers over long stretches into sewerage drains”(Chaturvedi, 2012; p.2). According to Ranade and Bhandari (2014) an estimated 44 million m$^3$ of wastewater is generated in India on a daily basis, of which large shares are being discharged without any treatment into surface waters (~74% domestic and ~40% industrial). The industry alone produces roughly 6.2 million m$^3$ of toxic, organic and inorganic wastewater per day and despite growing concerns and increased efforts by authorities to address the issue in larger industries, the fact that a substantial amount of India’s industries are found in the unorganised sector$^1$ complicates the matter of control and compliance (Chaturvedi, 2012).

2.1.1 India’s textiles industry

According to the Indian Ministry of Textiles (2014) the textiles industry ranks second, after agriculture, as the most important provider of employment in the country. Occupying a total of around 45 million people, the sector accounts for 14% of the nation’s industrial production, which is equivalent to 4% of the Gross Domestic Product (GDP), while also generating 12% of India’s exports$^2$. Consequently, India is positioned third in global textiles export (behind China and the European Union) and takes the spot as the ninth leading exporter of clothing in the world (Ministry of Textiles, 2014).

India’s textiles and clothing industry can be divided into five general categories of production, namely; i) ginning, ii) spinning, iii) weaving and knitting, iv) dyeing and processing, and v)

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$^1$ According to India’s National Commission for Enterprises in the Unorganised Sector (2008) “the unorganised sector consists of all unincorporated private enterprises owned by individuals or households engaged in the sale or production of goods and services operated on a proprietary or partnership basis and with less than ten total workers”(p.3).

$^2$ Total textile and clothing exports are valued around US$ 35.4 billion for 2013/14 (Ministry of Textiles, 2014).
garments (NCAER, 2009). The structure of the industry is highly fragmented and the supply chain rather complex. According to Baskaran et al. (2012) the supply chain is among the longest in the world, due to the large number of intermediaries involved from the early stages until the product reaches the end consumer. The industry landscape largely consists of small, non-integrated units that have relatively low levels of technical sophistication. An exception is the spinning sector, which is mostly dominated by large firms and has undergone significant modernisation processes since the liberalisation of the Indian economy (NCAER, 2009). Other segments have not been able to modernise as rapidly and still lag behind, although increased rates of expansion and hence modernisation can be observed in the garments sector due to policy reforms3. The dyeing and processing sector, on the other hand, is regarded as one of the least modernised segments in the textiles industry and considered a weak point in the value chain. According to the NCAER (2009) the overall state of that sector is comparatively inferior to the international competition and prone to “redundant dying and bleaching techniques, inadequate technology upgrading, poor yarn quality testing facilities, poor quality of water, inadequate water supply, etc.” (p.121).

Processing activities are considered to be some of the most water intensive stages in the textiles production. In particular dyeing, which combines bleaching and colouring processes, requires large quantities of freshwater while also generating substantial waste outflows (Ranganathan et al., 2007). These effluents are categorised as hazardous and contain high levels of total suspended solids (TSS) and total dissolved solids (TDS) such as sulphate, chloride, sodium, carcinogenic dye ingredients, heavy metals, as well as high loads of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) (Prabha et al., 2013; Saravanan, 2007). If discharged un- or semi-treated (i.e. colour removal) the effluents can have severe impacts on the environment causing pervasive contamination and irreparable harm to water bodies and irrigated land areas alike, thus ultimately affecting the livelihood of local populations4 (Govindarajalu, 2003; Rajaram & Das, 2008; Saravanan, 2007; Srinivasan et al., 2014).

2.2 Theoretical groundings – some things to consider

2.2.1 The globalised world economy

While the discourse evolving around the notion of globalisation is diverse and “scholarly literature on globalization including its origin, dynamics, benefits, or perils, could now fill a medium-sized library” (Olsson et al., 2014; p.4), it is widely regarded as an intrinsic feature used to describe the contemporary world landscape. According to Dicken (2007) globalisation can take on various forms (e.g. cultural, political, economic, etc.) and separating these is often highly difficult due to interdependence and affiliation. Brown (2008) adds to this argument, that defining globalisation and its impacts is highly dialectic and thus dependent on the ideological stance of the beholder. Nonetheless, some of the most prominent and vividly discussed subjects within the globalisation debate focus on the economic dimension with regards to the capitalist market system and the interconnection of a multitude of processes inherently transforming the geo-economy (Bond, 2006; Dicken, 2007).

While the stressors and effects of these processes are diverse, some apparent features shaping the course of the global economy in recent years can be set out. These include a shift towards

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3 Significant policy changes include the de-reservation of India’s garments sector in 2000, the reduction of customs duties, the introduction of Technology Upgradation Fund Scheme (TUFS) in 1999 and the ceasing of the Multi-Fibre Arrangement (MFA) in 2005 (NCAER, 2009).

4 Economical losses due to soil infertility, decreased productivity, higher livestock mortality and health risks such as increasing infertility, skin diseases, infections have been observed.
trade-based internationalisation, privatisation, market deregulation and the geographical reorientation of production activities from industrialised to developing countries (Dicken, 2007; Hughes et al., 2008; Mayer & Gereffi, 2010). Furthermore, the neo-liberal approach, which dominates geo-economical governance and is advocated by institutions such as the World Bank, the World Trade Organisation or the International Monetary Fund, has enabled transnational corporations (TNCs) to emerge as new powerful actors in the international arena. In the era of free trade and economic liberalisation and with regards to increased consumption patterns, it has become increasingly profitable for TNCs from industrialised nations to reconfigure their production networks by relocating manufacturing processes from core to peripheral countries in the developing world (Gereffi, 2001). However, while this geographical shift might offer developing countries an opportunity for economic growth (due to foreign direct investment, employment and export sales) it is also often accompanied by negatives such as environmental degradation, biodiversity loss and social inequality (Dicken, 2007; Fernando, 2003; Sonnenfeld & Mol, 2002). Accordingly, it is to no surprise that some of the most ‘polluting producers’ are newly industrialised countries or emerging economies, catering for the inexhaustible demand in the western world (Lenzen et al., 2012).

2.2.2 Sustainable development: A theoretical, ethical and practical challenge

Sustainable development (SD) has been a highly debated and constantly evolving concept since the 1970’s. It gained increasing international attention since the report ‘Our Common Future’ was published in 1987 by the World Commission on Environment and Development (WCED) and has positioned itself in the global agenda on development issues since the United Nations (UN) Rio summit in 1992 (Rogers et al., 2008). Nonetheless, while SD was initially defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987; p.41), emphasising the importance of a balanced approach to development with regards to economic, social and ecological dimensions, it has been subjected to much controversy ever since, being “continuously contested in a struggle about [its] meaning, interpretation and implementation” (Hajer and Versteeg, 2005; p.176).

Common criticisms raised in political and academic circles are concerned with apparent imbalances and conflicts of interests between the three dimensions and respective development trajectories (Conelly & Smith, 1999; Hall, 2004; Jabareen, 2008; Rogers et al., 2008). As outlined by Goodland and Daly (1996; p.1007) economic objectives are inherently concerned with growth, efficiency and equity, while social objectives deal with matters such as empowerment, participation, mobility and cultural identity. Environmental goals on the other hand focus on maintaining the ecosystem’s integrity, as well as the planet’s biodiversity and carrying capacity. Accordingly, some scholars (Dryzek, 2005; Kates et al., 2005; Lane, 2006; Sonnenfeld & Mol, 2002) address the incompatibility of the contemporary capitalistic nature of the global economy and its underpinnings for development, with regards to ethical values and ideals central to SD such as social justice and ecological conservation. Others, (Fernando, 2002; Redclift, 2006) point out that the much needed call for the internalisation of negative externalities, such as environmental costs due to pollution and resource depletion, stands in stark contrast to the maxim of profit maximisation and overconsumption manifested in the western world. Further authors (Conelly & Smith, 1999; Goodland & Daly, 1996; Rogers et al., 2008) add to this argument that the current international economy’s fixation on growth nurtures actions and processes that exhaust natural capital stocks rapidly, while damaging supporting ecosystems incessantly. Consequentially, they argue that this trajectory is essentially unsustainable and leads to biophysical constraints that will not only impede the

5 Often also referred to as ‘pillars’ of SD.
needs of future generations but at heart also restricts weaker and emerging economies from following alternative development pathways than the one laid out by the global neo-liberal economy. Moreover, Goodland and Daly (1996) draw attention to the fact that the consumption of natural resources is generally looked at as an income generator in economic terms, whereas in reality it liquidates capital in the long-run. While natural capital is considered a perquisite for economic development, environmental assets are neither infinite nor can they be largely substituted by human-made capital, thus making nature’s resources a limiting factor to further development. Accordingly, Goodland and Daly (1996) argue that a transition to SD can only be realised when natural capital is no longer being depleted and is given time to regenerate by focusing on aspects of efficiency and the use of renewable sources. Hence, SD must be understood as “development without growth in throughput of matter and energy beyond regenerative and absorptive capacities” (p.1002).

At the same time it must also be mentioned that the concept of SD has been subjected to much theorisation and depending on the disciplinary background or ideological perspective, weaker (i.e. ecological modernisation, environmental economics) or stronger (i.e. social ecology, eco-socialism) variations of sustainability have emerged (Pepper, 1998). While stronger sustainability advocates a deeper connection to the environment, demanding to keep interventions in the natural world at a minimum, weaker approaches embody perspectives that are less connected to ecology and thus sanction intensive environmental interventions. Even so, in the wake of climate change, population growth and resource depletion, the urgency for SD has become more important than ever in global governance discourse. Nonetheless, the lack of consensus and repeated failure of multilateral negotiations advocating SD exemplifies the divergence between the ‘vision’ and its realities (Clémençon, 2012). Tensions between different ideological standpoints and de facto practices are a testimony to the ‘ethical paradox’ underpinning SD. This becomes even more apparent when one considers the deep divide between industrialised and industrialising countries “where the North demands ‘no development without sustainability’ and the South demands ‘no sustainability without development’” (Jabareen, 2008; p.189).

Consequently, a common conception of SD is that it all too often translates into trade-offs, manifested by policies and strategies that are underdeveloped and plagued by partiality and weak implementation (Dovers, 2005; Redclift, 2006; Rogers et al., 2008). Yet, Conelly and Smith (1999) argue that the concept of SD is integral to any significant efforts that strive to produce solutions and sensible policies aiming to address the diverse challenges that threaten the human and non-human world alike. Moreover, Kates et al. (2005) state that SD fundamentally engages competing interest groups and stakeholders to negotiate development objectives in respect of the planet’s resources and life supporting systems. Hence, SD facilitates a perspective that does not isolate development from nature, but instead places social goals and economic aspirations in direct context with the environment’s carrying capacity. In essence, as Dovers (2005) puts it, one has to understand that SD is a term that encapsulates the “messy, contested process of moving toward” (p.8) the ‘abstract’ state that is sustainability. Furthermore, the author emphasises that sustainability can be regarded as a ‘higher order’ that is neither quickly nor easily (if ever) achieved and thus requires significant and continuous efforts6 over time.

Nonetheless, as pointed out by Jabareen (2008) SD is a highly complex and ambiguous concept, stemming from its vague definition and hence has led to many alternative

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6 Not just with regards to policies but also behavioural changes emanating from adjustments in thinking about values and needs.
interpretations based on different standpoints and assumptions. Even so, Kates et al. (2005) argue that the absence of a definite and established meaning permits the concept to mature, allowing it to be adapted to the dynamics of a changing landscape, thus becoming adjustable to different contexts. However, the concept’s openness to interpretation has to be treated with caution as it can encourage the misuse of the term in order to justify actions (or lead to outcomes) that are inherently unsustainable. “If anyone can redefine and reapply the term to fit their purposes, it becomes meaningless in practice, or worse, can be used to disguise or greenwash socially or environmentally destructive activities” (Kates et al., 2005; p.20). Yet, according to Conelly and Smith (1999) any misemployed use or loose interpretation, seeking to appropriate the term to justify certain activities, can be challenged with reference to core themes central to SD (see table 1). Hence, the scholars argue that these key elements can ideally be used to disentangle the fuzziness of discursive interpretations and their implications employed by different actors and thus can aid to expose those whose actions are at odds with the principles and values integral to the concept of SD.

**Table 1** Key ideals and themes within SD as outlined by Conelly and Smith (1999; p.3)

<table>
<thead>
<tr>
<th>Economy-environmental integration</th>
<th>Economic decisions to have regard to their environmental consequences.</th>
</tr>
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<tbody>
<tr>
<td>Intergenerational obligation</td>
<td>Current decisions and practices to take account of their effect on future generations.</td>
</tr>
<tr>
<td>Social justice</td>
<td>All people have an equal right to an environment in which they can flourish.</td>
</tr>
<tr>
<td>Environmental protection</td>
<td>Conservation of resources and protection of the non-human world.</td>
</tr>
<tr>
<td>Quality of life</td>
<td>A wider definition of human well-being beyond narrowly defined economic prosperity.</td>
</tr>
<tr>
<td>Participation</td>
<td>Institutions to be restructured to allow all voices to be heard in decision making</td>
</tr>
</tbody>
</table>

Although from a theoretical angle these principles can be regarded as cornerstones for approaches and strategies that strive to generate sustainable solutions, practical realities prove to be far more complex. As expressed by Rijbersman and van de Ven (2000; p.336): “multiple solutions exist to a complex problem”. Nevertheless, Rogers et al. (2008) argue that from an operational standpoint SD is about furthering the greater good in terms of economical, environmental and social benefits. However, the authors also stress that benefits in either dimension should not be maximised at the cost of others. Accordingly, a major challenge of SD is concerned with the evaluation and assessment of different solutions and their respective constraints. Yet, it must also be emphasised that problems and solutions alike result from particular interests and objectives of a large number of different stakeholders (people, companies, government agencies etc.). Whether a strategy is considered to be sustainable is highly dependent on the beholder and their respective interests and “in itself seems of no direct relevance to the question of whether something is sustainable or not” (Rijbersman & van de Ven, 2000; p. 337). Although this remains a problematic issue, Rogers et al. (2008) point out that by encouraging participation and transparency in the design process of an initiative enhances sustainability, as capacity development is facilitated.
3. Tirupur’s troubles: A case of unsustainable growth

3.1 The setting

The city of Tirupur is a municipal corporation and the administrative headquarter of the Tirupur district in the South Indian state of Tamil Nadu. Located in the western parts of the state, approximately 50 km east of the city of Coimbatore, Tirupur lies amidst a cotton belt stretching around 80 km wide (Cawthrone, 1995). The river Noyyal, a tributary of the Cauvery, flows through the city and divides it into a northern and southern part. Informally known as ‘Dollar City’ or ‘Knit City’, Tirupur is regarded as India’s leading centre for cotton knitwear, responsible for over 80% of the nation’s exports, while also argued to be one of the country’s oldest centres for textile processing (Arumugam & Elangovan, 2009; Banerjee & Munshi, 2004; Heyer, 2013; Saravanan, 2007; Tirupur District Collectorate, n.d.). Providing retailers and buyer-groups worldwide with low-priced garments, Tirupur is deeply embedded in a global production network making it “one of the most dynamic garment clusters in the ‘developing’ world” (Vijayabaskar, 2011; p.39).

3.2 Climatic conditions

Tirupur’s climate is considered as arid and temperatures typically range between 40°C to 20°C. Meagre rainfalls, averaging around 600 mm annually, and a high evapotranspiration potential of 1500 mm to 2000 mm, make it a water-scarce region. The Tirupur area is frequently described as part of the ‘dry planes’, being sheltered by the Western Ghats mountain range, which creates a rain shadow over the region. Accordingly, precipitation is fairly restricted throughout the year and mostly occurs during the northeast (October to December) and southwest (June to September) monsoon periods (Arumugam & Elangovan, 2009; Blomqvist, 1996; Saravanan et al., 2011).

3.3 Demographic trends

Tirupur is one of two Class I cities in the highly urbanised Noyyal sub-basin, the other being Coimbatore (Srinivasan et al., 2014). Over the last decades, the formerly small town of Tirupur has transformed into an ever-growing city with a population of 444,352 (Census of India, 2011). According to Saravanan (2007) the trend of rapid urbanisation and thus the geographical expansion of the city is a fairly recent phenomenon and its origin can be traced back to the period between 1980 and 1990, when the continuous growth of Tirupur’s garment industry attracted more and more people from rural villages in the hinterlands, seeking new employment opportunities and alternatives to farming. Although agriculture continued to be a major source of income generation in the region until the mid 1990’s, in the years to follow the knitwear industry manifested itself as the most important employer in the region, significantly reducing agricultural activities in surrounding villages while also increasingly attracting long-distance migrants (Heyer, 2013).

