



HANDBOOK

Waste management in Developing Countries

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Handbook on “Waste Management in Developing Countries”

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CODWAP- Collaborative curriculum Development on Waste management in Africa and the Pacific region

In African and Pacific countries, one to two thirds of solid waste generated is not collected, and collected waste is mainly disposed in uncontrolled dumpsites and/or openly burnt, polluting water resources, soil and air.

Five universities in Mauritius, Papua New Guinea, Sierra Leone, Greece and Germany have pooled their knowledge to improve solid waste management (SWM) education and on-the-job vocational training. The project partners have developed educational tools that are customised, practical and suitable to the needs and priorities of African and Pacific countries. The goal was to improve capacities and awareness and behaviour on SWM issues from a lifecycle perspective among students, teachers, civilians, NGOs and other local stakeholders.

The project partners have designed and implemented a post-graduate programme in SWM and environmental protection in developing countries. Other key activities include training missions, workshops and interactive seminars for civil servants, NGO representatives and public awareness campaigns for the wider public.

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PREFACE

This **Handbook** provides a set of strategies for citizens' motivation by responsible personnel of Non Governmental Organisations, local and governmental authorities involved in waste management field. We describe approaches we have found effective based on the local community construction in Developing Countries.

The **Handbook** is divided into three sections; the second section addresses activate authorities (local or governmental) responsible personnel who may be looking for ways to improve their practice in Waste management field. Also it aims to activate citizens and representatives of citizens groups describing how individuals may be activated into waste management field activities gaining both an income and escaping marginalisation and poverty. The second section addresses governmental and local authorities who wish to be more motivated on Waste Management field. Third section presents case studies from around the world and achieved targets. Through the sections of the **Handbook**, we aimed to reply the need for assessment approaches that both "prove" and "improve" current practices.

While specific strategies and approaches are described, this work goes far beyond a tool bag of techniques. Collaborative learning, learning communities and assessment reflect a potential shift of perspective for these countries. Good assessment invites citizens to engage with their learning and with each other, and provides opportunities for both citizens and local society. Updating the educational experiences and presenting opportunities -rather than isolating individuals the results may prove amazing and totally transformative.

We're pleased to offer the product of our joint efforts. The ideas and different approaches presented in this handbook are the product of what the consortium have learned from their experiences in Developing Countries in the frame of the CODWAP project which

included both investigation and teaching activities; the current trends, the challenges which are faced by those countries and their actual needs which are reflected to the citizens. We hope you will adapt these ideas to your own settings and prove useful! Assessment, teaching, and learning are continuously evolving; this work should evolve, too. Here it should be mentioned that the images of the front page of the Handbook were taken by CODWAP partners during the training missions of the project in Sierra Leone, Papua New Guinea and Mauritius.

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PART I- Simple WM rules and best practices addressing to citizens and special social groups

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1. HUMAN RESOURCES IMPORTANCE

Urban Solid Waste Management (USWM) in developing countries comprises both formal and informal systems. The formal system consists of two actors: (i) the municipal body that is responsible for waste collection, transport and disposal; and (ii) private organizations interested in converting waste to marketable products such as compost or Refuse-Derived-Fuel (RDF) pellets. The informal system consists of many actors such as waste-pickers (rag-pickers), itinerant buyers, small scrap dealers, and wholesalers, who, together, recycle about 20% of the waste. Householders also contribute to informal recycling by indulging in source separation, albeit, in a limited way. Planning for USWM within the framework of sustainable development raises several intra- and inter-generational issues such as public health; livelihood of actors in the informal recycling sector; present and future costs to society; conservation of resources both renewable and non-renewable; and environmental impacts of waste disposal. The challenge, therefore, for urban planners is to identify approaches that are viable and sustainable, i.e. satisfy short-term objectives without compromising long-term objectives [1].

Local and state governments, pioneering businesses, religious communities, students on dozens of campuses across the country, traditional environmental and social advocacy groups, and a range of newly created groups have emerged as key factors to be implicated into SWM organised by urban planners. Civil society (including parents, religious leaders, and educators) plays a critical role in fostering the deeper social changes (e.g., in values, social norms, and practices) that will support the implementation of bigger structural changes required.

