

LEGISLATIVE FRAMEWORK FOR ENVIRONMENTAL PROTECTION FROM ELECTRONIC INDUSTRY IN EUROPEAN UNION, THEIR ADAPTATION CHALLENGES AND ASSOCIATED GAPS IN DEVELOPING COUNTRIES: PAKISTAN CASE STUDY

Arshad Ali*, Marek Vach, and Syed Hassan Ahmed

Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Kamýcká 129, Praha 6-Suchbát, 165 21, Czech Republic. *E-mail: mr.aali84@gmail.com

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Abstract

This article targets current situation of Restriction of Hazardous Substances (RoHS), Registration, Evaluation and Authorization of Chemicals (REACH), Waste of Electrical and Electronic Equipment's (WEEE) and Responsible Minerals Initiative (RMI) compliance and management in developing countries. The study focus is on adaptation challenges and related environmental protection issues within Pakistan. The emphasis is on how European Union (EU) and other global legislation can mitigate the environmental challenges triggered by EEE (Electrical and Electronic Equipment's) products if EU practices are considered as a role model for developing countries. The aim of this study is threefold: a) to review the challenges in adaptation of environmental legislation already in place in EU and other countries related to electronic industry; b) to review the existing practices related to EEE's related environmental and human health hazards within Pakistan; and c) to discuss the recommendations on how the legislations if adopted in a developing countries like Pakistan can minimize the adverse influence of EEE's on the environment and human health and support national development cause. The study finds that there are huge gaps to reach the optimum level of adequate EEE's base level management (production) and e-waste recycling. To the best of authors' knowledge for Pakistan this is the first time a study on adopting key legislations like EU RoHS, EU REACH, and The Dodd-Frank Wall Street Reform 2010 has been carried out. Similarly, 2019 EEE's Tsunami (Phthalates invasion) are highlighted for first time for government and policy makers in developing countries like Pakistan. This study recommends that switching to these legislations can be useful to tackle the rapidly growing EEE's related environmental, public health and other social issues.

Key words: conflict minerals, environmental policy, e-waste, phthalates invasion, regulated substances, WEEE.

Introduction

The innovation cycles for many EEE products in recent years are quite short, and such products generally have potential to contain materials and components which

can be considered hazardous as per EU standards (Press ... 2008). To abate the level of hazardous materials, there are regulations in place that control the threshold level of certain hazardous substances that are used in EEEs. EU has RoHS, REACH,

WEEE legislations in place. RoHS restricts the limit of substances at very fundamental stage, while REACH makes sure that in case of any Substances of Very High Concern (SVHCs) the whole supply chain is notified, and WEEE come into place at the end of life cycle stage, when the EEEs are abandoned. Kandil (2013) estimated that after 2017 the global e-waste will rise to 65.4 million tons annually needing to be disposed safely. Pakistan with a population of over 200 million is prone to various issues and adverse effects of EEE's from both environment and human health perspective.

The EEE's impacts in Pakistan are discussed in various research studies earlier, of these studies (Abbas 2010) is one of the primary researches that provide awareness regarding the important issue of lack of recycling facilities for e-waste management in Pakistan. The country mobile subscribers rose from 1.277 million in 2005 to 100 million by 2011 (Abbas 2011). As per 2018 mobile subscribers are 151 million (Anonymous 2018). This shows increasing usage trend in recent years. Due to lower income and buying power, people in Pakistan mostly prefer buying used and old phone as compare to buying new. Pakistan already import EEEs which are near their end of life cycle and there is no reliable statistics available on the amount of used electronics arriving in Pakistan (Iqbal et al. 2015). By looking at previous research studies focus was mostly on e-waste management issues. To the best of author's knowledge there is no literature available on RoHS, REACH and Dodd-Frank Consumer Act 2010 possible adaptation challenges and recommendations in Pakistan. The authors believe it is a high time for these legislations to be assessed to be part of Pakistan environmental protection future policies.

Objective of the study

The objective of this study is threefold: a) to review regulated substances environmental legislation already in place in EU and other developed countries; b) to review the existing practices related to EEE's related environmental and human health hazards within Pakistan; and c) to discuss the gaps of environmental regulation and recommend on possible legislation for developing countries, i.e. Pakistan. To meet the objectives of the study it is important to discuss a brief background of regulated substances legislation. Further details are provided in section 4.