Due to augmented in-migration, Tirupur’s urban area has been expanding continuously and has transformed into an urban agglomeration, which according to data provided by the Census of India (2011) is populated by a total of 963,173 people. However, increasing labour mobility, impacting permanent and temporary settlement regimes, might considerably influence the number of people actually residing in the city and the greater agglomeration area. This is due to the fact that, as mentioned by Carswell and DeNeve (2013a), many long-distance migrants employed in the textiles industry do not settle permanently in Tirupur, often

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3 For administrative purposes the Tirupur district is split into 8 ‘Talukas’ or into 13 ‘Panchayat’ Unions (blocks).
8 In India, Class I cities are urban settings with a population exceeding 100,000 (Census of India, 2011)
only staying for a certain time period such as several months or years. Hence, matters such as temporary residency might not be represented accordingly in official statistics.

In addition, it must be emphasised that the drastic population growth of the city is contrasted by a lack of housing developments, thus leading to an expansion of slum settlements in the municipal corporation. While Saravanan (2007) points out that the Tirupur City Corporate Plan published in 1999 identified 88 slums in the city with a population of 63,094 residents, a more recent study\(^9\) reports a total of 129 slum quarters scattered throughout the city encompassing 15,226 households. However, even though the study mentions that it is not uncommon for several families to share a single household, it does not specify the total number of people residing in the slum areas\(^10\), but rather focuses on the fact that a vast majority of the dwellings are lacking individual water supply (90%), access to sanitation facilities, electricity, proper roads and sewage drains and thus are deemed unfit for tenure.

3.4 The industry profile

Despite Tirupur’s involvement in the cotton trade since the 19\(^\text{th}\) century, textile manufacturing only gained increasing importance in the 1930’s. However, the city’s role in the textile trade was limited to production for the domestic market until it started exporting cotton knitwear to Europe in the 1970’s (Banerjee & Munshi, 2004; Blomqvist, 1996; Cawthrone, 1995). Since then the textiles industry has experienced phenomenal growth, turning Tirupur into India’s leading centre for knitted garments\(^11\) as well as one of South Asia’s largest knitwear clusters, providing the global market with garment exports (Carswell & De Neve, 2014; NCAER, 2009; Rajaram & Das, 2011). While exports were quoted to be worth around US$ 4 million in 1985, direct exports were valued at US$ 2.5 billion by 2008-09 (Heyer, 2013), highlighting the remarkable growth trajectory and dominant export orientation of the sector.

Tirupur’s industry landscape is frequently described as a highly dynamic and flexible manufacturing cluster with a dense network of decentralised production units, which are connected through subcontracting and extensive inter-firm relations (Carswell & DeNeve, 2013a; DeNeve; 2012; Heyer, 2013). Previous national policies regulating labour-intensive sectors such as garments production, in essence reserving it for small-scale industries (SSIs), significantly shaped the structure of the Tirupur industrial cluster. In order not to surpass the capital ceiling fixed for SSIs, growing firms would frequently split into smaller sister-companies (often owned by family, relatives or affiliates), inherently strengthening informal linkages and cooperation (Blomqvist, 1996; Vijayabaskar, 2011). Accordingly, a highly fragmented production chain developed, largely dominated by small- to medium-sized units specialising in just one or two stages in the garment production (see fig.1 for a sequential representation of phases in the knitwear production). However, the de-reservation of the garments- and the knitwear sectors (in 2000 and 2005 respectively) enabled firms to actively engage in the expansion of their operation capabilities to meet increasing demand by buyers.

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\(^9\) Conducted by the National Institute of Technical Teachers Training and Research (2014) for the Tamil Nadu Slum Clearance Board.

\(^10\) According to data provided by the Census of India (2011) 71,856 people live in Tirupur’s slums, while the UN-HABITAT (2006) reports a slum population of 204,553.

\(^11\) In literature Tirupur’s textile industry is often also referred to as a hosiery sector. As specified by the NCAER (2009; p.84) “traditionally ‘Hosiery’ is knitted products used for covering of the legs and feet i.e. stockings. But ‘hosiery’ is now used in wide sense and covers all knitted fabric such as, T-shirts, undergarments, knitted trousers, socks, stockings, etc.” Accordingly, this paper adopts the interchangeability of terms such as hosiery, knitwear and ready-knitted garments in consideration of the fact the Tirupur’s textile industry specialises (almost entirely) in garment manufacturing made from knitted cotton fabrics.
and thus led to the rise of large manufacturers in the cluster in recent years (Heyer, 2013; Vijayabaskar, 2011).

Nonetheless, Banerjee and Munshi (2004) claim that inherently three types of firms characterise the industry landscape. First of, direct exporters, which are firms with direct connections to foreign buyers and access to fixed capital, thus more inclined to integrated levels of manufacturing. Secondly, indirect exporters, which are independent manufacturers and hence resemble direct exporters except that they do not possess first-hand relations with clientele from abroad. As a result, they often function as subcontractors handling excess orders for direct exporters. And thirdly, job-workers, which are small to medium sized production units or workshops that have specialised in a certain stage in the production chain. Direct and indirect exporters alike, commonly employ job-workers to carry out specific orders or parts of orders and hence utilise them as sub-suppliers. However, it must be emphasised that the organisational structure and size of export houses (direct and indirect exporters) is highly heterogeneous and while a few are large and fully integrated, carrying out all the stages from knitting to packaging in their own factories, others have limited their level of integration to a set of stages in the production process (DeNeve, 2012; NCAER, 2009). Even so, the majority of Tirupur’s firms produce outputs on job-work basis and thus depend on export houses and/or domestic buyers for contract orders, since they do not produce on their own initiative (NCAER, 2009).

According to government data (Tiruppur District Collectorate, n.d.; NCAER, 2009) there are around 6250 units operating in Tirupur. However, Saravanan (2007) points out that such official data merely accounts for registered firms and consequently does not represent much of the unregulated and informal activities involved. Accordingly, various scholars (Carswell & DeNeve, 2014; DeNeve, 2012; Sellamuthu et al., 2011) estimate a total of around 10,000 units in Tirupur, employing roughly 400,000 people. However, actual employment numbers might fluctuate considerably, due to the fact that a large share of units is found within the informal or unorganised sector, subjected to high labour mobility and prone to non-secure and casual employment (Carswell & DeNeve, 2013a; Vijayabaskar, 2011).

The industry’s high labour intensity has generated a constant need for workers, attracting a diverse workforce to Tirupur for decades, which according to Carswell and DeNeve (2013a) can be broken down into three broad categories. On one hand, there are settled workers, which permanently reside in Tirupur. Although some originate from the city or the region, most are actually migrants who settled in Tirupur and have no intention of returning. On the other hand, long-distance migrants are labourers that seek employment for a certain time

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12 Number of units and operation: 1,500 knitting, 700 dyeing and bleaching, 300 compacting and calendaring, 2,500 knitted garment making, 500 fabric printing, 250 embroidery, 500 ancillary. 13 Carswell and DeNeve (2013a) and Heyer (2013) point out that this number is most probably an underestimation of the actual employment total, while Rajaram and Das (2011) state that the knitwear industry employs around 500,000 people.
(several months to years) with the intention of returning home eventually. The last group are defined as *commuters*. They live in surrounding villages and travel distances up to 50 km every day in order to work in Tirupur’s knitwear industry. However, Carswell and DeNeve (2013a) also point out that “although a widening group of workers are gaining access to Tiruppur, newly arrived and lower caste migrants remain the most adversely incorporated in the industry” (p.68). In particular, less attractive work such as the ‘dirty’ jobs found in the dyeing sector are often reserved for long-distance migrants and outsiders such as scheduled castes, while settled populations occupy better-paid jobs in the textiles branch. According to a study conducted by SAVE (2006) an estimated 65% of Tirupur’s slum population consists of migrant workers predominantly occupied in the knitwear industry. Yet, it must also be mentioned that high fluctuations in the labour market and the large but unpredictable demand for workers in the industry have severely impacted aspects of caste identity in workforce recruitment. According to Carswell and DeNeve (2014) the role of caste is becoming less and less important in the urban garment industry due to the fact that “factory owners and labour contractors now need ever more workers and employ whoever is capable of doing the job, irrespective of their caste or religion” (p.117).

3.5 The water dilemma

As pointed out by Ranganathan et al. (2007) the water quality of the Noyyal and Tirupur’s warm climate are considered to be highly advantageous for dyeing operations. Thus, the cluster showcases a high concentration of units specialising in wet processing activities, which in turn are some of the largest water users in the region (Srinivasan et al., 2014). However, excessive water consumption by textiles industries since the 1980’s, throughout the 1990’s and early 2000’s severely depleted fresh water resources in the Noyyal basin, threatening agricultural activities as well as the already short-handed provision for the growing domestic sector.

Although two water schemes\(^{14}\) supplied the city with 28.5 million litres of water on a daily basis, the pressures of rapid urbanisation (due to the expansion of the knitwear cluster) exposed the obsolescence of Tirupur’s water supply. According to Madhav (2008) “water supplied by the two schemes is not able to meet the water demands of the city” (p.6) and therefore many domestic users are highly dependent on the use of groundwater for drinking and household purposes. However, in order to satisfy their inexhaustible need for water, processing units also resorted to groundwater extraction, importing large quantities of freshwater from wells, boreholes and aquifers as far as 50 km away from Tirupur on a daily basis, which in turn resulted in a dramatic decline of groundwater levels in the Tirupur area (Srinivasan et al., 2014). Despite being recognised as a drought prone area by government authorities, outlining the region’s dependence on water resources in the basin and its vulnerability to unsustainable utilisation practices, economical benefits derived from Tirupur’s thriving knitwear sector outbalanced the detrimental over-exploitation of local water bodies (Madhav, 2008; Srinivasan et al., 2014).

The critical situation regarding Tirupur’s water condition was further intensified by the massive amounts of wastewater generated by processing units\(^{15}\). As mentioned earlier (see section 2.1.1), outflows produced by dyeing and bleaching units are considered highly hazardous, and if discharged into the environment can cause irreversible ecological damage.

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\(^{14}\) The first scheme was inaugurated in 1962 and diverts 7 million litres of water per day from the Bhavani river at Mettupalayam, of which 4.5 million litres are supplied to Tirupur city. The second scheme was launched in 1993 and diverts an additional 45 million litres per day from the Bhavani, of which 24 million litres are directed to Tirupur and the rest to surrounding villages (Saravanan, 2007).

\(^{15}\) Depending on the study the amounts of wastewaters generation vary between 80–120 MLD.
and impact the health of livestock, fish and humans. According to (Rajkumar & Nagan, 2011) in addition to the vast industrial outflows, around 3 MLD of untreated urban wastewater also end up in the Noyyal, making it “one of the most polluted rivers in the State” (p.559).

Suitably, Tirupur’s industrial pollution is well documented and numerous studies (Appasamy et al., 2000; Rajaram & Das, 2011; Rajkumar & Nagan, 2011; Ranganathan et al., 2007; Saravanan 2007; Saravanan et al., 2011; Srinivasan et al., 2014) point out that the continuous discharge of effluents by the dyeing sector into the Noyyal river has lead to an acute deterioration of surface waters while also contaminating the groundwater in the area and further downstream regions due to accumulation in the soil and percolation. Moreover, various research papers assessing Tirupur’s groundwater quality in recent years (Arumugam & Elangovan, 2009; Geetha et al., 2008; Prabha et al., 2013; Sellamuthu et al., 2011; Senthilnathan & Azzez; 1999) emphasise that it is clearly unfit for drinking in addition to being often unsuitable for irrigation purposes due to high salinity content (medium-high to very high sodium and chloride toxicity).

Accordingly, the inherent contamination of the Noyyal’s surface and groundwaters and thus the subsequent deterioration of the river’s side canals, tanks (32) and reservoirs (2) not only affects the well-being of the ecosystem but also considerably impacts farming activities (agriculture and livestock) in the sub-basin (Srinivasan et al., 2014). Due to the high salinity of the waters, irrigated lands become infertile and turn barren, while livestock mortality has been reported to increase. Furthermore, the polluted water is also said to have severe effects on local populations and their physical condition. According to Govindarajalu (2003) the metals and chemicals found in the industrial effluents are harmful to human health and there is a direct correlation between increased skin diseases, gastritis, allergies, respiratory infections and the consumption or direct contact with polluted waters16. Saravanan (2007) adds to this argument that people working in Tirupur’s dyeing sector are also often prone to skin diseases, allergies and stomach aches, while Ranganathan et al., (2007) refer to a study by Rajaguru et al. (2002) that “indicates that the ground water in the Tirupur area is also contaminated with substances capable of inducing DNA damage in human cells” (p.308). In addition, Srinivasan et al., (2014) communicate that increasing rates of infertility have been recorded for people living downstream of the industrial cluster of Tirupur.

3.6 Addressing Tirupur’s water challenges

Faced by increasing pressures and tensions with regards to Tirupur’s dire water situation, numerous undertakings were set in motion since the mid 1990’s to deal with the challenges. Yet, some of the most consequential measures directly affecting water pollution and supply issues resulted from an array of judicial actions and the combined effort of public-private actors.

3.6.1 Pollution response

Attempting to halt effluent discharges into the Noyyal by dyeing and bleaching units, the Ayacutdars Protection Association filed a written petition to the Madras High Court in 1996, detailing the extent of environmental pollution and its consequences in the area. This lead to the subsequent employment of the ‘polluters pay’ directive, in which the High Court ordered the Tamil Nadu Pollution Control Board (TNPCB) to enforce stricter environmental standards and controls on polluting units, while making sure that common effluent treatment plants (CETPs) and individual effluent treatment plants (IETPs) were installed. In addition, the High

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16 The study conducted by Govindarajalu (2003) was carried out in 31 rural villages located in the Noyyal sub-basin (within the Tirupur area). 1120 villagers (most of them farmers) were examined for their medical condition with regards to water-borne disease.
Court directed the TNPCB to assess ecological damages and instruct the processing units to compensate farmers for their losses (Srinivasan et al., 2014). However, according to Saravanan (2007) the implementation process was rather sluggish and the installation and completion of treatment plants was continuously delayed and stalled by appeals from the industries. Hence, it was not until 1998, that eight CETPs and circa 300 IETPs had been set up for operation, while processing units without any treatment facilities in place were ordered to close down.

However, despite mandatory effluent treatment in the Tirupur cluster, the pollution scenario continued unscathed. This is mainly due to the fact that most installed CETPs and IETPs were not treating their effluents according to prescribed standards set by the TNPCB (Appasamy et al., 2000). A report issued by the Central Pollution Control Board (2005) emphasises that at the times of inspection all eight operational CETPs in Tirupur failed to reduce TDS (in particular salts such as sulphates and chlorides) to permissible limits, while only 40% of the BOD and COD were being removed during the treatment. Hence, the water discharged back into the Noyyal was only partially treated and in ‘gross violation’ of baseline levels.

Correspondingly, Ranganathan et al. (2007) point out that the nearly all treatment plants in the cluster were unable to retain inorganic contaminants due to technological restrictions. Yet, it must also be mentioned that factors such as additional costs encountered by treating wastewaters and lax enforcements of penalties by authorities had an impact on the levels of compliance among industrialists. Nelliyat (2007), for example, communicates that “since there is no subsidy for operation or maintenance cost, many industries are not willing to operate their effluent treatment plants. Besides, the Tamilnadu Pollution Control Board (TNPCB) did not take any serious action against the industry when they violated the standard (effluent norms)” (p.13).

In response to unsatisfactory effluent treatment measures and the continuous discharge of polluted wastewaters into the environment, the High Court of Madras ordered Tirupur’s dyeing sector in late 2006 to adopt zero liquid discharge (ZLD). The units were given until the 31st July 2007 to upgrade their IETPs and CETPs, and informed that a failure to comply would lead to an immediate closure of offending units. Furthermore, the court ruled that the industries should compensate the farmers impacted by the pollution of the Orathapalayam dam, while also paying for the clean up of the Noyyal and the reservoir (IELRC, 2009).