1.1. Economic and socio-economic aspects of waste management

Focus is on the application of decision-making techniques to analyze problems involving technology, particularly its social impacts. Areas of study include decision making under uncertainty, decision making in a passive vs. active environment, sequential decisions, estimating payoffs, forecasting, and technology assessment. These systems-analysis

techniques are used to formulate and solve a variety of socio-technological problems, especially those that arise in educational, industrial, and environmental professions

- Factors to be considered in waste management systems
- Environmental economics
- socio-cultural aspects of waste management
- waste management in Developing countries (Demand and Potentials)

In many low and middle-income countries, collecting, sorting, trading and recycling of disposed materials provides income to hundreds of thousands of people worldwide. Many of these people are working parallel to the formal solid waste system – only in an informal manner. This means that these people are not contracted by municipal governments or other entities that are responsible for providing waste related services. Although this informal waste sector has been given credit for its services by various NGOs and academics, few attempts have been made to value the costs and benefits the activities of this sector for local and global societies [2].

Day to day management of solid waste produced by the community is one of the fast growing problems in developing countries. Prevailing management strategies are inefficient, because of their complexity, cost and lack of technology. These ignore solid waste management's socio-economic and ecological characteristics. Improper management of these wastes led to public health hazards, unaesthetic appearance, pollution of water bodies such as lakes, groundwater sources, etc. Most parts of India are not efficient in handling wastes when compared to developed countries. In order to improve the present practice and to avoid environmental degradation, an effort is made to arrive at optimal solid waste management strategy by incorporating spatial analysis tool (Geographic Information System- GIS) [3].

The use of GIS or economic instruments by local authorities raises many questions [4]:

- What are the benefits and the drawbacks of each system?
- What are the most appropriate instruments to achieve their objectives?
- What are the pernicious effects and how to avoid them?
- What are the consequences of “Green Dot” systems for local and regional authorities?

- Which accompanying measures are necessary to ensure effective functioning of the chosen system?
- What are the consequences on collection and treatment costs?

1.2. The importance of interpersonal skills in project management

The skills of managing the project budget, schedule, and resources have been viewed as the key to delivering successful projects. These three skills are often pictured as a triangle with one skill assigned to each side, or as a three legged stool. Take one skill away and the stool collapses. There is no denying the importance of any of these skills; they are tangible, measurable, and learnable.

Over the years, we have taught and mentored project managers and then monitored their projects. They could develop a work breakdown structure (WBS) expertly, estimate hours, and assign resources with ease; they managed scope and solicited requirements from users with precision and confidence. They would even measure the work - executing the technical skills of the 1st triangle (figure 1.1) [5].

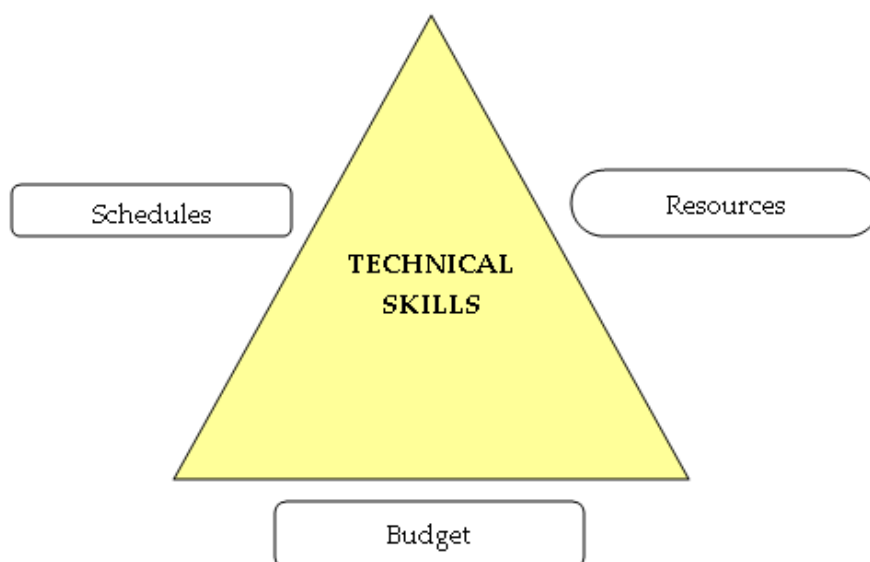


Figure 1.1. Technical skill Triad [5].