Method

This is a narrative assessment that emphasized importance of having legislative framework dealing with electronic industry environmental and social challenges in developing countries. This study considers EU and other developed countries as a benchmark due to their existing strict legislation ensuring environmental protection from electronics during manufacturing, operation and end of life stage (disposal of electronic waste). Furthermore, a survey about environmental legislative framework awareness was conducted with engineers working in electronic industry manufacturing and environmental protection in EU and Pakistan.

Legislation Background – Developed Countries

RoHS Directive

RoHS Directive is an EU directive that administers the restriction on use of certain

hazardous substances in electrical and electronic equipment's. RoHS directive has been enforced since 2003 with a recast under the name of RoHS II that was published in Official Journal of European Union and enforced on 1 July 2011 (Directive EU 2015/863 2015). According to Annex II of RoHS Directive (RoHS 2017) as shown in Table 1 it restricts the use of certain substances including: Lead, Mercury, Cadmium, Hexavalent Chromium, PBB (Poly Brominated Biphenyl) and PBDEs (Poly Brominated Diphenyl Ethers) under a threshold level of 1000 ppm except for cadmium (100 ppm) in a homogenous material in EEE. In 2014, EU Commission revealed the intention to add four new phthalates: DBP (Dibutyl phthalate), BBP (Butyl benzyl phthalate), DEHP (Bis (2-ethylhexyl) phthalate) and Diisobutyl Phthalate (DIBP), with maximum concentration value 0.1 % by weight (1000 ppm) in homogenous material. Starting 22 July 2019, the total number of RoHS substances is 10 (Table 1). In addition to these restrictions this directive is known for CE (Conformité Européenne) which means European Conformity. The CE marking shows the conformity of EEE/products with all EU legislation applying to the product. This CE mark is a key indicator of EEE compliance with EU legislative requirements. In a nutshell this legislation prohibits and minimize the use of toxic substances at manufacturing level. Any electronic product that is set to be placed on EU market must meet all EU RoHS requirements regardless of where it was manufactured.

REACH Regulation

REACH is an EU Regulation since 2006 with objective to guarantee a high-level

safety of public health and the environment, also encouraging development of alternative approaches for assessment of hazards of substances and making sure trouble-free circulation of the substances in the internal EU and Turkish market. It is established on the basis that it is the responsibility of the manufacturers, importers and other subsequent users to make sure that they produce, make available on the market or use the substances that have minimal or no adverse influence on the environment or the human health. Its terms are emphasized by the preventive principle (Regulation (EC) No 1907/2006). REACH deals with Substances of Very High Concerns (SVHCs) as of July 2020, there are 209 SVHCs on European Chemical Agency (ECHA) list (ECHA 2020). According to REACH Regulation manufacturers, importers or distributors has the responsibility to notify the customers of any SVHCs presence.

WEEE Directive

WEEE is an EU Directive 2002/96/EC of the European Parliament and of the Council (January 2003) dealing with the most rapidly growing problem of waste generated by EEE. Some researchers have found that 30–50 million tons of items from electronics industry are abandoned annually (Fogarasi et al. 2014, Menikpura et al. 2014). In 2016, Europe including Russia produced 12.3 Mt of electronic waste with 4.3 Mt only recycled (Baldé et al. 2017). Studies predicted that around 50 million tons of e-waste will be generated around the world in 2019 (WEEE Forum ... 2019). All EU member states contribute towards electronic waste collection, recovery and recycling costs.

Table 1. List of substances covered by RoHS and REACH legislation, WEEE Directive covers all equipment using current and Dodd–Frank Wall Street reform and Consumer Protection Act covers 3TGs.

Substance	Concentration	Intrinsic property	Presence in EEE assessment source is (BOMCheck 2019)	Relevant legislation
Cadmium	100 ppm	Carcinogenic	Likely	
Lead	1000 PPM	Carcinogenic, affect nervous system	Very likely and in some cases RoHS exemptions are used.	
Mercury	1000 PPM	Carcinogenic	Likely	
Chromium VI	1000 PPM	Toxic effects in multiple organ systems	Likely	EU RoHS
Polybrominated Biphenyls	1000 PPM	Carcinogenic, endocrine disruptor	Likely, mostly used as flame retardants	
Polybrominated diphenyl ethers	1000 PPM	Carcinogenic, endocrine disruptor	Likely, mostly used as flame retardants	
DEHP	1000 PPM	Reproductive toxic, impair fertility	Likely. It is widely used as a plasticizer in polymer products, mainly PVC	
BBP	1000 PPM	May impair fertility, toxic to aquatic organisms	Likely. It is used in polymer products, mainly PVC	
DBP	1000 PPM	Reproductive toxic, very toxic for aquatic organisms	Likely. It is often used, in combination with other phthalates, in flexible PVC	EU RoHS since July 2019
DIBP	1000 PPM	Risk to impair fertility, may cause harm to unborn child	Likely. It is used, in combination with other phthalate plasticizers, in rubber, chlorinated rubber and PVC	
REACH SVHCs (Substances of very high concern)	1000 PPM	Variable: Toxic for production, very persistent very bio accumulative, carcinogenic, mutagenic, PBT-persistent Bio Accumulative toxic	As of 16 July 2019, there are 201 substances on REACH candidate list many of them are found in electronics. (ECHA 2019)	EU REACH