Nevertheless, on the 28th January 2011 the High Court directed the complete closure of Tirupur’s dyeing sector due to non-fulfilment of the ZLD directive, shutting down over 600 units indefinitely. The TNPCB was entrusted with enforcing the closure, while also given the authority to designate operation permits to facilities that had achieved ZLD. However, due to the fact that majority of units were facing difficulties in implementing the strict ZLD requirement, the TNPCB issued trial permissions to various units allowing them to run their operations between 30-70% of their capacity. According to the Dyers Association of Tirupur (DAT, 2013) 18 CETPs servicing 490 member units and over 100 industries with IETPs were granted trail run permissions “based on improvement in technology and new machinery additions in treatment”.

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17 According to Appasamy et al., (2000) around 164 dyeing and bleaching units had been shut down by 2000, decimating the total number of units from over 860 to circa 702, of which 424 had IETPs and 278 were connected to 8 CETPs.

18 The Orathapalayam dam is a large water reservoir downstream of Tirupur, inaugurated in 1993 for irrigation purposes. Yet, industrial effluents turned the reservoir into an accumulation of toxic wastewater.
3.6.2 Water supply initiative

Due to scarcity issues and surging water demands in the cluster, a public-private partnership known as the New Tirupur Area Development Corporation Limited (NTADCL) was inaugurated in 1995. Set up as a ‘special purpose vehicle’, this collaboration between the Government of Tamil Nadu, the Tirupur Exporters Association (TEA), the Tamil Nadu Corporation for Infrastructure Development (TACID) and the Infrastructure Leasing and Financial Services (ILFS) sought to address inherent water management challenges in the Tirupur area (Madhav, 2008; Nellyiat, 2007; Saravanan, 2007). According to Madhav (2008), the NTADCL’s central responsibilities focused on “the offtake, treatment and transmission of water, distribution of water to industries and the municipality for domestic consumption, and treatment of the collected sewage, and maintenance of the sewage treatment plants” (p.2).

Correspondingly, the NTADCL advanced a water scheme known as the Tirupur Area Development Project (TADP), which by its completion would extract a total of 185 MLD of water from the Cauvery river around 56 km from Tirupur. An extensive system of pipelines and various pumping stations were build to guarantee the supply of 125 MLD of water to dyeing and bleaching units, 25 MLD to the Tirupur municipality and the distribution of the remaining 35 MLD to rural villages in the surroundings. Moreover, the scheme also incorporated the construction and operation of several plants treating extracted raw water to potable standards and sewage works treating domestic wastewaters. The project was finished in 2005 and cost roughly US$ 220 million, which was funded partially by equity and debt allocation (Madhav, 2008; TWIC, 2011).

Yet, despite the prominence as India’s first public-private venture in the water and sanitation sector, providing an “umbrella coverage for the entire water supply requirements of Tirupur Planning area spread over 225 SqKm” (TWIC, 2011) 19, the NTADCL has encountered considerable criticism with regards to the implementation and operation of its water scheme. Due to the fact that the project is based on a cross-subsidisation scheme (charging the industry higher tariffs in order to subsidise domestic off-take) the industry was considered as the most important consumer and thus “the management can prudentially afford to neglect domestic users” (Datta, 2009; p.77). Accordingly, the industry’s supply has been prioritised from the outset and while their demand has been attended to, domestic users are still facing shortages. “The water being supplied by NTADCL does not satisfy the needs of a large section of people in Tirupur. The water is being supplied only once in 15 days which lasts for about 3 to 4 days. With the booming population and increased migration, the existing projects are woefully inadequate” (Madhav, 2008; p.12).

Further criticisms directed towards the NTADCL are concerned with inadequate water quality, unfair pricing and a failure to address water needs of the poorest. According to Datta (2009) Tirupur’s residents have been issuing complaints that they are receiving un-chlorinated water, which is supposed to be diverted to dyeing and bleaching units, while also being charged nearly twice the price of municipalities close by. Moreover, Datta (2009) and Madhav (2008) point out that due to the privatisation of water provision and hence the commodification of water, populations with the lowest incomes are being discriminated against. This is due to the fact that slum areas have been largely ostracised from water development works and thus are being denied equal access to potable water from the scheme. As a result, they are subjected to sporadic water availability and often resort to purchasing

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19 According to information provided by TWIC (2011) the project fully secures the water supply for Tirupur’s residents and surrounding villages, while also providing a new sanitation network for the municipality including onsite sanitation facilities for slum areas, in addition to allocating quality water for the processing industries.
According to Madhav (2008) the NTADCL’s failure to attend the needs of a large share of Tirupur’s poorest infringes “international norms of availability, quality, non-discriminatory accessibility and information dissemination” and thus the “NTADCL clearly is in violation of the human right to water” (Madhav, 2008; p.13).

3.7 Tirupur’s unresolved pollution issues and concerns

Although mandatory effluent treatment conforming to ZLD norms is regarded as a means to terminate the pollution of water bodies in the Tirupur region, various issues regarding the industry’s impact on the environment are unresolved.

One highly controversial issue deals with the disposal of sludge, which is an end product resulting from effluent treatment, i.e. the concentrated contaminants extracted from the wastewater and turned into a solid state. As stated by Rajaram and Das (2008) “the threat of water contamination is fully averted only when this toxic sludge is properly disposed in a secured landfill” (p.66). Yet, according to Srinivasan et al. (2014) the practice of dumping sludge in unsanctioned areas such as along the riverbanks of the Noyyal is an obvious problem. In their study the authors also point out that the dried up toxic sludge often becomes airborne, resulting in an increase of respiratory-related diseases near dumping grounds. Likewise the sludge disposal issue has been commented on in India’s national media. For example, an article by Vimal Kumar (2014, April 12th; The Hindu) describes that illegal dumping of industrial sludge has become a serious threat to Tirupur’s ecosystem and water bodies such as the Nanjarayan tank.

Moreover, the problematic of on-going effluent discharge in spite of the ZLD directive is being reported. According to the newspaper correspondent Vimal Kumar (2014, January 9th, 2014 February 11th; The Hindu) industrial pollution in Tirupur continues as effluents are still being discharged into the Noyyal and are “still found in large quantities in open areas and streams in the surroundings of dyeing units”. Further, the articles refer to farmers who question the seriousness of the ZLD directive and the permission of treatment plants to continue to operate on trail-basis even though it has been well over 2 years since ZLD norms were enforced and thus term the trail runs “an eyewash”. However, it is also expressed in the articles that dyeing units illegally discharging of their effluents do so in order to reduce power costs, which according to the president of the DAT (Mr. Nagarajan) constitutes 50 per cent of the operational costs in effluent treatment.
4. Methodology

4.1 Positioning the study

4.1.1 Research approach and purpose

To frame the approach of a study is integral for conducting fruitful research. According to Creswell (2014) and Silverman (2005), methods and the resulting implications are influenced significantly by the methodological path decided upon by the researcher. Consequently, it is of great importance to clarify the premise of one’s research at the outset in order to position the study within a suitable approach (Silverman, 2005). Because this empirical study is concerned with investigating developments, an inductive research approach based on a qualitative methodology was deemed most appropriate.

Yin (2009) argues that within the social sciences the purpose of a study can most commonly be classified into three main categories, being either descriptive, explanatory or of exploratory nature. Whereas the descriptive style is used inherently to describe an area of interest, topic or phenomenon, the explanatory study is rather concerned with explaining its patterns or trends, while the exploratory approach aims to explore a theme, where often a lack of or no research is evident (Yin, 2009). However, crystallising a study’s purpose and hence placing it within one of the categories is not as straightforward as it might seem. According to Yin (2009) it is not uncommon for studies to fit several profiles, since overlapping characteristics might be at hand.

This also holds true for this study, since descriptive and explanatory features can be ascertained. Obvious descriptive attributes of this study include the collection of retrospective accounts of local people recounting events and water affairs in Tirupur. At the same time explanatory traits are also present throughout the study with regards to reviewing and elucidating accumulated materials. Yet despite these indications, the purpose of this study is essentially of an exploratory nature, due to the fact that it attempts to shed a new light on occurrences in Tirupur over the last 20 years. Furthermore, the explorative scope of this study is backed by the apparent lack of scientific literature dealing with trending and contemporary issues in a sustainability context. While previous research about Tirupur has been conducted, it is often limited to a certain disciplinary perspective and thus attempts to establish relationships with other fields of study are scarce or out-dated.

4.1.2 Research design

A research design is a systematic plan allowing the investigator to collect and analyse empirical data in order to address the research questions. The design can consist of various inquiry types and techniques and provides the study with an overall framework and further orientation (Berg, 2004; Bryman, 2004; Creswell, 2014; Flick, 2014). According to Yin (2009) the five most prominent procedures to gather evidence are: Experiments, histories, case studies, archival analyses and surveys. In order to select the most suitable design for a study, Yin (2009) emphasises the importance of three conditions: “…a) the type of research questions posed, b) the extent of control an investigator has over actual behavioural events, and c) the degree of focus on contemporary as opposed to historical events” (p. 8).

In respect of the study’s objective and in consideration of Yin’s conditions, a research design favouring the adaption of a case study was deemed most appropriate because of the following reasons: a) The case study design facilitates the exploratory nature of inquiry complying with the study’s research questions posed. b) My role as a researcher was rather limited in terms of steering the course of affairs. The thematic of this study was bound to investigating actual occurrences specific to the location (i.e. case scenario) and hence the acquisition of situated
knowledge was key. c) The research does not merely dwell on the past but is concerned with on-going developments. Accordingly, it “investigates a contemporary phenomenon in depth and within its real-life context” (Yin, 2009; p.18).

4.1.3 Research strategy
Having positioned the study’s approach within a qualitative methodological context and having adapted an exploratory case study design, a research strategy making use of triangulation was decided upon in order to collect and analyse primary and secondary sources of qualitative but also quantitative nature.

4.2 Data collection methods
According to various scholars (Berg, 2004; Creswell, 2014; Flick, 2014; Silverman, 2005) the technique of triangulation combines different collection methods in order to get a better understanding of data and empirical evidence. Furthermore, it allows for better assessment of the reliability and validity of sources and interpretations, due to the fact that shortcomings and limitations of a certain method can be addressed using an alternative perspective, adding supplementary knowledge and fostering the study’s originality (Creswell, 2014; Flick, 2014). Consequently, for this study data was converged in a triangulating manner using the following methods: i) Interviews and ii) observations providing primary research materials, and iii) a thorough analysis of public documents as secondary sources. In addition, a rigorous review of literary materials of academic nature provided the study with theoretical grounds and an overview of contemporary research.

4.2.1 Primary research
In order to obtain first hand data for this case study, a research visit to Tirupur was organised. In Tirupur face-to-face interaction with various individuals connected to the ready-knitted garment industry was sought. This fieldwork spanned over the period of 4 weeks (April 7th – May 4th 2014) to permit a successful collection of evidence and allow for possible refinements, such as adaptation of methods and establishment of contacts in order to gain access to necessary sites and individuals.

4.2.1.1 Interviews
Focusing on situation-based accounts and to further in-depth knowledge, qualitative interviewing was chosen as an appropriate technique, since it facilitates a dynamic approach granting valuable insights of people’s lived experiences (Bryman, 2004; Roulston, 2010; Silverman, 2005).

According to Berg (2004; p.78) qualitative interviewing can be categorised into three distinctive structures, either following a standardised, an un-standardised or semi-standardised design. For this research project, a semi-standardised approach was adapted due to the fact that it encourages flexibility adhering to the situation, neither imposing a desired response on the interviewee nor drifting too much off-topic while engaged in interaction (Berg, 2004; Mason, 2002). In order to facilitate this kind of communication, an interview guide was devised in preparation, which according to Gilbert (2001) can be seen as a reminder to the interviewer to cover certain aspects and sub-topics. The structure of this guide was mapped out in a set of open-ended questions, designed with regards to the research problem and questions in mind.

Aiming to primarily interview two different target groups, adjusting the posed content was key. As a result, two differing sets of interview guides were formulated. One set was directed
towards industrialists operating in the processing of textiles and hence tailored to a business-oriented context relating to socio-economical developments and water thematics (see appendix I). The second set was devised for labourers employed in the garment industry. Here, the emphasis was placed upon narratives of socio-economical aspects with special regards to water availability and access over time (see appendix II). A third guide directed at industrialists and labourers, with questions exclusively focusing on the water situation was also employed (see appendix III).

To ensure that questions in the guide were appropriate and understandable, the first interviews carried out in the first days after the arrival in Tirupur were considered part of an orientation phase and hence regarded as pilot interviews. According to various scholars (Creswell, 2014; Gilbert, 2001; Silverman, 2005) the information gathered during pilot interviews allows the researcher to channel gathered information and adjust the context and precision of questions asked in future sessions. Consequently, information collected during the pilot interviews was used to fine-tune the inquiry approach and allow the individual to assimilate to the setting and “establish familiarity with the new culture and learn some of the many verbal and nonverbal factors that may cause interviews to go amiss” (Brinkmann & Kvale, 2015; p.168).

Despite the initial focus on industrialists and labourers, additional interviews with other individuals were also conducted throughout the field study. These supplementary interviews included NGO and association representatives as well as industry affiliates among others. Yet, throughout the study it also became evident that gaining access to labourers working in processing units would prove extremely difficult. Accordingly, a focus group approach was adapted in the last days of the field study, in order to avert a situation where no primary data from labourers would be at hand. While the focus group interview does not offer the precision of a one-to-one interaction, according to Brinkmann and Kvale (2015) “in the case of sensitive taboo topics, the group interaction may facilitate expression of viewpoints usually not accessible” (p.176).

In total, 26 interviews and one focus group with 5 individuals were carried out in Tirupur. Whereas some interviews followed a more structured approach with respect to the interview guide, others followed a highly discursive, spontaneous format. Accordingly, some interview session were rather time extensive (≥ 45 minutes) while others were relatively short in comparison due to the fact that they were impromptu conversational exchanges.

4.2.1.2 Observations

According to Yin (2009) observations are a common method used in case studies and often provide fundamental knowledge to understand phenomena. Observational methods can take on various forms depending on the research context and chosen methodology (Flick, 2014; Mason, 2002; Silverman, 2000). For this study, two kinds of observations were pursued during the fieldwork in order to get a better comprehension of social structures, culture and also environmental conditions. Due to the qualitative scope of the research, both observational techniques collected data in natural situations (Flick, 2014), meaning out in the field and not in a controlled environment such as a laboratory for example. On that account the forms employed were i) non-participant observation, and ii) participant observation.

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20 Targeting labourers occupied in processing units such as dyeing and bleaching houses.
21 Due to: i) issues of mistrust towards the researcher ii) the omnipresence of supervisors/personal that might impede individuals to speak freely while being interviewed on factory premises iii) finding appropriate times and places to conduct interviews (breaks and free time).
Whereas the non-participatory method was aimed at observing events, behaviour and surroundings (specifically visible ecological aspects) in a passive manner and hence “refraining from interventions in the field” (Flick, 2014; p.308), the participatory approach was aimed to actively engage within the environment. As a consequence, data collected through observations adhering to the latter method was influenced by communication and interaction, providing a different perspective to the former\textsuperscript{22}. Both methods were used to capture qualitative insights and grasp relevant aspects in order to get a better understanding of the current situation in Tirupur. These observations were either caught on photographic image or summarised in field notes.

### 4.2.2 Secondary research

Throughout the study a bulk of secondary research was revised, making extensive use of books, articles and journals, electronic databases and the Internet. Whereas the materials used for the literature review mostly consisted of academic, peer-reviewed research papers and publications to set the ‘tone’ of the study, further documents of non-academic origin were used to collect further data and records of societal life and events in Tirupur.

#### 4.2.2.1 Documents as data

According to various scholars (Flick, 2014; Gilbert, 2004; Mason, 2002) the term ‘documents’ can incorporate a myriad of formats including texts, audio and visual materials. Whereas some are public, others are of private nature, yet all documents are a construct of the social world and hence are prominently used in qualitative research (Gilbert, 2004). For this case study, an assortment of publicly accessible text documents was chosen in order to compliment data gathered during the fieldwork and reviewed in the literature. As stated by Flick (2014, p.359) using documents as data can “provide a new and unfiltered perspective on the field and its processes”. Hence, in some cases documents might offer an alternative view on the subject matter depending on their origin. For example, a newspaper article might not intend to focus on the scientific approach often present in academic literature, yet it may strive to convey a different message to its readers. Accordingly, the data retrieved was aimed to broaden the researchers perspective beyond a disciplinary approach within academia and gather information from various standpoints to increase the knowledge capacity.