- Managing the project budget means we have the right amount of money at the right time to pay for the right things. It is critical to the success of the project.
- Managing the schedule is controlling the duration of the project.

- Managing resources is having the required knowledge, competencies and tools available at the right time.

The interaction between the constraints in the Technical Skills triad is widely understood. Changes to one area in the triad impact one or both of the other two areas. For example, if something changes the project resources (adding enhanced skills or losing skilled staff), the schedule could be changed (lengthened without the right resources or shortened if resources are more efficient) and the budget impacted (fewer resources may cost less but have to work longer; more efficient resources may cost more).

- Communication is a vital human activity. It is not a one-sided activity. Just because we provide information, it doesn't guarantee communication has occurred.
- Expectations are set when we mentally process information, actions and emotions. The same information, actions and emotions can result in differing expectations when processed by different people.
- Relationships take care and feeding - they don't thrive when ignored. A well tended relationship can withstand occasions of poor communication and disappointment.

As with the interactions among the technical skills, there are interactions within the soft skills (figure 1.2). Poor communication can severely affect our ability to manage expectations and can permanently damage relationships. Improving these soft skills makes it easier to manage the project.

- Managing (our) attitude can be very challenging when things get hectic or frustrating, as things do in a project.
- Alignment is the guiding light for personal thinking. How we align with the organization's strategy, customer's vision, and project's purpose is critical so that we know where we are going and why.
- Accountability is two-fold: doing what we promised and accepting responsibility for what we do. It is action and reaction. That was enough for people to trust that the promised actions would take place.

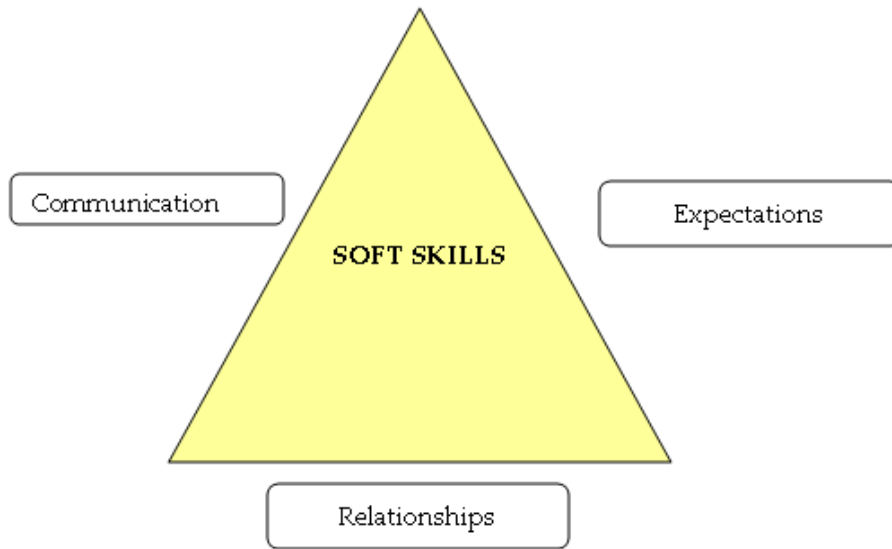


Figure 1.2. Soft skill Triad [5].

The same type of interaction occurs within this triad as with the other triads and can have severe consequences (figure 1.3). Conversely, if our thinking is kept in alignment with where the project and stakeholders want to go, it is easier to be accountable for what occurs in the project and control our attitude.