Dodd–Frank Wall Street reform and consumer protection Act – responsible mineral initiative RMI

The Dodd-Frank Wall Street reform and consumer protection Act section 1502-1504 of the United States of America re-

quires persons and companies to disclose their mineral sourcing origin. The act is in place since 2010 (Dodd-Frank ... 2010). Prior to this reform and consumer Act, RMI formerly known as Conflict Free Sourcing Initiative (CFSI) started in 2008 and was adopted by few of the leading companies

in electronics business. The idea was to assist them to be updated about their choices on 3TGs (Tin, Tungsten, Tantalum and Gold) conflict-free sourcing in their raw material supply chains. The RMI provided companies with means and resources that can enhance the regulatory compliance and encourage responsible 3TGs sourcing from war-affected and high-risk areas globally but especially in Africa. The aim is that a RMI template is distributed among the supply chain and information on sourcing of minerals (country of origin) used in their products are obtained. Revenues from conflict minerals sourced from the Democratic Republic of the Congo (DRC) have backed conflict, severe human rights abuses, and labour and environmental violations in the country for many years. Corporations that depend on 3TGs for their design and manufacturing products or parts are aware of these social and environmental abuses. Companies are keen on taking necessary action to avoid the benefits from these mineral

businesses continue to fund the conflict in any form, these companies are encouraging conflict free sourcing in these areas (RMI 2017). Conflict minerals reporting is a requirement in USA but currently EU companies are also demanding their supply chain to also provide information on 3TGs sourcing using same CFSI reporting template. For example, Germany is making it a requirement for supply chain to do their due diligence for importers of 3TGs and their ores originating from conflict-affected and high-risk areas (Regulation (EU) 2017/821).

Situation in Developing Countries: Case study of Pakistan

In order to assess the legislative framework situation in developing countries a case study of Pakistan was selected. Table 2 provides an overall situation in fast growing economies of China, India, Bangladesh and of the selected case study country.

Table 2. Existing legislation in developing countries.

Legislation	China	India	Bangladesh	Pakistan
RoHS	China RoHS 2	E-waste (Management and Handling) Rules 2011. From May 2014 restricts 6 RoHS substances	Management of WEEE, Draft Regulations, March 2017	PEPA, 1997. National Environment Policy (2005) and Import Policy Order (2016)
REACH	China REACH MEP Order 7	Hazardous Substances (Classification, Packaging and Labelling) Rules, 2011	Bangladesh Environment Conservation Act (BECA) 1995. No list of substances restriction is available.	Same as above
WEEE	Regulation on Recovery Processing of Waste Electrical and Electronic Products	E-waste (Management and Handling) Rules 2011.	Management of WEEE, Draft Regulations, March 2017.	Same as above
Legislation Covering 3TGs		None	None	None

Pakistan is signatory to number of United Nations and other international treaties to safeguard Environment. It formulated and enacted the Pakistan Environmental Protection Act in 1997 (PEPA 1997). This Act has some clauses which in broader sense cover hazardous substances under EU RoHS, EU REACH and EU WEEE legislation but electronic waste is discussed along with other type of waste. Article 31 of PEPA (1997) allowed to make further rules and regulation and Pakistan formulated IEE/EIA Regulation 2000 and Hospital Waste Management Rules 2005 but no rules were developed to handle e-waste when the environment was handled entirely by Federal.

After the 18th Amendment of 2010, Environment was transferred from Federal to Provincial jurisdiction. Subsequently the provinces in haste formulated their own provincial laws, but they are mostly based on same PEPA 1997. For example, Punjab Environmental Protection Act 2012 is issued as an amendment to PEPA 1997 with replacement of term 'National' to 'Punjab'. Other provincials are not much different either. No further rules and regulations were formulated by any province till date related to EEEs. Hence, Pakistan currently have no direct legislation dealing with environmental challenges from electronic industry and specifically electronic waste at both national and provincial level.