Living in the age of digital globalisation, the Internet and hence the World Wide Web was used as a main platform to collect documents. In order to select appropriate materials, online search engines such as ‘Google’ were used to locate suitable information available in the virtual realm. Keywords used in the online search process (see table 2), were crystallised from the theoretical grounding and issues identified within the literature review and fieldwork notes.

Even though collected documents were predominantly of qualitative nature, some quantitative materials such as statistical data and numeric records were also considered for further analysis. However, as Flick (2014) points out, web pages and Internet documents can be highly challenging and ‘tricky business’. Accordingly, in order to offer a certain degree of credibility, special emphasis was laid upon selecting evidence from official institutions and organisations such as national state departments, NGOs and associations. While a careful

\textsuperscript{22} An example would be when I passed a water collection point, where people were queuing with buckets and containers. My initial impression was that this water collection point enabled improved access and availability to fresh water to the people inhabiting the area. However, after approaching some people in the queue and asking some questions about this collection point, they expressed that water would often run out after several days and it would take some time before being refilled. Hence the actual availability of fresh water was restricted and distribution problems only became visible after seeking a participatory approach to observation.
selection of documents with regards to authenticity was of utmost importance, there is no inherent guarantee that selected materials are free of bias or other tendencies. Hence, all information retrieved from documents was critically examined according to content and origin. However, in some instances text documents with an augmented degree of affiliation were added to the material assortment in order to mirror the contemporary discourse from different perspectives.

Table 2 Overview of keywords used in web search

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Keywords</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>Pollution, CETP, IETP, effluent discharge, untreated waste water, groundwater depletion, contamination, water consumption, ZLD</td>
<td>Textile industry, garment industry, ready-knitted garment, processing units, dyeing, bleaching, Tiruppur, Noyyal basin/river, Tamil Nadu, India</td>
</tr>
<tr>
<td>Social dimension</td>
<td>Bonded labo(u)r, forced labo(u)r, child labo(u)r, discrimination, equality, social rights, labo(u)r migration, working standards, health, poverty</td>
<td></td>
</tr>
<tr>
<td>Economical dimension</td>
<td>Certification, standards, development, investment, export</td>
<td></td>
</tr>
</tbody>
</table>

4.3 Research ethics

The issue of cultural sensitivity was an important aspect of this study due to the fact that the research was depending to a great extent on the empirical evidence amassed during the study visit to Tirupur. Coming from Western Europe and thus an inherently different cultural setting to South India, a careful and sensible approach to communication and behavioural characteristics was of significance. As pointed out by Brinkmann and Kvale (2015) “when doing cross-cultural interviewing it is difficult to become aware of the multitude of cultural factors (habits, practices, positions, narrative resources) that affect the relationship between the interviewer and interviewee” (p.168). Since all interactions were conducted on a voluntary basis, it was key to establish a common ground, where notions of trust and mutual respect were valued. To facilitate this approach, I followed Gilbert’s (2001) suggestion to repeatedly assess my appearance and overall conduct when engaging in interviews.

Moreover, to foster favourable conditions, interviewees were always asked for their consent to participate in the study and also briefed about its purpose. In addition they would be informed about the fact that their persona would be kept anonymous in the case of publication. However, as Silverman (2000) points out, researchers often “ponder over the dilemma of wanting to give full information to subjects but not ‘contaminating’ their research by informing subjects too specifically about the research question to be studied” (p.200). This dilemma was also encountered during my research, since certain subject matters such as social inequalities and environmental degradation often led to a more restricted and defensive interview stance of certain individuals. While the intention of my study is not based on exposing inconsistencies within Tirupur’s garment sector, it most certainly aims for a credible and holistic approach and thus tries to get as much truthful and unrestricted responses as possible.

23 For example articles from the national Indian newspapers ‘The Hindu’ or a memorandum from the Tirupur Dyers Association (DAT)

24 Especially with regards to the fact that some of the questions posed during interviews were of highly sensible nature (e.g. child labour, pollution and health issues).
possible. Accordingly, in order to facilitate an informative interaction, the introductory part at the beginning of the interview session\textsuperscript{25} would focus on my interest for developments in Tirupur, rather than pinpointing negativities connected to the textile industry. Extracting any kind of sensible information was postponed to a later stage during the interviews, when a conversational flow and some kind of relationship had been established\textsuperscript{26}.

In addition, it was also decided at the outset of the study that interviews would generally not be audio (or video) recorded but instead protocollled in a written format. This decision was made upon the premise that interviewees would possibly voice their opinion more freely in a setting without the presence of a device, which is a constant reminder to respondents that each word is precisely recorded. Hence, the absence of an audio (or video) recorder was supposed to enable a more personalised interaction offering the interviewees additional confidentiality and in essence increased security\textsuperscript{27}.

4.4 Transcriptions and data processing
According to Brinkmann and Kvale (2015) there is no all-embracing way of transcribing interviews. Yet, the authors point out that in most research, oral interactions are mainly transformed to written means by either following a word-for-word approach or using a more formal, literary style. Regardless of which technique is chosen for transcription, recording the interview is essential. While audio and video recordings are the most common, other methods of documentation include note taking and remembering (Brinkmann & Kvale, 2015).

Having ruled out audio and visual recordings in the early stages of the project, all interviews in this study were documented by taking notes during the sessions. In order to complement these notes, memorised impressions and aspects would be added after each interview. While certain drawbacks such as forgetting exact wordings and the loss of some information in the conversation due to distractions is possible, other characteristics might enhance the qualitative content of the data. For example, Brinkmann and Kvale (2015) argue that “the interviewer’s active listening and remembering may work as a selective filter, not only as a bias but potentially also to retain those very meanings essential to the topic and the purpose of the interview” (p.206). Hence, during the course of interviewing, information was already being processed and roughly sorted according to interest. While engaging details would be condensed for further inquiry, peripheral information deemed as irrelevant was not further pursued (see fig.2 for an illustrative portrayal). Besides narrowing the abundance of information, this technique allowed for ‘on-the-spot’ clarification of certain responses, since condensed knowledge would be redirected towards the interviewee, either being confirmed or dismissed. Sometimes however, the vagueness or inaccuracy of statements\textsuperscript{28} only became apparent after the interview sessions, when data was being revised, which could complicate further analysis.

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\textsuperscript{25} Except for the interview with the NGO representative, where an openly critical approach was possible.

\textsuperscript{26} Often personal information and pleasantries were exchanged to get acquainted.

\textsuperscript{27} Physical evidence in terms of tapes could be traced back more easily to certain individuals and possibly bear negative consequences depending on their content (e.g. talking about corruption and law violations).

\textsuperscript{28} For example in some cases, interviewees were not entirely sure when to date events and would ‘guesstimate’, which could be considerably off the actual date by a year or so.
While the handwritten notes, taken during the interactions, were primarily a means to document raw data, thorough transcriptions were only finalised after combining them with memorised details and aspects in a digital word document. These transcriptions were then analysed using a ‘bricolage’ approach. According to Brinkmann and Kvale (2015) this eclectic technique allows the researcher to find a best fit by mixing methods, conceptual approaches and discourses and hence facilitates an adapted generation of meaning. Using this approach allowed to incorporate linguistic and interpretational features, derived from analogies and sayings in some cases, while also making use of theoretical reading in order to identify themes, specific to this study.

Figure 2 Condensation of information during interviews
5. Findings
5.1 Industry aspects

5.1.1 Initiation of ZLD
One of the most significant occurrences in recent years, severely impacting and changing the landscape of the Tirupur textile cluster, is considered to be the introduction of ZLD norms. Hence, it was one of the most discussed topics during the interview sessions, evoking many different perspectives and responses. Correspondingly, the vast majority of industry informants identified it as the most crucial legislative directive since the instalment of effluent treatment plants was ordered in 1996. Yet, while the initial implementation of ZLD was issued by the High Court in 2006, most interviewees actually stated 2010-2011 as the period when strict ZLD standards were systematically enforced. Accordingly, many regard the complete closure of the dyeing sector in the beginning of 2011 as the de facto start of the ZLD period in Tirupur.

Yet, at this point it must also be mentioned that while some individuals clearly recalled the lack of success regarding early policy efforts (pre closure) by authorities to impose ZLD norms, others refrained from going into particularities, adapting a rather cautious approach complying with official protocols. Accordingly, these accounts would consent to the premise that a failure to provide the TNPCB on inspection with evidence of effluent treatment corresponding to ZLD standards, led to an immediate closure of the specific dyeing unit.

However, some interviewees recounted a differentiated picture, where non-compliance to standards among processing units was not necessarily met with immediate closure and that many dyeing houses in Tirupur still operated without any effluent treatment system conforming to ZLD until 2010 or the eventual closure of the whole sector in the February of 2011. One informant (#15) found particularly critical words for the time period following the initial directive to implement ZLD, explaining that in the years leading up to the closure of the dyeing industry, many of the units shut down by TNPCB would run again within a short amount of time, often without undergoing any substantial change. One of the main reasons for these incidents, according to the interviewee, can be attributed to high corruption levels considerably influencing the enforcement of rules and regulations. However, due to corruption being a highly sensible issue, specific accounts regarding this subject were generally formulated in a suggestive manner, especially among industrialists.

Although slightly contrasting portrayals of the implementation phase of ZLD following the court order in 2006 surfaced during the interviews, one has to acknowledge the fact that ultimately all dyeing operations in Tirupur were suspended officially and with immediate effect in 2011. In accordance, there was almost complete unanimity among the interviewed industrialists that the closure was the result of the general lack of compliance to ZLD norms due to a widespread inadequacy of at the time installed effluent treatment systems.

5.1.2 Adjusting to the shut-down and ZLD
During the interview sessions it became apparent that the closure of the dyeing and bleaching units had wide-reaching implications. According to most interviewees the pollution situation with regards to industrial effluents had greatly improved. Especially accounts from industrialists and industry affiliates suggested that the ZLD norms were predominantly being met and thus the discharge of effluents into the environment was an issue of the past. Most of them argued that during the closure, technology levels had been improved substantially and

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29 No matter if the unit operated its own IETP or member of a CETP.
Tirupur was now considered to be one of the first textile clusters to successfully implement full ZLD. Correspondingly, interview data reflected a commonly shared sense of pride and accomplishment among industry informants regarding recent developments, indicating that they had encountered and overcome challenges of past years.

However, several industrialists as well as an officeholder in an industry association indicated that even though the majority of the polluting units had been taken care of, an uncertain number of illegitimate units continued operations within Tirupur’s boundaries. “Some units do not dispose of their effluents properly. Unauthorised [units] operate in one area and within a month, if closed by the TNPCB, they set up in a new area again” (#9). According to distinctive accounts, these unlicensed dyers are often found to be small-scale units with low-tech equipment, capable of moving their activities relatively quick and thus often manage to escape indefinite closure by authorities. Consequently, various interviewees pointed out that these illegal dyers would cast a shadow on Tirupur’s newly reincarnated dyeing sector.

Although, generally informants did not deny the existence of units violating the pollution norms, many expressed a rather reserved attitude towards the subject, implying that the overall situation for the industry was rather complex and they had enough things to worry about themselves. One industrialist summarised his position as follows: “It is not up to me to close down [or denounce] illegal units. It’s the Pollution Control Board’s role to control and penalise… but it’s not [always] done in a necessarily proactive manner” (#8).

Considering the fact that the vast majority of industrialists stated that large capital investments had to be made in recent years in order to acquire new machinery and upgrade existing technology in order to be able to stay in business, one might speculate if the implementation of ZLD and the financial burden might have also driven some units into illegality. For example, one owner of a dyeing and bleaching house described his hardship following the court orders. He stated that even though he had invested into his own IETP and upgraded it several times throughout the years, he eventually could not afford an additional amelioration to his plant. As a consequence his license did not get renewed and he was shut down and remained so until further changes had been performed. After a period of 3 years, during which he had outsourced his operations to another region where no ZLD was in order, he redirected his attention to Tirupur and opened a new processing unit, but this time became a member of a CETP. Hence, the financial burden of complying to ZLD norms significantly impacted his livelihood and decision whether to stay in the city or outsource the production to elsewhere.

5.1.3 Impacts on performance and profitability

According to numerous statements from interviewees, the economical dimension is pivotal in the readjustment of Tirupur’s dyeing sector and thus one has to distinguish between units being closed down because of pollution violations and others ceasing their operations because of issues relating to monetary insecurity. Consequently, findings from the interviews showed that there was a considerable trade-off with regards to economical activity following the ZLD directive. All of the industrialists that had been interviewed expressed that profit margins had been severely affected and many units were facing financial difficulties in the years to follow. However, reasons for this slump were not solely attributed to the enforcement of full ZLD but also partly to international occurrences such as the global recession and the financial crisis in Europe and the United States (2008-2012). Accordingly, overall export demand had already

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30 In his case it was the failure to install mandatory monitoring instruments, so that the TNPCB can track the effluent flows online.
31 2 years suspension due to a lack of funds and 1 year because of a personal dispute unrelated to ZLD.
been compressed prior to the official industry closure and thus strained the cluster’s economic growth. Even so, the vast majority of informants indicated that ZLD norms and the suspension of the dyeing sector further intensified the volatile situation of recent years.

Even though all industrialists pointed out that with the closing directive imposed, all processing activities in Tirupur were brought to a halt, various accounts specified that actual shut down periods and conditions varied among units. While some dyers explained that they were closed for a considerable stretch (several years), other respondents stated that they resumed operations within several months of the court order. According to a CETP functionary, the terms of suspension for dyeing and bleaching units was depended on the status of installed effluent treatment systems and as a result could last “6 months to 3 years”(12). Moreover, the source also explained that to the present date some units remained closed due to non-fulfilment of ZLD requirements.

Yet, despite the fact that some units re-joined their activities ahead of others, various industrialists also disclosed that it was the subsequent restrictions on the actual production that impeded their economical performance in the aftermath of the closure. Accordingly, it was expressed that during the closure they had to negotiate with the banks in order to secure further access to capital32 and even though funds were cleared and facilities had been upgraded, dyeing activities were still being restricted by the TNPCB. Findings showed that out of all the interviewed processing units, not a single CETP member was operating at their full potential, due to the fact that the CETPs treating the discharge were not permitted to run at full capacity levels but somewhere in between 30–70%. As a result the member units’ output was restricted and hence their reported economic profitability was marginal and even non-existent in some cases.

However, interactions with large export oriented manufacturers (either integrated textile companies and/or large scale processing units) all operating IETPs, revealed that they were allowed to function at full capacity levels. Furthermore, they were in possession of licenses granting them to run the production 7 days a week. In contrast, interviewed industrialists affiliated with smaller dyeing and bleaching units were merely permitted to operate 5 days a week. Yet, further inquiries showed that licenses and functional restriction were also dependent on the location. Hence, most of the large units were situated in the outer periphery of Tirupur, while smaller dyeing houses were mostly found within the closer city limits. Asked about the terms, one industrialist explained that most of the bigger units relocated further out to take advantage of space, allowing them to expand their facilities but also because of regulations specifying the levels of air pollution and sound disturbances. Furthermore, he pointed out that for newer units being granted a license, facilities had to be distanced at least 5 km away from the Noyyal33.

Another significant topic, recurring in interview sessions, was concerned with supplementary costs resulting from ZLD and the implications it had on the garment sector in Tirupur. All interviewed industry informants, without exception, pointed out the fact that the overall production costs had increased substantially with the practice of ZLD. One of the main

32 The negotiation of new loans was considered by many to play a significant role in the actual suspension period of their unit. Several informants pointed out that while the government of Tamil Nadu offered subsidies and interest free loans for the upgrade of effluent treatment plants, there was no support provided for the substantial investments for newer and improved dyeing machinery, necessary to minimise effluent output in order to comply with ZLD requirements. Therefore, complications in financing and acquiring new technology also considerably influenced closures and/or operational performances.