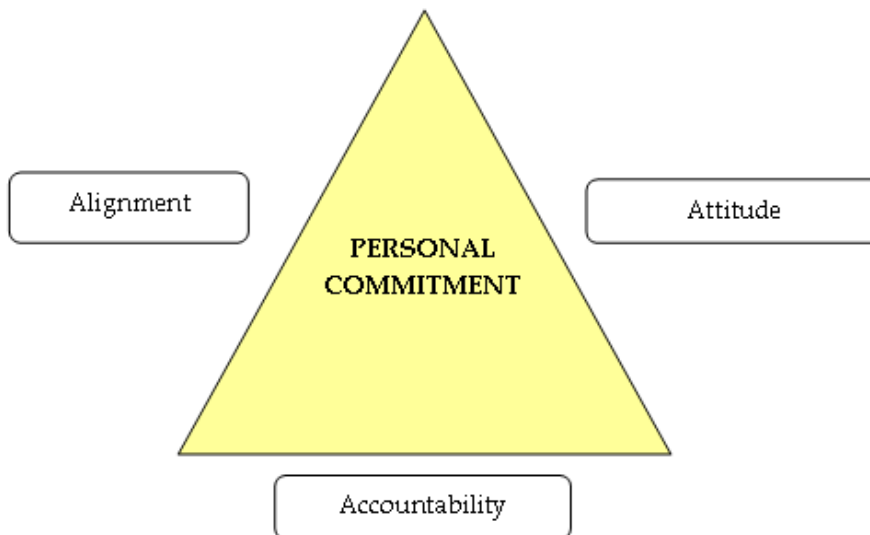


Figure 1.3. Personal commitment Triad [5].

The fourth triad (figure 1.4) in the pyramid involves a deeper level of the internal human. The current environment demands that these values be incorporated in all project actions.

And it's no wonder - redoing work that doesn't meet the needs is a luxury most organizations cannot afford.

Just like the other triads, impact in one area affects the others. For example, if our actions cause our integrity to come into question, the quality of the project results will also be put in doubt. This will create the perception of a lack of interest in serving the audience.

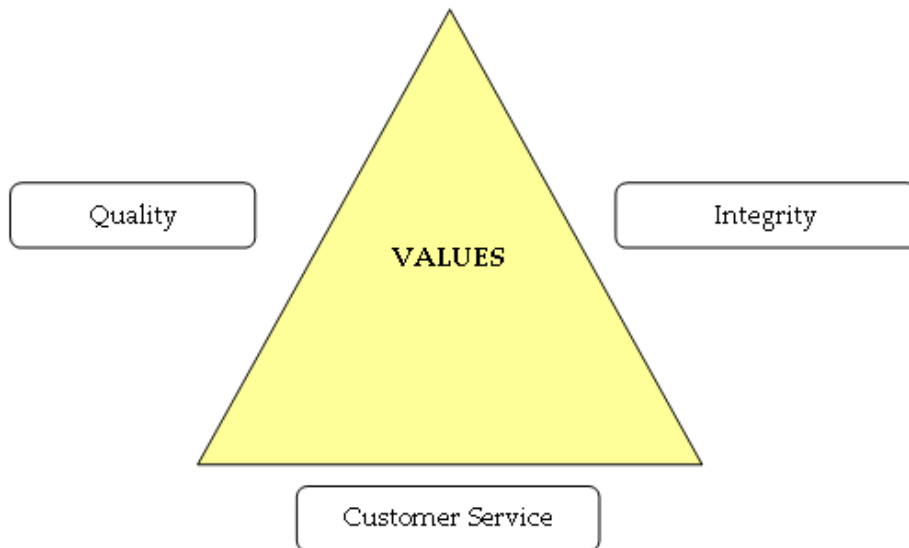


Figure 1.4. Values Triad [5].

Balancing the four triads requires applying the appropriate amount of attention and effort on the right triad for the situation at hand. Without balance, any one side of the pyramid is just a triangle. Thus, each triad does not receive equal attention all the time. To effectively balance the triads we must understand what the current conditions require, assess what the results of our actions will be, and take the best actions to achieve a strategic project goal. In the end we must achieve successful project completion and have a positive influence on the corporate project management maturity.

The Pyramid Model covers the four areas of discipline that we find essential to project management:

- Technical skills: our ability to manage schedule, budget, and resources
- Soft skills: our ability to manage relationships, expectations, and communication
- Personal commitment: how we apply ourselves to attitude, accountability, and alignment
- Values: how we apply ourselves to quality, integrity, and customer service

The focus on these four triads lets us help our organization's project managers assess their skills - helping them identify their strengths and areas for improvement. Project teams are developed based on an understanding of each team member's abilities in the triads, helping us build better balanced teams.