On 16th March 2017 Bangladesh Ministry of Environment and Forests published draft rules establishing national requirements for WEEE management, prompting a reasonable concern for EEE producers with manufacturing companies in the country. While not exactly matching the typical EU RoHS, the draft does contain RoHS-based requirements which for sure will impact electronic industry (Compliance... 2017).

From Table 2 it is evident that Pakistan among all these developing countries in the region needs some serious efforts to make legislation like RoHS, REACH, WEEE and conflict minerals reporting for its electronic industry sector.

Discussion

Adaptation challenges – environmental issues due to legislative gaps and recommendations

For a country like Pakistan the adaptation challenges to these legislations along with environmental and social issues caused by these legislative gaps are not very different from those already faced by Vietnam, India, Bangladesh and China which are briefly discussed in this section.

Adaptation challenges

1. Underdeveloped electronic sector and professional awareness

With 7.8 % growth in 2018 still only 3.24 % is contributed to Gross Domestic Product (GDP) by Pakistan electronic industry sector and this is due to the lack of industries in Pakistan (State Bank ... 2018). In past one of the reasons was unstable security situation that huge electronic manufacturing companies were reluctant to setup their production facilities. Recently Samsung, Huawei and Nokia have shown interest to setup their mobile phone manufacturing facilities in Pakistan (Business Recorder ... 2019). If successfully installed these manufacturing facilities will boost underdeveloped electronic sector of the country.

2. Professional awareness

A survey was conducted as a part of this research and 52 professional in envi-

ronmental industry from EU and Pakistan participated. Participants were asked to answer some basic questions concerning electronic industry environmental challenges. The survey results in Table 3 clearly indicate, that due to lack of leg-

islation and underdeveloped electronic sector in Pakistan even the professionals working in the environmental protection and electronics sector have very limited knowledge of the threats posed by toxic substances from electronics.

Table 3. Survey results – awareness about environmental challenges from electronic industry among engineers, in %.

Respondent engineers	Q1: Are you aware of harmful substances in electronics?		Q2: Do you know any legislation for environmental protection from electronic industry?		Q3: Do you know cross-wheeler bin sign?		Q4: Your facility have electronic waste segregation?		Q5: Do you know what CE marking is?		Q6: Do you know 3TGs in electronics?	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
EU	90	10	55	45	100	0	100	0	90	10	67	33
Pakistan	65	35	50	50	80	20	40	60	20	80	30	70

3. Communication gap

There is a serious need to improve communication and cooperation between ministries of environment at both federal and provincial level, Pakistan Customs Authorities, ministry of commerce and telecommunication in Pakistan.

4. Customer approach

Lau and Wang (2009) reported that currently many customers are not aware of China RoHS existence, and it is important to add that currently in Pakistan where is no awareness of RoHS, REACH or other legislations related to EEE among the public, therefore they are unable to act as a driving force to make the electronic industry realize its obligations for safer environment. A good example is of public awareness currently practiced in EU where people are aware of the influence of mismanagement of the electronic equipment and try to buy only from reliable companies that are having a take-

back system and are trying their best to go green in electronic industry. Customers demand for green and environmentally friendly electronics can be a huge driving force for electronic companies to adopt environmentally friendly products (Doua and Sarkis 2013), and for enforcing RoHS, REACH and other similar legislations.

5. Suppliers responsibility

For many suppliers in Pakistan environment and sustainability is not a priority due to the lack of strict legislation that are practiced in EU countries. Many companies have not done their homework on how they can look for more sustainable alternatives for hazardous substances in their electronic products. There is very limited research on how to go about and adopt more green technologies in the supplier and manufacturing chain.

6. Enforcement of existing regulations

Pakistan being a signatory of Basel convention is still unable to fully comply with its agenda due to lack of awareness and research, and that is why WEEE and other similar legislations (RoHS) are a challenging task especially with the rapid growth of information and communication technology.

7. Lack of electronic industry top management support

Pakistan has mostly small to medium size electronic industry business firms that are reluctant to adopt any new regulations that would affect their profit plans. Testing substances for RoHS and REACH compliance with proper WEEE disposal would add to the financial burden. Doua and Sarkis (2013) reported similar challenges to RoHS regulations implementation in China.

Environmental and social issues caused by legislative gaps

This section provides details on the environmental and social issues caused by legislative gaps.