33 Following a directive from 1997/8 according to informant #11.
reasons for this was attributed to the high running costs of the CETPs and IETPs. Accordingly, in order to turn liquid effluents into a solid state, numerous steps were added to the wastewater treatment, including advanced membrane practices (reverse osmosis) and thermal processes (evaporation and crystallisation). While the purchase of high-end technology had already proven to be a costly factor, the immense energy consumption of the newly installed treatment systems also substantially augmented the variable costs, ultimately affecting the overall price for processed garments. According to separate industry functionaries (#7; #12) the average additional cost amounts to approximately Rs. 10 per kg of dyed fabrics. Yet, some industrialists stated that they encountered substantially higher supplementary costs. For example, one respondent (#2) pinpointed the expenses to around Rs. 20 per kg of fabrics, while another (#15) even stated that his production costs had risen by Rs. 35 per kg since adapting ZLD. Although, additional charges for electricity and diesel (to fuel generators in order to bridge power cuts) were identified as the main cost drivers, various industrialists indicated that the cost of firewood (to power thermal processes) also significantly affected the overall production costs, besides the acquisition of dyes, fabrics and of course water.

Moreover, further findings suggested that supplementary costs arising from ZLD also led to temporal changes in the production network with regards to sourcing activities. According to discussions held with industrialists, a market reorientation among buyers of ready-knitted garments was at hand. Dyeing and bleaching units as well as fully integrated manufacturers stated that due to augmented production costs, purchase orders were being put off and in some cases even terminated. Several industrialists explained that in the years following the ZLD adjustments, many export agents and western retail brands had started sourcing from elsewhere in order to keep the costs low. Yet, various interviewees also pointed out that in order to compete with other regions not subjected to environmental regulations, such as the ZLD norm, numerous dyeing houses and manufacturers had also relocated their bulk processing to different regions in India or countries such as Bangladesh. However, while some started to outsource from more distanced places, some chose to relocate in close proximity to the city of Tirupur. According to one industry informant (#15), there is a tendency among some manufacturers to merely resettle processing activities to outer parts of the Tirupur district in order to take advantage of the locally established networks and channels of the cluster, while being subjected to a considerably weaker to non-existent enforcement of pollution controls.

5.1.4 Impacts on labour migration and occupation

According to the industrialists the closure of the dyeing sector also severely affected the work market in Tirupur. While the garment industry had been the major employer in the region since the mid 1990’s, attracting labour from the surrounding regions, the ban on dyeing activities led to fundamental changes in migrant flows and employment arrangements. Consequently, labourers previously working in processing units had to find alternative ways to generate an income and likewise the industry had to adjust to considerable workforce fluctuations.

Interactions with industrialists indicated that labour flows had decreased drastically since the closure period and even by the time numerous units had resumed operations, a general deficit of un-to semi-skilled labourers was apparent. One industrialist (#8) stated that after the closure only roughly 30% of the labour force returned to Tirupur, which made it increasingly difficult to acquire and secure workers and thus competition among dyers for low skilled employees has intensified ever since. Various industry informants also agreed upon the
premise that in recent years there is a considerable shortage of labourers and some even argued that they observed an overall trend of transformation among the workforce.\textsuperscript{34}

Accounts from several interviewed labourers (#FG) depict a similar portrayal. During group discussions various individuals explained that they had worked in Tirupur for 15-20 years as manual labourers in the dyeing sector, but left the city subsequent to the closing directive. Due to the fact that they had no education, they were unable to find other work and thus either followed the dyeing industry to other regions\textsuperscript{35} or turned to other low wage jobs in construction or agriculture. Nevertheless, they went on to explain that as soon as the dyeing activities in Tirupur began to revitalise, they chose to return, in order to search for resurfacing employment opportunities in dyeing and bleaching units.

Moreover, further findings from the group discussions also suggested that ZLD measures were indirectly impacting the income levels of labourers and hence the attractiveness of being occupied in dyeing and bleaching houses. According to interviewed workers, present-day production outputs of the units employing them are much lower than before the industry closure and due to the fact that they are predominately paid on a ‘contract basis’\textsuperscript{36}, their earnings depend on the productivity of the unit. One individual, for example, recalled that prior to the closure, he (and his co-workers) would process around 300 cases per month, while current outputs amount to roughly 100 cases.\textsuperscript{37} Yet, it must also be pointed out that according to various interviewees the overall wage levels for workers employed in the garment industry have increased over the last couple of years. One source (#7), with considerable expertise in the garment field and industry proceedings, explained that issues such as minimum wage were renegotiated on a four years basis with regards to the Industrial Dispute Act and Tripartite Agreement. Furthermore, he pointed out that because of these negotiations people employed in the knitwear branch were subjected to higher wages compared to others occupied in the textile industry, such as in the power-loom sector for example. On that account, however, it must also be said that some informants raised concerns during the interviews, emphasising the fact that augmented labour wages in Tirupur (among other things) could potentially lead to a reorientation of processing activities to other regions in order to reduce rising workforce expenses and thus stay afloat in the highly competitive market.

5.2 Water affairs
In addition to severely polluting the environment, Tirupur’s garment industry has also been subjected to much criticism for unsustainable water consumption leading to the depletion of groundwater resources in the Noyyal basin. In order to gain a better understanding of the affair, interviewees were asked to express their views on Tirupur’s current water situation and developments. Due to the fact that almost all interviewed individuals were either from Tirupur, the Tirupur region or had been residing within the city boundaries for more than 20 years, also enabled crucial insights with regards to domestic consumption trends beside the aspects of industrial utilisation.

\textsuperscript{34} See section 5.3 for an elaboration
\textsuperscript{35} In this case the interviewees stated that they went to work in dyeing units in Bangalore.
\textsuperscript{36} Note: Contract basis refers to a ‘per-piece-payment’. According to the informants, the per-piece-payment is based on the bulk of processed fabrics, often per ‘case’, were 1 case is equal to 100 kg of dyed fabrics.
\textsuperscript{37} Note: Output is largely depending on the size and capacity of the unit (incl. machinery, workforce, etc.). In this case the individual worked in a rather small to medium sized dyeing house with a maximal output of 1000 kg per day. In comparison export units with a daily output average of 15 000 kg were also visited.
5.2.1 Demand and supply for a dwindling resource

Accounts gathered during interactions disclosed that Tirupur’s water situation had improved dramatically since the mid 1990’s. According to all the interviewed industrialists the initiation of the NTADCL was key. Various informants explained that through this project (often referred to by individuals solely as the 3rd scheme), the difficulties of water provision for industrial means were considerably reduced. They went on to elaborate that prior to the supply scheme offered by the NTADCL (pre-2005) they had to extract water from bore wells and aquifers in the regional surrounding and transport it to individual processing units with the help of lorries equipped with large tanks. According to one source (#2), purchasing water from locations distanced around 40 km from Tirupur was a daily procedure and depending on the size of the unit multiple delivery journeys were normal.

Retrospectively, most interviewees affiliated with the dyeing sector displayed a general recognition of the unsustainability of past practices. Yet, they mostly reflected on economical disadvantages such as the substantial costs for acquiring and transporting water, rather than addressing the issue of overexploiting the region’s resources. When specifically asked about the subject matter of water scarcity, several industrialists referred to the fact that in recent years, records showed that groundwater levels were on the rise again and hence suggested that the problems regarding depletion had been dealt with accordingly. However, some individuals did communicate a more critical approach in consideration of the industry’s water consumption. One industrialist (#15), for example, explained that Tirupur is in essence a textile cluster without a proper water source and consequently the industry’s high demand for fresh water clearly diminished the region of the resource’s availability. Nonetheless, the source also implied that since the implication of the 3rd scheme the conditions had generally improved and furthermore added that the provisional closure of the dyeing sector and hence the subsequent reduction of units operating in Tirupur had clearly stabilised the water provision for industrial but also domestic purposes. Still, it must also be emphasised that many industrialists and industry affiliates regarded the contemporary water supply as adequate but not ideal and accordingly issued concerns regarding the continuously rising prices for water and the lack of infrastructural efficacy.

Interestingly, interviews conducted with individuals associated with large processing units were more positively inclined to current and future water affairs. Reviewing their accounts revealed that apart from investing heavily into more efficient dyeing equipment, such as machinery with a lower material to liquid ratio (MLR), many had also specialised their operations with regards to recycling water. As a result many of these units were able to reuse large quantities of treated water (ranging from 80-98%) in the processing activities, which meant that they had to purchase considerably less water from the NTADCL. According to all the interviewed large-scale manufacturers, the introduction of water recycling was a necessity in order to fulfil environmental regulations leading up to the ZLD directive. Yet, while the initial costs for installing treatment plants (in their case IETPs) able to recover water via reverse osmosis were substantial, they went on to explain that with regards to constantly rising water prices, the benefit of being able to reuse water had become highly valuable and essential to their operations. However, it must also be pointed out that the majority of small and medium sized dyers visited during the study had also acquired machinery with lower MLR in an effort to make their processing activities more efficient and less water intensive. Moreover, they all claimed to be CETP members and thus were presumably entitled to water recovered during the effluent treatment processes. Nonetheless, unease expressed among

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38 Absence of direct connections to NTADCL pipelines and mediocre access to water distribution stations (WDS).
smaller industrialists with regards to water supply and additional costs suggested that they were more reliant on the NTADCL than the larger industries visited.

5.2.2 Changing demands and needs

Further analysis of data indicates that the industry’s demand for water has not only dictated the past but also considerably influenced supply projects in recent years and will continue to do so in the future. While the NTADCL project was established to secure fresh water for domestic and industrial purposes alike, evidence suggests that industrial developments have been vastly prioritised with regards to water access and availability. Accordingly, pipelines have been installed to primarily address the needs of dyeing and bleaching units in the Tirupur region and the lack of systematic infrastructure in place to provide the ever-growing number of domestic users in Tirupur with fresh water is a testimony to this reality. However, recent developments have changed the knitwear sector’s demand unquestionably. With more efficient machinery in place (1:4 MLR compared to 1:15 MLR) most of the units are able to process fabrics with less water and due to increased recycling practices among dyers, demand for more fresh water has been reduced substantially.

As specified by a functionary of an industry association (#7) the garment sector was utilising roughly 95-92 million litres of water per day around the millennial change, while the daily consumption had dropped to 70-60 million litres around the time the 3rd scheme had been inaugurated and since the clamp down on the dyeing and bleaching sector in 2011 the industry’s water usage is estimated to be around 25-20 million litres per day. According to several industrialists this trend has led to an evaluation of current supply priorities by the authorities in charge. For example, one source (#9) explained that due to lower MLR machinery and state-of-the-art water recovery from the ZLD treatment, the industry is provided with an excess of water. Further, he added that as a consequence the NTADCL was facing a dilemma, since as a public-private venture with various stakeholders, it is required to be economically profitable, yet it confronted increasingly lower demands from processing units. Another industrialist (#15) also communicated that the NTADCL had approached manufacturers in recent times, urging them to utilise more water and hence suggested that the venture’s positive return on investment could be at risk.

In consideration of these premises, efforts to redirect the supply focus on domestic users are at hand. According to several interviewees the municipality of Tirupur, which is struggling to supply its constantly growing population with adequate water access, will be the main recipient in the future.39 During numerous interviews, individuals explained that the city had grown so quickly in the last decades that the municipality was facing extreme difficulties to provide basic infrastructural necessities to peripheral areas. For example, one source (#16) explained that while the centre of Tirupur was relatively well developed in terms of pipelines, entitling residents to source water from the tap, quarters outside this core area were still quite limited with regards to individual supply connections. Accordingly, people still resort to buying water from tankers or gather it from Water Collection Points (WCP). In addition, it was emphasised on several occasions that ‘the further you move out, the worse it gets’, thus implying that due to the high rate of urbanisation an increasing number of people settling in dwellings and slums in the outskirts of Tirupur are subjected to no or substandard access to water and sanitation.

39 By the end of 2015, 160 million litres of the NTADCL will be supplied solely to the Tirupur municipality, while 20 million litres will be available for the industry (#11).
Even so, most conversations suggested that the overall contemporary water situation with regards to availability had ameliorated significantly in comparison to the past. According to more elaborate statements, specific references were regularly made to the period starting around 2005/6 as the benchmark for noticeable developments and hence mapping the last decade as a significant phase of transition. “Water situation is good now compared to back in the days. You don’t even have to go back 20 years to notice the change. 2006 to now is already a massive change”(#13). However, further analysis of interview findings also indicated a differentiated rate of development with regards to water being supplied to domestic and industrial sectors. Accordingly, collected data communicated that the municipal water provision and infrastructure was still far from optimal and in drastic need of expansion and improvements.

5.2.3 Aspects of water quality and contamination

In spite of the assertions that Tirupur is no longer facing acute water scarcity due to the implementation of more recent supply schemes, recycling among processing units and rising groundwater levels, issues of pollution are still prevailing. According to the majority of interviewed individuals the strict ZLD norm has transformed Tirupur’s garment industry into a more environmentally friendly sector, where effluents are being treated so that water sources are not being threatened anymore. However, decades of intense pollution cannot easily be undone and the direct discharge into the Noyyal with highly toxic effluents has culminated in the contamination of soil and water sources, not only in the immediate surroundings of Tirupur but also downstream regions.

While the majority of the interviewed industrialists refrained from answering questions regarding aspects of contamination, a few communicated that people in Tirupur were still exposed to the consequences. For example, one industry informant summed up the contemporary situation as follows: “We are not healthy, but we are safe”(#5). Such statements were recurrent during the study and while being brief could be very concise, illustrating that water can be sourced locally but is of questionable quality. Moreover, on several occasions interviewees explained that water extracted from wells in the Tirupur area was not suitable for drinking purposes and hence emphasised the importance of water imports through supply schemes.

While interview material displays a considerable number of statements proclaiming the industry as being ‘pollution free’, various industrialists pointed out that other actors are the culprits now. “The government and media tend to focus on the industry in terms of pollution, yet the problem of municipal and domestic waste is way more problematic than the industry nowadays”(#2). Hence, some argued that there was a clear deficit of rules concerned with sewage treatment and waste disposal, facilitating an unbalanced approach to combating pollution issues. However, during several discussions the thematic of ecological damage previously inflicted by the industry also surfaced. Accordingly, several informants pointed out that even though the garment sector was ordered by the High Court of Madras to compensate farmers for their losses (due to barren land and increased livestock mortality) caused by effluents, until the present day reparation payments were still outstanding or inadequate. Furthermore, one source (#16) explained that one of the best examples for the industry’s lack of compliance is the contamination of the Orathupalayam reservoir. He stated that its waters, formerly used for irrigation purposes and fishing, are still saturated with toxic effluents and

40 Noteworthy occurrences affecting the state of progress included the 3rd scheme in 2005, the initial High Court order in 2006 with regards to effluent discharges, the establishment of the Tirupur district in 2009 and hence administrative independence from the districts of Erode and Coimbatore, the dye and bleach house closure in 2011 and the consequential industry shakeout among processing units with regards to ZLD implementation.
even though the authorities directed the dyeing industry to clean it up on several occasions since 2003, nothing has happened so far. Hence, the polluters pay principle has been considerably ineffective in terms of addressing persistent ecological problems and the repercussions of former discharge practices are still at large.

5.3 Social aspects
The garment industry has significantly contributed to Tirupur’s immense population growth since the 1990’s. The push for development has attracted a large number of people seeking new employment opportunities and transformed the city into an economic cluster, merging rural and urban lifestyles. As a result, the industrial environment has been pivotal in shaping Tirupur’s socio-economical dimension. However, findings indicate that in more recent years labour practices are subjected to increased social change.

5.3.1 Labour trends and work conditions
Information gathered during the study suggests that Tirupur’s garment industry and specifically the dyeing sector has been experiencing gradual changes among their labour force. As mentioned afore, industrialists communicated on numerous occasions that in recent years they were facing a lack of un- to semi-skilled workers. Several informants explained that levels of education amongst the younger generations in Tirupur had increased substantially in the last 15-20 years. As a result many people had the possibility to pursue other lines of work in preference of ‘dirty’ manual labour. Accordingly, the majority of labourers employed in the sector come from rural settings, have a limited education background and seek to generate an alternate income to agriculture. However, various informants also pointed out that whereas in the 1990’s most migrants came from rural areas in the region or in the state of Tamil Nadu, over the last decade more people from all over the country were moving to Tirupur in order to find work within the textile industry. One industrialist (#15), for example, explained that until the early 2000’s all his employees were Tamil. But a few years later, around 2008/9, the share of labourers from neighbouring states employed in his company had risen considerably. He went on to add that his current workforce of roughly 900 people was about 40% Tamil and the rest had migrated from different places in India, with about one third coming from the northern territories. Interestingly, according to an association representative (#7), recruiting workers in other states (especially in the north) has become increasingly prominent in order to address the deficit of manual labourers in Tirupur’s textile sector.