The Pyramid Model is a strategic essential tool for building better project managers, more cohesive project teams, and a more mature project culture in your organization [5].

1.3. CHANGE MANAGEMENT

The process of managing change is concerned with how people can be encouraged and empowered to work with the new resources; what support strategies are needed to help overcome resistance to change; methods of consultation; the roles of managers at different points in the change process; and the influence of organisational climate, structures, and ways of working on how well change is managed.

The structure of a 'change management' (CM) based approach aims to reflect the most productive way to think about managing change. There are five key sections in the toolkit. Each one contains tools and insights from the literature to help you come to grips with the issues outlined below:

The nature and the scope of the change. This is the first thing to think about because it influences all your subsequent actions. How big an initiative is the implementation of the *People's Network*? We have already said that getting the hardware and software in place and doing the training is by no means the whole story. What else is involved to ensure that the vision of improved library services becomes a reality?

Choosing priorities for action in your own environment. Managing change involves a lot of different activities: once the options have been considered some difficult choices need to be made about what to focus on in your organisation. What needs to be worked on first? What must be put in place as soon as possible?

The nature of your organisation. Whether you work at strategic level in a local authority or in a small branch library it is important to understand how your organisation works and how ready it is to engage with change. This will help to ensure that the processes you

use fit comfortably with your organisation. If you manage change in a way that is not congruent with your environment it will at best produce more conflict than necessary and at worse not produce the results that you want.

Key factors. It is important to do a systematic analysis of the factors in your organisation that will support progress and those that might hinder it. This enables you to draw up a sensible action plan based on the real environment in which you work.

Working with people. This is probably the most challenging part of managing change. You need to consider how to support people through the changes they are facing, how to empower them, when to apply pressure and when not to. Individuals also need to think through the implications of e-Government and 'joined up thinking' for themselves; to identify clearly the effect it will have on their roles and activities; to sort out the support they think they will need; and to develop their own vision of the future.

Action points for local authority followed in a training day [6]

- Revisit the introductory document already produced (for service users) to describe the changes that ICT would bring to that particular service. The new introductory document should be aim at staff and convey the service values reflected in the proposed changes.
- Consider the most appropriate focus for real collaborative planning (link this into individual library plans).
- Concentrate on generating images of early concrete practice (i.e. tangible exemplars of the new way of working in action).
- Develop criteria to show the impact of change. Convince others that better evidence of impact is needed for ICT-based changes (because of their cost and scale).
- Use staff meeting to support management of change – employing some of the

toolkit.

- Institute a dialogue about the role of managers in supporting staff through change, with the people being managed.
- Match management responses to the phases in the individual change process identified in the toolkit.

The main issues or reasons of failure in the organisation and implementation of projects when it comes to local authorities are listed below [7]:

- lack of clear Chief Officer and/or members ownership and commitment at appropriate levels in the organisation;
- lack of a clear and powerful vision for what the deliverable or outcome would be, or where it does exist, failure to communicate that vision and lack of clarity about what is required in terms of “new” behaviours and approaches that is consistent with the new vision;
- no link to the core objectives of the business, i.e. a lack of clear link between the programme / project and the organisation’s key strategic priorities, including agreed measures of success. This is often expressed as: “the reasons for change were never clear to us”, or “there appeared to be no clear benefit or sound business case for doing it in the first place”;
- no sense of urgency (no burning platform for change), or the initiative was not given any serious priority so was under-resourced and everyone had their day jobs to do at the same time;
- not removing the obstacles to change (which signals that you are not really that committed to the change);
- failure to create short term wins and no follow through, e.g. neglecting to anchor the change securely in the corporate culture as the way we do things;
- lack of effective engagement with stakeholders, e.g. no consultation or communications with staff or customers failing to create a sufficiently powerful coalition to guide change;

- o lack of skills and proven approach to programme (or project) management and risk management, such as no single point of responsibility, and too little attention to breaking the initiative into manageable steps;
- o procurement and Commercial issues such as: evaluation of proposals driven by initial price rather than long term value for money (benefits realisation); lack of understanding of and contact with the supply industry at senior levels in the organisation and lack of effective programme (or project) team integration between clients, the supplier team and the supply chain; and
- o follow through benefits realisation issues such as: not finished, overtaken by the next initiative, so we got no benefit from it; lack of budget or the budget was withdrawn before we got the benefits; “They did it to us, then walked away, so we went back to doing what we always did”; stopping the change project before the benefits have been realised.