1. Illegal e-waste arrival in Pakistan

Any EEE's produced and exported into the developing countries both as a new or an e-waste product has different implications. Efthymiou et al. (2016) discussed already known routes for black-illegal e-waste trade that flows from USA, EU and Australia to the developing countries. This flow has been referred to as unfair flow by Wang et al. (2016), they also reported that China ends up receiving and processing 70 % of e-waste by 2012. Pakistan being a close business partner of China due to its geographical position end up receiving a huge portion of such used or near-end of life cycle EEE's as well. Imran et al. (2017) reported that USA exports only 1 % of its e-waste to

Pakistan but another study indicated that around 80 % of the US' e-waste is routed to developing states including to Pakistan (Panambunan-Ferse and Breiter 2013). It is worth mentioning that majority of countries (Taiwan, Japan, China, EU and others) indicated as top exports to Pakistan by Imran et al. (2017) are having their own regulations that are somewhat similar to EU-RoHS. These regulations to some extent is believed to be limiting the amount of release of hazardous substances presence in the EEE's/e-waste arriving in Pakistan but it depends on the end of life period of the products.

2. Exposure of human health to toxic substances

Toxic and non-toxic components in the EEE's and e-waste restricted by RoHS and REACH in EU and other countries are not separate that makes the workers more prone to the hazardous substances. A special disturbing scene is that these informal recycling businesses violating the labour laws by employing child labourers as young as 8–18-year-old, they work without any necessary protective equipment's like goggles, face mask or gloves (Abbas 2011). Figures 1–3 show examples of violation of occupational health standards.

Most work is carried about by these children and other adults with bear hands without any Personal Protective Equipment (PPE). Most of them are from poor urban areas with very little or no education and have no awareness what so ever about the threats of hazardous substances presence in e-waste. The children at the development stage are exposed to neurotoxicants, endocrine disrupters and other carcinogenic substances found in electronic waste.

3. Environmental pollution

Environmental pollutants transport phenomena to water, soil and air contin-



Fig. 1. Female worker in informal e-waste recycling areas working without gloves (Photo source: Giovanni Porzio, obtained with permission).



Fig. 2. Female workers residing near informal e-waste recycling areas holding an infant in one of the most contaminated area (Photo source: Giovanni Porzio, obtained with permission).



Fig. 3. Child labourers in scrap areas are exposed to very high level of toxic substances from e-waste informal recycling (Photo source: Giovanni Porzio, obtained with permission).

ues from these informal e-waste recycling practices. Syed et al. (2013) reported that Lyari River is most frequently used as a trashing site if the waste is not dumped into some landfills. Iqbal et al. (2015) also highlighted this environmental issue in their study. The uncontrolled burning of electronic products in Lyari area is causing air, soil and water pollution, this local impact can turn into a regional issue as Lyari flow into Arabian sea and mangroves associated with Indus Delta are found to be heavily contaminated with metal content (Siddique et al. 2009). These toxic metal contents from EEEs burning and trashing can be certainly one of the prime reasons for this pollution. For 2016 Europe including Russia has the highest electronic waste regional collection rate of 35 % (Baldé et al. 2017) most of this collected back through proper take-back program

with minimum threat to environmental pollution. Pakistan still has a long way to go in terms of controlling environmental pollution from the electronic waste.

4. Social issues

People who are residing in nearby areas are even if not directly related to the e-waste informal recycling burning are exposed to high level of pollutants including Lead, Mercury, Hexavalent Chromium and other pollutants from plastic burning, etc., their wages are very low in comparison to the working hours they should deal with (Imran et al. 2017).

Recommendations

Government role

Pakistan government should adopt these EU legislations as China did for RoHS.

China has shown its intent and commitment towards tackling restricted substances issues in EEEs. Similar measures have shown by many other countries by introducing their own RoHS these countries include Japan, Republic of Korea, India, Vietnam, UAE and recently Bangladesh have joined the list. Now for developing countries these new legislations would make electronic companies think of establishing their production facilities in countries like Bangladesh and Vietnam as cost of manufacturing is very low, this would give people more jobs and a good social status, at the same time their products can compete in EU market by fully complying to EU-RoHS and REACH type of legislations. Pakistan should allocate more funds, as there are currently not enough available for implementation of requirements of international agreements like Basel Convention (Abbas 2010) and this is the reason e-waste intrude into Pakistan. There should be effective communication between various ministries as the issue with EEE's will further grow an estimate suggests that by 2030, the developing countries (Pakistan is one of them) would have to get rid of double the number of computers in comparison to developed countries (Sthiannopkao and Wong 2013). The government should encourage the electronic industry sector to keep themselves updated regarding EU RoHS, WEEE and ECHA development for REACH (SVHCS) future candidates.