Further material also suggests that Tirupur’s industry has adapted its labour practices in more recent years. According to interviewed industrialist, issues such as child labour and inhumane working conditions are proscribed and thus non-existent in Tirupur’s factories. Several informants pointed out that people working in their units would be engaged in accordance to the laws issued by authorities. Hence, most dyers and manufacturers stated that 8-hour shifts were the standard in the sector. However, further inquiries suggested that many manufacturers opted to organise work schedules in 12-hour stints, often referred to as 1½ shifts. According to an informant (#16), this practice was very common and preferred among manual labourers working on per piece basis. Yet, one industrialist (#15) also explained that with the high turnover rates of workers in recent years, industries often faced a dilemma, stating that, “two thirds of workers turn down a job offer when they can only do 12 hour shifts…they want to work as much as possible” (#15). Data gathered during an interview with a NGO representative (#14) conformed that 12-hour shifts are well established in the knitwear sector, but also suggested that 16-hour shifts are not uncommon. Moreover, the source explained that another recurrent work practice was to work three days with occasional breaks and then rest
for three days. However, this method was generally practiced in the knitting and stitching divisions and spinning mills rather than in dyeing and bleaching units.

At the same time further findings indicate that even though the occupation of child labourers was banned and thus considered taboo among all interviewed industry informants, the issue was not entirely resolved. Accounts from the NGO representative (#14) emphasised that the practice of child labour had decreased substantially in the last years, due to increased pressures from activist-, media- and stakeholder groups, yet it still upheld some presence in the industry. However, the source also pointed out that the root of this problem was generally found somewhere in the lower levels of the production chain. Accordingly, children would not be working in units located in Tirupur, which supply brands, retailers and export houses directly. But subcontractors and suppliers on the second tier, situated outside the municipality or district might not be as stringent on the ban and so as one moves down to tiers three and four, child labour would be more frequently encountered.

5.3.2 Urban life and awareness
Findings from the interviews also disclosed that Tirupur has been subjected to a constant surge in housing and estate prices, which considerably affects poorer population groups. The fact that a significant number of labourers working in the textile sector are rural migrants with low incomes intensifies the problematic situation of accommodation. According to several sources, illegal dwellings are mushrooming in the outer peripheries, while the population of existing slum quarters rises. Further statements gathered during the focus group meeting revealed that the living situation has become increasingly difficult in recent years. The individuals explained that 20 years ago they were able to reside in houses, however, at present nearly all of them were living in provisional huts due to the fact that they could not afford the current rent rates. At the same time, various sources pointed out that often manufacturers would tend to accommodate their workers on the factory grounds. According to one industry affiliate (#13) providing means of accommodation to the workforce had several advantages, such as the elimination of commuting routines and a convenient alternative for migrating labourers seeking temporary housing. However, information gathered during the interview session with the NGO representative also suggested that workers living within factory quarters are often more vulnerable to infringements of their rights. According to the source, in many instances labourers are kept under close control by employers and subjected to various forms of mistreatment and discrimination. Furthermore, it was emphasised that workforces with a migration background are more susceptible to these kinds of pressures due to the fact that they are often not familiar with local customs and regulations and thus are positioned as outsiders to the community.

Nonetheless, numerous interviewees argued that Tirupur’s social landscape was undergoing significant adjustments. According to several sources, people were showing increased awareness with regards to their occupational situation and as a result working habits and methods were steadily changing. Increasing westernisation and augmented costs of living as well as the competition for workers challenged established traditions and former practices. Consequently, on various occasions industrialists explained that the employees were not as devoted to their employer as they used to be in the 1990’s. For example, one owner of a dyeing unit (#9) explained that 20 years ago the workforce would continue working until “their work was done”, but in recent years employees would “look at their clock all the time”. Moreover, further accounts from individuals suggested that increased information flows and improved means of communication (such as the use of mobile phones) were progressively impacting peoples’ consciousness and ultimately the way of living. As a result,
cooperation among the textile industry and labour unions were becoming ever more important in present times, as explained by an industry functionary (#7).

However, according to the NGO source (#14), actual membership amongst Tirupur’s 13 labour unions is rather low, only constituting of roughly 3-4% of the estimated worker population. Further information extracted from this particular informant also indicated that in many instances manual workers occupied in the textile industry were unaware or reluctant to enter unions or associations dealing with labour right issues due to various forms of pressures exerted by some industries.

5.4 Opportunities and barriers to further development

In order to strengthen the understanding of contemporary affairs in Tirupur and to further a holistic approach, allowing to investigate aspects of increased sustainability with regards to development measures since the mid 1990’s, interviewees were asked to assess the current situation of Tirupur’s garment industry. Moreover, special emphasis was placed upon accounts concerned with present issues as well as future outlooks.

Findings suggested that many industrialists identified international certifications and ‘green’ labelling as an important window of opportunity. The premise that Tirupur’s dyeing and bleaching units implement ZLD measures in processing was regarded as a unique selling proposition in the global textile market. Accordingly, some industry affiliates communicated that various retail and fashion brands were positively inclined to the ZLD measures and thus specifically opted to source from Tirupur. At the same time it must also be mentioned that various sources implied that the lack of certificates clearly impacted business operations. Hence, exporters without some sort of accreditation (ISO, etc.) were unable to attract and secure premium customers (from overseas) and thus were cut off from the profitable export market. Yet, due to the augmented westernisation of Indian lifestyles, especially with regards to fashion trends, a growing number of processing units unable to meet export standards focused on production for the domestic market. However, it must also be pointed out that most industrialists mentioning the notion of certification or auditing were primarily referring to standards regarding quality management rather than environmental labelling. In essence, only two respondents (#1, #15) outlined to be either certified or part of an initiative specifically concerned with social and environmental standards.

Nonetheless, the potential of being regarded as a distinctive production cluster with high environmental requirements, was seen as a vital driver for future development. According to numerous industrialists, the extensive investments into ZLD technologies were starting to yield benefits. Closed loop water systems and recycling practices were considered as increasingly advantageous with regards to continuously rising prices of resources. Simultaneously, issues such as resource optimisation and alternate energy sources (wind and solar power were mentioned on several occasions) were seen as further opportunities, allowing Tirupur’s garment sector to become a hot spot for ‘greener’ textiles. Accordingly, an

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41 Various scholars (Carswell & DeNeve, 2013; Heyer, 2013) point out that the number of workers employed in Tirupur’s textile industry, often quoted to be around 400,000, is most probably an underestimation due to the fact that a vast number of labourers working in the informal sector are not fully accounted for. Accordingly, some interviewees reckon that Tirupur’s textile industry occupies a total of around 1 million (#11) to 1.5 million (#2) people, which would translate into 43,750 being union members out of 1.25 million (mean value).

42 Pressures could take on various forms ranging from verbal threats to physical attacks.

43 Besides being able to reuse water, several individuals also explained that they recovered various types of salt in the forms of brine solution, sodium chloride and sodium sulphate decahydrate and one interviewee (#12) even stated that there were on-going trials to turn sludge into biofuel and construction material.
industry functionary (#7) also explained that the cluster was actively seeking an accreditation promoting its ZLD efforts, in order to be more attractive and get other clusters to follow.

However, one of the major barriers identified by most interviewees was the current state of infrastructure. Even though various industrialists and industry representatives explained that over the last decade, major construction works had been initiated in order to expand and improve road conditions, upgrade and erect new facilities, they still regarded Tirupur’s contemporary physical connectivity as a shortcoming to further development. Yet, it must also be emphasised that the subject of infrastructural hurdles was not limited to issues of transportation. Interview data indicates that the majority of respondents viewed power generation and hence the supply of electricity as the most problematic aspect impacting Tirupur. Various accounts suggest that the enforcement of the ZLD directive played a significant role directly impacting electricity consumption. Due to the fact that treatment plants had to undergo substantial technological upgrades (including the addition of various energy intensive processes and machineries) intensified demand and usage patterns. One source (#13) explained that the electricity shortages really rocketed around the year of 2010 and that currently their production facilities only received around 3-4 hours of electricity per day from the grid, while the rest of the time they would resort to diesel generators. Another interviewee (#12) pointed out that with the rising costs of diesel, off-grid electricity production with generators was becoming increasingly expensive. Yet, at the same time also added that compared to two years ago, where they would be subjected to power-cuts for 12-14 straight hours, the present situation had ameliorated.

5.5 Observations

During the stay in Tirupur, visits to multiple processing units of various sizes, as well as effluent treatment plants were made. On-site observations were captured on photographic image (when permitted). Occasionally, on-the-spot interactions were engaged in to augment situational knowledge (when necessary) and documented in field notes. In addition, daily excursions were made around the municipality of Tirupur in order to enhance an understanding of the setting and real-life occurrences. All gathered material was collected within a 5 km perimeter of the city centre (central station used as an orientation point), except for two visits (one processing facility and one common effluent treatment plant) that were located further away (ca. 8 km and 10 km linear distance respectively).

5.5.1 Industry visits

One recurrent observation made when visiting CETPs and production units operating IETPs (often located in the outer areas of the municipality) was the large stockpiles of firewood encountered on sites (see fig.3). While wood is often used as a cheap fuel to power thermal processes (boilers, dryers, steam generation etc.), I was also informed that firewood was commonly being used for evaporation activities in order to treat the industrial effluents.

Another regular sight during visits was the presence of amassed sludge, which in essence is the left-over product from the effluent treatment (see fig.4). When I asked about disposal methods, I was told that due to the hazardous nature of the sludge (especially mixed salt slurry and chemical sludge) it is commonly disposed in secure landfills after being dried. Yet, despite the fact that the various types of sludge were highly concentrated remnants of an array of toxic elements and pollutants, I observed workers on several occasions handling sludge without any kind of protective gear, but with bare hands and feet. These workers were occupied with the collection of sludge, either in baskets or plastic bags, and transporting them to other parts within the facilities (either by foot or with the help of lorries).
Figure 3 Stockpiles of firewood assembled on separate industry premises (above; Arulpuram CETP, below; a processing unit of a large vertically integrated textile manufacturer) Photos by author.

Figure 4 Sludge accumulation at the Arulpuram CETP (above; Workers collecting mixed salt slurry, below; biological sludge, right; chemical sludge) Photos by author.
Furthermore, signboards at the entrance of every unit offered some indication of the quantity of effluents generated, while processing facilities with an IETP additionally informed about sludge being produced on a daily basis and also specified the disposal method. Accordingly, taking a closer look at these signs (which sometimes did not correspond to the actual date or were left blank) also suggested that considerable amounts of sludge are being stocked on premises (see fig. 5). Despite the signs, it generally remained unclear how much of the sludge had actually been disposed of in secure landfills and how much was being stored on facility grounds.

Moreover, it became increasingly evident during my stay in Tirupur that in some cases inadequate storage and dumping of chemical waste were being practiced. It was observed on numerous occasions that stockpiles of hazardous waste had become so substantial that they had spilled over into the environment (see fig. 6). Such observations suggest that there are high risks of secondary pollution threatening the surroundings.

Figure 5 Signboard of a processing unit with IETP detailing sludge production/accumulation (Photo by author).

Figure 6 Chemical waste overflowing the grounds of a processing unit. This picture was taken while standing in the dried up riverbed of the Noyyal, only a few kilometres away from the city centre (Photo by author).
Further sightings, often made in close proximity to industry facilities, included wasteland patches that had been turned into dumps, where dried sludge, ash and other materials had amassed (see fig.7). Whether these sites had been declared official dumping grounds is not known, however the lack of any signs or indicators identifying it as a ‘secure’ landfill for possibly hazardous waste might suggest otherwise.

5.5.2 Excursions around the municipality

Temperatures around 40°C, dusty air and the arid climate were a constant reminder that the study visit to Tirupur was carried out during the dry season. Accordingly, one of the first observations made while walking through the city was the lack of water in the riverbed of the Noyyal. Depending on where along the banks situated, the hydrological characteristics of the Noyyal took on various forms. Further upstream, the river transitioned from completely dried up in some stretches to minor streams in others. Yet, towards the city centre the river flow increased considerably. The colour of the water was of a dark brown-blackish tone, pungent and filled with faeces, garbage and other domestic waste (see fig.8).

Figure 7 Dumping grounds near industry sites (above; waste appears to be mainly ash although bags with other contents such as mixed salt are found amongst the debris, below; various kinds of dried sludge and ash) Photos by author.

Figure 8 Noyyal river (left; small stream flow, above; close up of water, bottom; urban sewage feed-in) Photos by author.
The further downstream I went, the more the Noyyal’s colour turned greenish and the presence of algae intensified. The remnants of the river then transformed into stagnant pools of dark green water, which suggests high levels of eutrophication (see fig.9).

Moreover, one could spot that all along the Noyyal, truckloads of urban solid waste had been dumped into the riverbed. Often it seemed as if the Noyyal and tributary channels were misused for the convenient disposal of garbage. Also, considering the fact that the Noyyal’s flow is seasonal and it was peak dry season, suggested that the streams running through the riverbeds primarily consisted of urban sewage. Furthermore, it came to my attention that side streams feeding into the Noyyal were often densely populated. These settlements were crammed closely along the low banks of stream intersections feeding into the Noyyal, often leaving no buffer zones to retreat to in case water levels would rise abruptly (i.e. in the event of a flash flood during monsoon seasons). Also a clear lack of sanitation facilities and infrastructure was apparent. In contrast to most areas in the city, where some kind of open or covered drainage system channelled the sewage flow, these quarters did not have any kind of sewage system. As a consequence, residents were exposed to the constant presence of raw sewage (see fig.10, 11).

Figure 9 Noyyal river (left; algae and waste build-up, top; water close up, bottom; nutrient saturated riverbed) Photos by author.

Figure 10 Slum settlement along a stream feeding into the Noyyal (Photo by author).
Another observation made was concerned with public water access. I had been told previously that due to the groundwater being unfit for drinking purposes, people tended to buy water. However, in order to make potable water accessible to poorer populations, WCPs had been set up around the municipality, allowing people to source safe drinking water free of charge. During one of my excursions I came across one of these WCPs and observed how people (mainly women) were queuing up with pots and canisters (see fig.12) and ended up asking a few questions about water availability. I was informed that this particular WCP was set up around 5 years ago (2009) and was the only one in the neighbourhood quarters (except a number of boreholes and taps, where they collected water for household chores such as washing, but were deemed unfit for drinking and cooking). Furthermore, I was told that this WCP was connected to a large water tank, which was filled every 10 days or so by the municipality with 10 lakhs of water (ca. 1000000 litres). However, the people also explained that the water reserve wouldn’t commonly last for the entire period and could be exhausted after just several days.
6. Discussion
6.1 Developments and trends in the knitwear industry

Tirupur’s transition from a small town to one of South Asia’s leading centres for knitwear manufacturing over the last decades is a testimony to the ever-present dynamics of on-going economic globalisation. The cluster’s heavy export orientation gained momentum with the liberalisation of the Indian market economy in the early 1990’s, enabling the textiles industry to expand extensively in order to cater for the rising demand of ready-knitted garment products in the West. While previous national policies reserving garment production for SSIs considerably shaped Tirupur’s industry landscape, findings suggest that in more recent years the cluster has - and continues to - undergo a process of reorganisation. Although Tirupur’s industry environment is inherently characterised by its decentralised and flexible structure, dominated by small to medium sized firms and units specialising in certain stages in knitwear production, more recent occurrences affecting the garments industry and specifically the processing sector are challenging the existence of many smaller and financially weaker firms.

The de-regulation of the knitwear sector in the early 2000’s, permitting firms in the cluster to expand their operational activity in order to propel mass production and benefit from economies of scale, certainly paved the way for many large-scale and vertically integrated factories in the outskirts of Tirupur. However, statements from industry respondents indicate that the implementation of environmental regulations also played a significant role in the industry shakeout. Accordingly, the enforcement of effluent treatment measures by authorities created a new business atmosphere in the knitwear cluster, severely impacting the processing sector and as a consequence Tirupur’s economic development as a whole.  