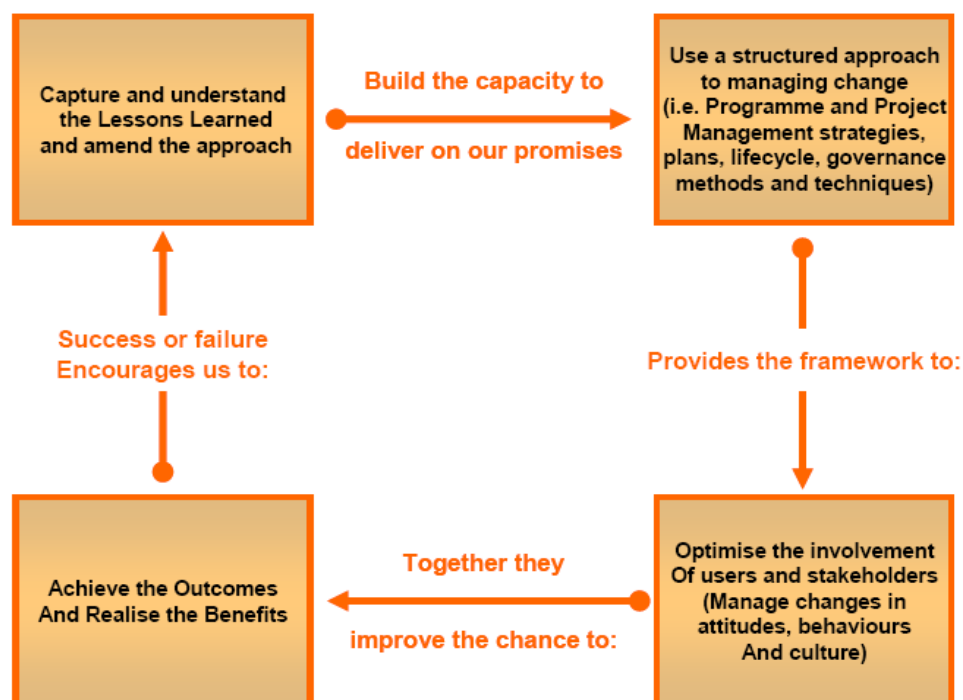


Figure 1.5. Appropriate steps for the achievement of change management targets [7].

Following the steps described in the figure 1.5, one can achieve the target of CM is to:

- Assess the overall organization and the organizational units affected by the change;
- Define the change management strategy;
- Identify the impact of the change on the organization;
- Develop and implement a communication and publicity program;
- Design and describe the target jobs and organizational structure;
- Design, develop, and implement the training and education programs;
- Plan the change management implementation and implement the change; and
- Monitor and evaluate the organization's performance once the change has been implemented.

However, only if the human dimension is taken into account through Change Management (CM) approaches, can a more satisfactory outcome be assured. Standard approaches to governance provide:

- common processes and requirements which are designed to provide levels of rigour and scrutiny appropriate to the size, value, risk, complexity and strategic significance of each initiative;
- a common set of definitions, processes, sequences and procedures that both ensure the same meaning from initiative to initiative, and demonstrate a more rigorous and structured approach; and
- an approach that recognises that most of the issues, risks and problems encountered by change initiatives are people based, and therefore integrates the people aspects of change within an overall approach that is based upon programme and project management.

Change management is a highly complex issue for public sector bodies, where continuous rounds of legislative change bring new requirements almost every day. The critical issue is that change deals with people. Real people, who have hopes and fears, needs, wants and aspirations and often unconsciously, will interpret and report situations and opportunities through the filter of their own experiences or aspirations, and that's what needs to be taken into account.