Public awareness

People should be educated through various channels. Iqbal et al. (2015) suggested TV commercials and printed media articles could help in making the public aware of hazards of e-waste. Not many people in Pakistan are aware of green environment

and sustainability, making them aware to look for CE mark and China RoHS type logo while buying new products. This should encourage suppliers to provide more environmentally friendly electronic products.

Corporate and producer extended responsibility

Being a developing country that is prone to the toxic substances from EEE's, a fee of 2–5 % of the original cost of the product production should be charged from the country (Wang et al. 2016), which is making the EEE/e-waste available on the Pakistani market, this fee could be used to fund the development of a formal recycling facility in the country. All the manufacturing and supplier of electronic products should be obliged to put their sustainability and environmental regulatory information on WEEE, RoHS REACH and mineral sourcing and what are their plans for take back program. Pakistan should go one more step forward and be a leader in developing countries to encourage the suppliers to disclose their conflict minerals information for the EEE's placed on its market, this will help support conflict free sourcing of minerals.

Regional cooperation with better environmental legislations

Many countries in the region have planned or already adopted RoHS type legislations including China, India, Bangladesh, Vietnam and UAE. There is huge scope of these legislations to be enforced on government level as they have profound impacts on the betterment of environment in EU countries. The RoHS aspect of the managing EEEs related environmental issues is not the only legislation that need

to be enforced but nonetheless a positive sign that the country would be committed to addressing its growing e-waste problem both upstream and through end-of-life management. Time has come for Pakistan to catch up with global RoHS and other EU and global environmental legislations developments.

In the past due to political instability and lack of active legislative structure environmental legislations were not progressed coherently. Pakistan provincial legislative institutes missed an opportunity in 2010 when the environment came under the provincial jurisdiction and they instead of upgrading the laws simply scaled down PEPA 1997 to their respective provincial jurisdiction. Since the democratic governments have now being elected regularly and there is smooth continuation of democratic process the lawmakers should develop the rules and regulation to adopt to new challenges. It must be noted that PEPA 1997 was developed when the electronic mobile industry was not of the scale as it is now. Therefore, countries like Pakistan should upgrade their rules and regulation imminently.

Watch out for 2019 EEE's Tsunami

Four new phthalates that have approached their sunset date in July 2019 includes DBP, BBP, DEHP, DIBP as discussed earlier in RoHS introduction part of this paper are now regulated for their concentration in electronic products at value of 0.1 % by weight (1000 ppm) in homogenous material per Directive EU 2015/863 (2015). The electronic companies which are not able to come up with other suitable alternatives for these phthalates in their products will look for alternate market as EEE's with above threshold limits of these phthalates cannot be placed on EU market. The best

option for them would be to sell their products in developing countries with no strict regulations on these hazardous substances. Lack of EU RoHS type of legislation in many developing countries including Pakistan had to face 22 July 2019 triggered Tsunami of electronic products containing these hazardous substances. This shift of market preference and phthalates containing electronic products invasion would create more challenges in electronic industry and its subsequent waste management in developing countries.

Conclusions

With rapid increase in severe environmental risks originating from EEE's and other related products, Pakistan and other developing countries should recognize that RoHS, REACH, WEEE and RMI type of legislation are no longer an option but a necessity these days considering their lack/outdated legislative framework. However, their adaptation will face multiple challenges as discussed in this study for Pakistan case, but there is no escape from adopting these similar legislations as EU and many developed countries did. Developing countries like Pakistan should make sure that any EEE manufactured or arriving at the country's market should be required to pass the RoHS, REACH, WEEE and possibly RMI compliance requirements. Compliance with these regulations can help Pakistan to minimize the impacts of EEE's driven challenges to environment and human health at very root level especially after the 2019 EEE's Tsunami when additional regulated substances were added to EU RoHS. Pakistan could lead as an example by adopting RMI and request at least as a starting point suppliers and manufacturers like

Samsung, Nokia, LG Electronics to provide details of their mineral sourcing areas this will help reduce the environmental and social abuses in other areas such as Congo and other African countries. It is recommended that policy makers in developing countries like Pakistan come up with extended producer responsibility requirements, companies should contribute financially to ensure end of life electronic products proper take-back and safe disposal like in European Union.

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