With the introduction of CETPs, IETPs and the polluter pays principle, former cost effective yet highly polluting discharge practices were prohibited, thus officially ending an era where engaging in processing activities was synonymous with fairly low investment requirements. Obliged to secure capital for the installation and operation of effluent treatment plants, followed by technological upgrades and the acquisition of new machinery in order to comply to subsequent ZLD norms, many dyeing and bleaching units faced an increasing financial burden. In the period between the establishment of treatment plants in 1998 and the closure of the processing sector in 2011, the number of units operating in Tirupur decreased from around 860 to approximately 600. About another 200 units ceased their activity in the post-closure period up to the time of field research (April 2014). Even though it can be argued that the inherent reason for this development points to the fact that units violating pollution regulations were shut down by the TNPCB, interview findings also disclose that some dyers were unable to sustain their operational activities in Tirupur due to a lack of capital.

Moreover, it must be emphasised that many dyers expressed their hardship of staying in business, since returns on investments had already been strained prior to the industry closure due to the volatile export situation caused by the recession in EU and US markets. Yet, whereas large manufacturers claimed to have recovered from difficulties in previous years, accounts voiced in smaller units were rather sceptical of the current state of affairs. A central reasoning for this can be attributed to the fact that none of the CETPs in Tirupur were

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44 Due to interconnection and job-work relationships of firms operating in the cluster, i.e. if one sector (e.g. processing units) is facing challenges others (e.g. garment manufacturers) will also be impacted.

45 Prior research by Blomqvist (1996) outlines that small dyers could invest as little as Rs. 30,000 in order to engage in processing activities with an output of 200 kg per day, while middle sized units would invest around Rs. 100,000 with an output of 500 kg per day. Very large units (at the time) using imported machinery and a capacity output of around 1000 kg daily would need investments exceeding the Rs. 200,000 mark.
licensed to run at full capacity levels and thus members were restricted in terms of production output. On the other hand, larger units generally operating IETPs were reporting to run their activities at full capacity, while some even indicated that they were in the process of upgrading their installed capacities.

Consequently, it can be argued that units connected to CETPs are not able to optimise their operational performance and hence are loosing their footing in the highly competitive market environment. This seems to be a rather crucial trend with regards to securing their existence, since larger units and integrated manufacturers with augmented quality control have seized dominance in processing activities destined for export. Although dye-houses ineligible for export production have primarily redirected their focus on servicing the domestic market, additional costs and restrictions imposed in Tirupur have made it increasingly difficult to compete with other textile clusters that have lax environmental regulations. In essence, it can be said that in the face of strict ZLD requirements, Tirupur’s processing industries have ultimately lost their comparative cost advantage and although units in the cluster have undergone considerable modernisation (i.e. upgrading to soft flow machinery and effluent treatment) the outcomes differ significantly for smaller and financially weaker positioned firms than for large and vertically integrated manufacturers.

Furthermore, it must be pointed out that the closure of the sector in 2011 forced many export houses to outsource their contingent of dyeing operations to elsewhere in order to continue business activities. Yet, in spite of the fact that dyeing and bleaching activities in Tirupur have been resumed for some time, the trend of outsourcing processing to other places is still at large, which essentially puts many supply units operating on a job-work basis relying on orders in a chokehold. Therefore it can be argued that unless CETPs are able to successfully conclude their ‘testing phase’ and provide concrete evidence to authorities that they are capable of treating higher loads of effluents, the cluster’s dyeing and bleaching sector will continue to struggle and deteriorate in the future, leaving only units that are able to reduce overall costs, either by passing them on to buyers or offsetting them through economies of scale. Moreover, there is a possibility that this trend could reverberate, affecting a large share of people whose livelihoods depend on Tirupur’s garment sector. Hence, it can be said that the textile cluster’s operational longevity is highly significant for the well-being of many people in the region. According to Conelly and Smith (1999) quality of living is a key aspect of SD. However, further weakening of the processing sector could potentially destabilise Tirupur’s entire textiles industry and result in the degradation of living quality for many.

6.2 Resource and pollution management

6.2.1 Water use and allocation

In consideration of the study’s findings one can argue that Tirupur’s water situation has changed undoubtedly since the mid 1990’s. Foremost, with the establishment of the NTADCL and the subsequent implementation of the TADP, considerable development efforts were made to address inherent water management challenges in the cluster. Yet, despite the project’s official designation to secure and improve water provision for industrial and domestic sectors alike, evidence indicates a rather differentiated picture showcasing asymmetrical ambitions fundamentally impacting the development progress.

It can be said that as main water users in the cluster, Tirupur’s processing industries have been the NTADCL’s key focus from the outset (Datta, 2009; Madhav, 2008). Accordingly,

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46 Out of 20 CETPs installed in Tirupur only 18 were in operation, running with a capacity of 30-70%.
they were significantly prioritised with regards to the project’s implementation and operation, whilst infrastructural works concerned with supply, access and sanitation for domestic users (urban and rural) have been compromised. Interview findings clearly communicate that by the time the supply initiative was completed in 2005/6, processing units were endowed with water from the NTADCL, thus no longer requiring to extensively source groundwater from surrounding regions. Although, many industrialists stated that current water allocation could be optimised with regards to pricing and distribution, all agreed upon the fact that they no longer faced supply shortages. In essence it can even be argued that that the dyeing sector is momentarily provided with an excess of water due to a sharp drop in demand, which according to Srinivasan et al., (2014) in concurrence with interview statements is due to increased modernisation of dyeing machinery and recycling practices, as well as the closure of over 50% of dyeing units in the cluster.

Water provision in the municipality on the other hand still remains a highly problematic affair to this day. Even though, authorities (TWAD, 2014) state that the city’s present water supply permits an average of 80 litres per capita per day and thus meets the demand of the urban population, one might question whether it is allocated in a fair and equitable manner. As pointed out by Chaturvedi (2012, p. 80) “Per capita figures of supply are calculated even more simplistically by dividing the total installed capacity by the population. We need to go very far to search the truth”. While findings suggest a decent water supply structure in the urban centre, infrastructural developments appear to be irregular depending on the location of the neighbourhood and therefore having direct access to piped water in Tirupur’s less developed and peripheral areas is not a given. Observations and interactions also suggest that populations with low incomes rely on WCPs scattered throughout the municipality for potable water. Yet, insufficient and erratic deliveries severely impact water availability and as a result many continue to purchase water from private sources. Hence, one is inclined to believe that a large part of Tirupur’s inhabitant’s rights to equal access to clean water is not being attended to. This stands in stark contrast to the NTADCL’s purpose and assigned responsibility of improving water coverage in the municipality and surrounding areas. While previous studies (Datta, 2009; Madhav; 2008) have addressed this predicament beforehand, the fact that this still remains a contemporary issue strengthens the assumption that developments and water works servicing the public domain are not able to meet the requirements of a rapidly growing population.

Further evidence, suggesting a highly partial development orientation since the establishment of the NTADCL, is concerned with the venture’s assignment to enhance the municipality’s sewage system and provision of adequate sanitation to Tirupur’s slum areas. Although observations suggest the presence of some sort of sewage infrastructure in core areas of the city (ranging from covered to open drainage), interactions and multiple excursions revealed an inherent lack of sanitary facilities in slums and the city’s outer parts. A recent investigation by national authorities (NITTTR, 2014) also attests the overwhelming deficit of water supply connections, sanitary and drainage facilities (among other things) in Tirupur’s numerous slums. Accordingly, one might contest whether sustained efforts improving and overseeing water services for the urban poor have been made since the NTADCL was granted the exclusive rights for water development works in Tirupur. Rijbersman and van de Van (2000) point out that participation is of essence to ensure that solutions to a problem can be as sustainable as possible and not the outcome of a certain stakeholder’s interests. However, given that the project has foremost attended to the industries needs, while deferring infrastructural developments for the urban (especially the poorer population) raises the question whether all voices were given equal attention in the decision making process.
Nonetheless, it must also be emphasised that with the implementation of the third supply scheme industry demands have inherently been addressed and as a result extensive groundwater extraction for dyeing purposes in the Tirupur region have ceased officially. Yet, an assessment of the overall implications this has on the rehabilitation process of groundwater sources remains uncertain. While industrialists generally argued that groundwater levels were rising and thus concerns regarding overexploitation were no longer justified, the inherent lack of contemporary studies detailing groundwater recovery in recent years makes this matter inconclusive. The latest official data provided by the TWAD (as of march 2009) lists 1 block within the Tirupur district as semi-critical, 3 as critical, while classifying 1 block as overexploited. Merely 8 blocks including the Tirupur municipality were considered safe with regards to groundwater flows.\textsuperscript{47} However, one might extrapolate that by deducting the dyeing industries’ former consumption of groundwater from current withdrawal scenarios, pressures on aquifers in the region should be reduced significantly. Even so, one has to acknowledge the fact that large parts of the urban and rural population continue to rely on groundwater for self-supply, while agricultural activities in the region (regardless of their decline since the 1990’s) remain highly dependant on the use of groundwater. Accordingly, evaluating current groundwater developments is rather complex due to inconsistent data and ambiguous estimations as highlighted by Srinivasan et al. (2014).

\textbf{6.2.2 Pollution risk and abatement}

Since the days of unparalleled industrial pollution, peaking in the late 1990’s, Tirupur has committed to significant measures in order to halt further environmental deterioration and avoid irreversible ecological damage in the region. Resulting from public action, a series of judicial interventions and directives have transformed Tirupur into a textiles cluster that advocates strict ZLD norms. However, as shown in the case profile, early efforts such as the polluters pay principle and the formation of CETPs and IETPs from 1996 onwards did not have the desired effect to eliminate pollution flows in the Noyyal. Information gathered from a plethora of research studies and documents, as well as evidence from the interviews, reveals that ultimately effluent discharge practices by processing units continued uninterrupted until the closure of the whole dyeing sector in 2011. Moreover, findings suggest that issues such as lax penalty enforcement, technological restrictions, additional costs and complications regarding funding facilitated a culture of negligence among many industrialists, which broadly speaking encapsulates why it took over a decade and a closing order to crack down on polluting industries and systematically enforce ZLD norms in the cluster.

That being said, from an official standpoint\textsuperscript{48} Tirupur’s dyeing sector currently complies with the ZLD directive and thus one is led to believe that effluent discharge practices have ceased. Yet, findings from the interviews suggest that there are still units in the cluster that dispose illegally of their effluents. This premise is supported by reports in public media describing the illegal dumping of industrial effluents into the surrounding environment. However, industrialists described such incidents as isolated cases that do not mirror the overall situation in Tirupur. Even so, accounts elaborating on these matters indicated that dyers involved in such illegal activities were able to evade the authorities due to their small-scale operational scope and informality. Furthermore, remarks by interviewees also suggested that persisting corruption levels in institutional bodies such as the TNPCB continued to undermine the overall efficacy of pollution controls. Nevertheless, one has to acknowledge that all registered

\textsuperscript{47}Groundwater use: >100\% (overexploited), 100-90\% (critical), 70-90\% (semi-critical), < 70\% (safe).

\textsuperscript{48}According to a statement released on December 6th, 2012 by the Press Information Bureau of the Indian Ministry of Textiles.
processing units operating on a legal basis in Tirupur are currently connected to CETPs or IETPs and that industrial effluents have to be treated according to ZLD standards. Thus, one might argue that the cluster has been able to avert a complete ecological crisis caused by unsustainable effluent discharge practices. Yet, while literature on the critical condition of ground- and surface-waters in the Tirupur region prior to the industry closure is extensive, “there are no studies on water quality in the post-2011 period” (Srinivasan et al., 2014; p.34). Hence, whether the ZLD directive has positively impacted Tirupur’s water bodies is subject to further research.

At the same time, it must be mentioned that although ZLD norms were enforced to solve Tirupur’s effluent dilemma, evidence suggest that due to inadequate follow-up management a new contentious issue emerged. Observations revealed massive sludge accumulations on industry sites and empty land plots within the Tirupur area. Considering the toxic nature of this residuum advances a general concern whether Tirupur continues to face more serious environmental risks. According to Rajarm and Das (2008), only proper disposal in locations such as secured landfills can prevent further contamination of the environment. Yet, Tirupur’s CETPs and IETPs have amassed massive amounts of sludge since the implementation of ZLD norms without concluding where to store it indefinitely. Moreover, due to the arid climate in the region, the dried sludge is frequently dispersed by winds, becoming a threat for secondary pollution, not only risking to further contaminate soils and surface waters, but also endangering the health of people who come in contact with the hazardous material (Srinivasan et al., 2014). The fact that some units also resort to illegally dumping sludge on the banks and in the dried-up riverbed of the Noyyal is also highly counterproductive, since the concentrated remnants of the effluent inevitably end up in the water bodies again, thus turning the ZLD directive into a fruitless endeavour. If such matters are not dealt with adequately, the intervention’s purpose to halt further environmental degradation is inherently negated. Numerous scholars (Conelly & Smith, 1999; Goodland & Daly, 1996; Rogers et al., 2008) emphasise that SD essentially demands the offset of pollution and waste production in order to minimise environmental damage caused. Accordingly, it can be argued that actions that result in the opposite cannot be deemed sustainable.

Another critical aspect in order to achieve ZLD is concerned with excessively high power consumption. In CETPs and IETPs large quantities of electricity are needed to recycle wastewaters and turn effluents to sludge. Yet, due to erratic supplies from the grid most plants rely heavily on diesel generators, which in turn emit substantial amounts of CO₂ (Rajakumari & Kanmani, 2008). At the same time, thermal processes executed with machinery such as the evaporator and crystalliser are fuelled additionally with firewood. Observations and further enquiries pointed to the fact that vast amounts of wood were necessary to keep these machines running and evaporators in specific are considered to have a substantial carbon footprint (Rajakumari & Kanmani, 2008). Consequentially, one might question whether the development path of Tirupur’s dyeing sector focuses primarily on the technological feat of having achieved ZLD and optimising its water usage, while turning a blind to the fact that other resources can just as easily be exploited. As pointed out by Chaturvedi (2012, p.123) “deforestation concerns are legitimate and their extent unappreciated” resulting in the fact that “India’s remaining forest resources are rapidly being depleted”. However, it must also be said that efforts to install alternative energy sources have been made. According to the DAT (2013) an official request for funding was made to the Indian Government so that the dyers association could install 103 MW of solar panels to supply the 18 CETPs with power. Whether the project was realised is not documented, but interview material suggests that numerous industrialists were inclined to install their own solar systems to cut down on the operational costs of their IETPs. Although scholars such as Goodland and Daly (1996) point
out that switching to renewables is a crucial step towards the transition to sustainability, one must also be aware of the fact that many of Tirupur’s processing units have essentially not ‘decarbonised’ their operations. Instead they have increased their use of resources (fossil fuels, wood) in order to bridge their increased energy usage since the ZLD intervention.

While pollution abatement measures attending to industrial effluents have taken much of the centre stage in Tirupur since the mid 1990’s, other pollution matters have been largely neglected. In the wake of rapid urbanisation, the inadequate disposal of domestic waste and discharge of raw sewage have become increasing problems severely impacting the ecosystem as well as being the cause for serious health issues (Chaturvedi, 2012; Saravanan, 2009). According to Rajkumar and Nagan (2011) around 3 MLD of Tirupur’s untreated urban wastewater flows into the Noyyal. Observations made during excursions along the river clearly indicated that the flow of the river, despite being essentially non-perennial, was sustained by urban wastewaters. Hence one might describe the Noyyal as the municipality’s drain for raw sewage and solid waste. Consequently, the question arises why this is not being managed since the off-take and treatment of the Tirupur’s sewage loads were contracted to the NTADCL. Further downstream the situation was not much better since the river had turned into stagnant pools filled with algae indicating high levels of eutrophication. Considering the grim state of the Noyyal, one is inclined to question whether enough attention by local authorities is given to urgent matters such as urban waste and sanitation management. Moreover, it seems that poor governance and weak coordination among institutional bodies infringe informed planning strategies and development efforts to address inherent challenges that will only get more severe in the future.