Local Authorities need to develop skills and competencies to address the management

fundamentals of ownership and accountability and enshrine this in a new integrated corporate culture. Living in a marketplace where continuous change is the norm, whether it is economic, political or commercial change, Local Authorities need to develop management approaches that recognise this and work towards change becoming an integral part of the culture.

Change requires managers and leaders to make strategic choices and tactical trade-offs to make progress and achieve change. They know the consequences of their actions but have to make the choice anyway. That's why it's important to get the strategy right, and to understand the implications and consequences of that strategy up front [7].

Success requires the ability to predict which issues should be tackled early and which later. Make the wrong choice or go into a change programme without having done some homework and it could cost time, money and credibility with the key stakeholders involved.

Consider adopting a standards-based approach based upon best practice principles that will help sponsors make the most appropriate decisions. Working within a common framework of programme project and change management also helps manage the consequences, tradeoffs and their impact on key stakeholders.

1.4. Public involvement training method

Nearly twenty years ago, when climate change had just begun emerging on the public and policy agendas the need for governments to help lead in the transition to a more sustainable interaction of humans with their environment was rather important to be achieved. While governments are critical in setting priorities and policies, and in modelling the new behavior, civil society is absolutely indispensable in bringing about this profound change. The challenge of communicating with citizens and engaging them in this task was beginning to seem the key for change.

Two decades later, social movement for climate protection is slowly emerging worldwide. But social movements begin small and society is not yet fully on board regarding the need for comprehensive action. Clearly, civil society alone will not be able to address the

challenges posed by climate change. But civil society has two critical roles to play in climate policy and action: it can (1) mobilize for policy changes at higher levels of government, and (2) enact behavioural changes consistent with needed mitigation (and adaptation). Here it must be noted that those who could encourage such engagement have not communicated climate change effectively enough to generate widespread mobilization [8].

1.4.1. Audience Choice

Best practice in communication begins with consciously and strategically selecting an audience and understanding that audience's mental models and level of understanding of climate change, its interests, values, and concerns. This deeper understanding helps communicators make connections to issues already of concern to a given audience and frame climate change in a language that resonates. However subtle, different audiences need to be addressed in audience-specific ways that match frame, message content, and language with their specific information needs, pre-existing knowledge, and concerns.

1.4.2. Messenger Choice

To reach audiences heretofore unengaged, it is also important to carefully select the messenger. Scientists, environmental non-governmental organizations (NGOs), contrarians, and the media have dominated climate change communication in the past, resulting in a perception of global warming as a scientific, (still) highly uncertain, and controversial environmental issue. To alter that perception, change the groups of people involved, reach into sections of civic society yet-to-be engaged, and to cross social divides, the choice of messenger is a critical strategic decision. Effective communication matches the messenger both with the message and with the audience. "People like us" (or PLUs) are important for an audience's personal comfort, identity, and group-internal norms and cohesion. Often, PLUs (especially if we know and trust them personally) have greater credibility and legitimacy than someone who does not know an audience's circumstances as well [8].

1.4.3. Framing the 'Climate Change' problem

Naming and framing an issue is one of the most fundamental challenges for communicators, especially for an “invisible” global problem such as climate change. The task of framing—and re-framing as an issue evolves in public consciousness and political process—then is to identify those frame(s) that promise to be most powerful to a particular group of social actors. Frames are strategic tools of social movements and their counter-movements.

Leaders in the environmental justice community who have taken up the climate issue tend to focus on fairness, health, safety, and well-being. Such alternative frames help individuals, organizations, and communities already active on other issues see how their work might be impacted by climate change. It also helps people not yet concerned with global warming find common cause and ground. In short, not every conversation must begin or end with climate. Instead, we can open the door to climate change from a different side of the common house.

1.4.4. Communication

Communication can play an essential role in mobilizing and sustaining civic action. As such, communication expresses and supports the fundamental work of civic engagement. A first approach to this deep linkage is through language: communication and community share the same linguistic root. Practically, communication and community can also mutually foster each other, whereas unsuccessful communication can alienate individuals from acting in the public sphere and hence completely fail to be an instrument of citizenship. Thus, communication needs to be designed and executed effectively, if it is to be a useful tool in building and sustaining the community that acts on a *res publica* (a matter of public interest) such as climate change, and in helping individuals create, and feel part of, a civic community.