6.3 Social implications

Since the 1980s Tirupur has grown substantially due to migrants looking for work in the textiles industry, which by the 1990’s had become one of the main sources of employment in the region (Heyer, 2013; Saravanan, 2007). Despite the industry employing a roughly estimated 400,000 people (Carswell & DeNeve, 2014), findings suggest that industries still face labourer shortages. The dyeing sector in particular is experiencing a deficit of low-skilled workers in recent years and evidence from interviews and the focus group indicates that the industry closure in 2011 has intensified this situation. Accordingly, many labourers previously employed in Tirupur’s dyeing and bleaching units followed the demand for workers in other Indian garment clusters. Although some returned to Tirupur in the post-closure period, industrialists claimed that the majority did not and thus competition for labourers in the industry is very high.

Moreover, it must be emphasised that the impacts of the industry’s constant need for workers are multidimensional. For one, the textiles industries have adjusted their strategies to address workforce shortages and fluctuations. Consequentially, recruitment of potential workers in other Indian regions and states (especially northern territories) has become a prominent practice, thus ultimately nurturing the influx of long-distance migrants to the cluster. However, considering that accommodation and estate prices in Tirupur are constantly rising makes this matter a serious concern from an urban development perspective. The lack of housing increases population loads in critical hot spots such as slum areas, while settlements in peripheral areas and on unsanctioned land are mushrooming. SAVE (2006) estimates that 65% of Tirupur’s slum inhabitants are migrants occupied in the textiles industry and according to the NITTTR (2014) the city’s number of slum dwellers is growing continually.
Yet, at the same time, matters of caste identity are deteriorating within Tirupur’s textile sectors. Although, scheduled castes and long-distance migrants are often found to do the ‘dirty’ jobs such as manual labour in processing units (Carswell & DeNeve 2013a), the role of caste is becoming increasingly unimportant in recent years as long as the job gets done (Carswell & DeNeve, 2014). While this implication might be more significant for semi-skilled and skilled jobs found predominantly in garment sub-sectors such as knitting and stitching, it suggests that chances and opportunities for lower-caste migrants to acquire better-paid employment are at hand.

It must also be mentioned that wage levels in Tirupur’s knitwear industry were allegedly higher than in the agricultural sector or other garment clusters, due to the fact that they are renegotiated on a four-year basis. However, according to research (Heyer, 2013; NCAER, 2009; SAVE, 2006) wage levels and work conditions in the knitwear industry remain relatively poor, especially for low-skilled labourers. Findings suggest that throughout different sectors the ‘per piece’ payment is a commonly adapted method to ensure productivity rather than offering daily wages to workers. As a result 12 hour work days, referred to as ½ shifts, are considered a standard practice and longer shifts are not uncommon. Moreover, some industrialists claimed that if they didn’t offer employees longer shifts, many would opt to work for someone else. While at first this seemed like a weak attempt to justify exploitation, it later became clear that it was indeed common for labourers to work as much as possible in order to accumulate and save money, since work in the garment industry can be quite irregular. Furthermore, it also suggested that in recent years workers displayed augmented awareness of their occupational flexibility and mobility in face of inherent labour shortages. Accordingly, labourers would increasingly switch between employers more often in order to improve their work situation, which in essence can be described as a way of self-empowerment.

6.4 Sustainability in context: Visions and realities

The balance between economic, ecologic and social dimensions is considered a key component of SD. However, conflicting interests and the capitalistic nature of the global economy make it difficult to pursue a development approach that is isolated from external forces affecting its path. Jabareen (2008) describes this as the ‘ethical paradox’ undermining SD and it certainly holds true for developing countries, such as India, that are on a quest to join the ranks of developed nations in the global community.

Catering for the demands of the West, Tirupur has sacrificed its sustainable use of resources and environment to achieve economic growth in a record time. Coming close to ecological collapse and after a period of 20 years since the first effluent treatment was introduced, finally more effective pollution control measures are in place. With the implementation of ZLD the discharge of industrial effluents (except for some illegal dyers) into the Noyyal has officially ended. At the same time, water recycling has reduced the industries consumption radically. As pointed out by Goodland and Daly (1996) the transition to sustainability demands that natural capital is maintained and resources used in a regenerative capacity. Accordingly, it can be said that Tirupur’s textile industries have undergone considerable efforts to steer in this direction by abandoning former practices and employing the use of more efficient technologies. While insufficient data does not yet provide conclusive evidence of the full implications, claims that the region’s water resources are said to regenerate and effluent discharge has been cut short are promising nevertheless. Furthermore, many industrialists

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49 Tripartite Wage Agreement
50 Depending on the sector (eg. knitting), order and time schedule.
claimed that by using recycled water they no longer required to purchase as much water and could reduce their overall spending. This is a crucial development, which could potentially address remaining water shortages for the domestic sector. With industries only consuming around 20 MLD of the 160 MLD of water provided by the NTADCL, the remaining quantities could be supplied to domestic users in the Tirupur area, thus addressing inherent issues of inequality and fair water allocation. Whether this is a feasible option\textsuperscript{51} is beyond the scope of this research, yet in consideration of accounts that the NTADCL was encountering problems due to low off-take from the industries, a revaluation of their strategic management with regards to operational activities could significantly reduce pressures on urban water supply in a rapidly urbanising Tirupur.

Nonetheless, major sustainability challenges remain. For one, ZLD being praised as Tirupur’s environmental rescue does not facilitate the sustainable use of the environment. The vast energy consumption of CETPs and IETPs creates increased power shortages, emissions and promotes deforestation in the region. Moreover, matters of sludge accumulation and its disposal pose serious environmental concerns. If this cannot be dealt with in a reasonable manner, ZLD could be a catalyst for further environmental contamination in the Tirupur area. According to Conelly and Smith (1999) economic-environmental integration and environmental protection are key themes within SD. Yet, it seems that economic incentives still dominate the industry’s actions, despite its effects on the ecosystem. As a result it appears as if there is merely a shift in forms of pollution, from water (effluents) to land and air (sludge and emissions). Secondly, although industrial effluent discharge has been attended to, urban waste disposal and raw sewage flows have proliferated, causing environmental risks, especially for the urban poor that are subjected to inadequate sanitation. Despite claims that Tirupur’s slums are being ‘upgraded’ findings suggest that they remain high priority concerns. According to Rogers et al. (2008) the eradication of poverty is one of the most important issues in SD and in order to do so basic needs have to be attended to. A right to clean water and sanitation is one of these needs and as long as people are being deprived of such, the development trajectory cannot be deemed as socially sustainable. Various scholars (Chaturvedi, 2012; Conelly & Smith, 1999; Rijbersman & van de Ven, 2000) argue that tackling such issues requires changes in management and institutional development. This will lead to increased participation, thus allowing more voices to be heard in decision-making processes, which is integral for SD.

The textiles industry’s unceasing demand for human resources also presents Tirupur with a difficult task, as increasing urbanisation exposes the inherent infrastructural limitations of the municipality and the fact that the population has outgrown the basic urban capabilities. Surely, it would be wrongful to argue that the textiles industry is the sole reason for the rural migration to Tirupur, yet it plays a significant role. Recruitment fares in other regions attract an increasing number of people that seek employment in the industry, however low income levels and rising estate prices in the city often lead to people settling in slums and unsanctioned land, which according to Anderberg (2012) intensifies social conflict, environmental- and health risks. Although some manufacturers provide housing compounds for their employees, it does not address the situation. Moreover, as interview findings suggest accommodation provided by factories could also subject people to increased control and deprivation of their freedom. Yet, it must also be said that Tirupur’s economic growth has

\textsuperscript{51} As pointed out by Chaturvedi (2012, p. 81) “Whereas there is abundant evidence that most domestic consumers, at virtually all levels in society, are willing and able to pay much higher than the of official price for water, only the presence of large commercial and industrial users (who are metered and pay a high tariff rate) may keep the water utilities financially viable.”
facilitated an alternative lifestyle and opportunities contrasting rural social life. Hence, as pointed out by many industrialists, education levels among younger generations are increasing and with it social awareness. While, this might not necessarily be the case for long-migration labourers that reside temporarily in Tirupur, overall changes in the worker-employer relationship and increasing self-empowerment of the workforce were said to challenge former practices.

7. Conclusion
To counteract the environmental depletion in the cluster, the legislative directive ordering the instalment of effluent treatment plants in 1996 set the cornerstones for the ZLD regulation issued by the High Court in 2006. Although the ZLD regulation was put forward to end wastewater discharge scenarios of Tirupur’s processing units, it remained rather unsuccessful and was met with negligence until the industry closure was enacted in 2011. Accordingly, it can be said that the closing order, which instructed the TNPCB to shut down all of Tirupur’s dyeing and bleaching units with immediate effect, forced the cluster to conform to strict ZLD measures. Hence, the industry closure can be regarded as the pivotal intervention that altered Tirupur’s prospects and the industry’s course of action.

To no surprise the intervention’s effects are been perceived with mixed feelings. Some claim that it has transformed Tirupur into a globally unique textiles hub that is environmentally friendly and a role model for garment production. Yet, concerns regarding augmented costs resulting from effluent treatment were omnipresent. Many industrialists argued that these additional costs had a considerable impact on their competitiveness in the market environment. Smaller dyers in particular expressed their hardship to stay in business, as CETPs were not running at full capacity levels. Larger units and integrated manufacturers, on the other hand, explained that they were recovering from initial setbacks since adjusting to ZLD and operations were revitalising. Generally speaking, most industrialists shared a common sense of pride, having successfully overcome a difficult phase, which had threatened to sideline the cluster from remaining a key player in global knitwear segment. Most exporters were hopeful that with the ZLD directive in place, new foreign buyer groups would be attracted to Tirupur and older clientele lost during the closure would return. However, smaller units primarily producing on job-work basis were not as optimistic and rather unsure of their future, being pressured by financial insecurity and low operational activity.

Clearly, the ZLD enforcement has had considerable ramifications for the cluster. Besides decimating the number of operating units and altering the business atmosphere in Tirupur, the most apparent change deals with industrial wastewater discharge practices. Nowadays, industrial effluents are treated extensively and officially no more wastewaters are being released into the environment. At first glance this development can be regarded as a feat of economic-environmental integration that halted further degradation of Tirupur’s ecosystem.

Unfortunately, this is not to entirely correct, as there has only been a shift in forms of industrial pollution. Toxic sludge has become the new threat to the cluster and contemporary solutions addressing this problem are vastly inadequate.

Another change triggered by the intervention is the grand-scale upgrade of technology in the processing sector. In order to comply with ZLD norms subsequent to the closing order, units installed new, more efficient machinery using less water in the dyeing process. Moreover, with wastewaters being recycled in the effluent treatment and fed back into the production cycle, industrial water consumption had been reduced significantly. This achievement also lowered the industries overall demand for water from the NTADCL, whose economic
feasibility largely depends on industrial water take-off. However, while industries no longer faced acute water shortages, they were confronted with a power crisis resulting from the high energy intensity of effluent treatment. Hence, an indirect effect of the ZLD directive has been the rise in energy consumption that has not only lead to a further destabilisation of Tirupur’s already fragile and erratic electricity supply but also augmented dependency on diesel generators in the cluster. Moreover, it can be said that the industry’s resource use, with the sole exception of water, has not been significantly reduced but remains rather high. This implies that natural capital continues to be depleted at a high rate, as units operations are highly carbon intensive, depending largely on firewood and fossil fuels.

The industry closure has also had considerable effects on Tirupur’s population. Many labourers working in the cluster’s processing units had to look for alternative work during the closure period. In general, the textiles industry is facing a great shortage of workers and competition among firms for workers has intensified greatly with the intervention. However, worker’s wages are also indirectly impacted by the ZLD due to the fact that many units are not able to maximise their outputs and labourers are often paid per piece. Hence, if productions are low, so are the earnings. It must also be said that despite the overwhelming need for labourers, most workers occupied in processing units earn the bare minimum and thus often live in slums or unsanctioned settlements, where access to water and sanitation facilities is poor. Findings showed that Tirupur’s surging estate prices make it near impossible for low-income communities to find affordable accommodation. While this trend is unlikely to change, the ZLD intervention could have a positive side-effect on water distribution in the cluster. Due to decreased industrial demand the NTADCL might have to reorganise their supply priorities and turn to the public and domestic sectors for increased off-take. This would benefit the urban poor immensely, as previous development measures have not addressed their right to clean water and sanitation.

Overall it can be concluded that the policy intervention has had considerable impacts on the textiles industry, its workers and the environment. However, whether this has led to fundamental changes contributing to the cluster’s sustainability is highly questionable. Tirupur’s ecological condition remains critical and economic motivations continue to deplete the region’s environment. While the closing order forced industries to comply with ZLD norms and end former discharge practices, no further developments protecting the ecosystem and attending to the perils of pollution have been made. The achievement of ZLD can be regarded as a first step in the right direction, but is still far from being sustainable. Low wages and long shifts for workers as well as cost-cutting by dumping effluents, sludge and waste into the environment also indicates that economic profitability prevails to be the main driver for the industries. Tirupur’s development continues to focus on aspects of growth and accordingly social and environmental objectives are often disregarded. However, it must also be said that generally speaking industrialists welcomed the idea of Tirupur becoming an environmentally friendly textile centre, arguing that it would create new opportunities. Whether such intentions will come true depends on how well the processing sector will do in the future and if global retailers and buyers are willing to source from a ‘slightly higher priced’ Tirupur. In order to survive in the competitive market environment, the Tirupur cluster has to adapt the image of a ‘green’ cluster, yet, to do so much more has to be done and not just resulting from policy interventions but proactively. However, if the industry decides to commit all its resources to the cause more might happen much quicker than without it - for the best or the worst.
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10. Appendices

Note: Questions in the interview guide were adjusted to the situation and simplified and/or reformulated when needed. At the same time they served as a reminder or checklist to the researcher what topics should be addressed. It must also be said that sometimes other questions (such as follow-up questions) were asked and occasionally certain questions in the guide layout were not being asked if they were deemed inapt.

Appendix I: Industry focus (Category I)

*How would you describe Tirupur’s industrial development (growth)? How has it affected environmental (eg. resources, surroundings), social (eg. lifestyle, employment) and economical (eg. business atmosphere) aspects?*

...  
*In what activities do(es) your unit(s) engage in (bleaching, dyeing, etc.)? For whom do you produce for (eg. domestic/export) and how long have you been in business?*

...  
*In retrospect, how would you describe the business climate and opportunities over the last 20, 10 and 2 years respectively?*

...  
*What policies/legislations have influenced your business operations the most in recent years (specify timespan if possible)?*

...  
*Do you think there is further potential for development and what would you deem as barriers or constraints?*

...  
*Do you think units working within the textile sector are more environmentally friendly since the mid 1990’s? Nowadays? What do you believe has changed since?*

...  
*How would you describe business opportunities and the supplier/consumer relationship now in comparison to the mid 1990’s? What are the most striking differences if any?*

...  
*How many workers do you currently employ and under what working agreement? What kind of background do these workers come from?*

...  
*Do you see a correlation between minimum wage and cost of living and how would you describe your payment scheme with regards to other competitors in the industry?*

...  
*How would you describe the labour situation in Tirupur? Do you see any trends in competition for labour (time/geographical)?*

...

Appendix II: Labourer focus (Category II)

*Where do you work, how long have you been working there and what was your previous occupation (if any)?*

...  
*What kind of wage agreement are you engaged in (contractual basis, piece by piece, daily wage, etc.)?*

...  
*How hard is it to find a job in the textile industry in Tirupur (now and earlier – specify time)?*
In retrospect of the last 20-25 years, how has your life changed in terms of financial means and social interaction?

How dependent are you on your employer and how does it influence your work and private life (also obligations to kin)?

Do you know of any policies that have changed your standing in the economy/work place/daily life? Are you aware of labour unions?

What do you consider as opportunity/barrier to your personal development (HDI indicators with regards to poverty, access to drinking water and sanitation)? Has there been any changes in recent years (specify timespan and dates to follow up)?

Have you heard or been informed of water issues and their connection to the textile industry?

Have you noticed any changes in the way the textile units operate in the last 20-25 years? Has it influenced your life and if so how?

Appendix III: Water focus (Category I & II)

How would you describe the current water situation in Tirupur (access/price/quality of water and sanitation infrastructure)?

Has it worsened or improved since the mid 1990’s (since you came here – specify year of arrival)? In what ways?

What do you consider as the most significant reasons for this?

In retrospect, how would you describe the impacts (if any) of the water situation on your daily life (in regards to socio-economical development)?

Are you aware of any legislations/efforts aimed at improving the water quality/availability in Tirupur region and if so how successful do you think these measures have been?

What do you think needs to be done to improve the current situation?