The role of communication would be to foster individual behaviour change. Someone engaging in civic action, by contrast, is an individual whose actions are committed to, done with awareness of, and in support of, a larger social, common, public goal.

Differently put, civic action is public action by members of a community in response to a public matter of great concern. “‘Public work’ is work by ordinary people that builds and sustains our basic public goods and resources—what used to be called ‘our commonwealth’”.

Communication plays a critical role in such “public work.” How we speak about the issue that concerns us, how we talk with one another, and how we articulate the solutions to the problem make all the difference. Communication is the most basic means by which we express the focus of civic action. It helps create a lens through which we view the matter of concern as well as understand its deeper causes, implications, and solutions. It develops and feeds on social capital. As a means to create common cause and understanding, it makes connections across issues and thus helps build a public that is engaged on climate change.

For individuals to become civically engaged political actors adds the challenge of overcoming widespread disenfranchisement from the political process. In short, there are internal (psychological and cognitive) processes that may prevent an individual from engaging on this issue, as well as social, political, and external structural barriers to such engagement (see Table 1.1 for a brief discussion of common barriers to civic engagement on climate change).

Table 1.1. Common Barriers to Civic Engagement on Climate Change [8].

Psychological cognitive barriers	Internal processing of climate change information may undermine motivation to engage on the issue. De-motivating emotional responses to climate change information commonly include: a sense of being powerless and overwhelmed, denial, numbing, a belief of being exempt from the threat, blaming others, wishful thinking or rationalization that the problem will resolve on its own through the help of experts, displacement of attention on other problems, apathy, fatalism, and other forms of “capitulatory imagination”. These types of cognitive and emotional responses are particularly common in response to issues which are scary, ill-understood, difficult to control, overwhelming, and in which people are complicit, such as global climate change. Common cognitive barriers include not understanding the issue (causes) or not seeing the relevance of climate change impacts or solutions to one’s daily life; misunderstanding, confusion, or disagreement with the actions, policies, or strategies proposed to address climate change; an unattractive future vision painted in people’s imagination (often one of doom); and lack of resonance with the framing and language in which climate change is being discussed.
Social barriers	Individuals are embedded in social networks, form social identities, engage in social interactions, and adhere to varying degrees to social norms that suggest what counts as appropriate or inappropriate behaviour. If engaging in civic action on climate change portrays a particular social identity, produces a social stigma, or reflects social norms in conflict with people’s desired identity and accepted norms, they are unlikely to engage in this particular type of civic action. If civic engagement takes “too much” time or resources, and is inconvenient or too demanding given other daily concerns and competing obligations, even people sympathetic to the cause may not get involved. Finally, individuals—deeply embedded in society through socialization, institutions, and modern-day habitual activities—may not question or see alternatives to common emission-generating behaviours, and resist calls for alternative behaviours. As long as everyone else still drives their cars, why should they get out of theirs?

Table 1.1.Continues.

<p>Political barriers</p>	<p>Individuals may be generally disinterested in political matters, prefer to leave political activism to others, and/or may feel deeply disenfranchised from the political process, and instead focus on matters of personal concern, impact, and influence. Some may hold a belief that government or industry or some other “other” will rise to the occasion and take care of the problem (a form of political transference). Others may not believe that existing institutions are failing in their responsibilities, thus why should they do anything that may be inconvenient? A related response is blaming others for the problem and/or projecting responsibility for remedial action onto those who will develop the necessary technological fix. Yet others, wedded to tradition and habit, may simply refuse to do anything different or new. Scientific uncertainty about the causes, urgency, or solutions of a problem can serve as a convenient rationale to hold on to the status quo.</p>
<p>Other structural, economic, institutional, and technological barriers</p>	<p>Even if the internal psycho-cognitive and external social and political barriers could be overcome, a person may still face structural barriers, such as lack of a convenient or economically-feasible alternative technology, existing laws and regulations, lack of public infrastructure, political institutions and electoral processes heavily controlled by vested interests, and so on. Information channels and communication infrastructure may also hinder engagement, even in this modern “information age.” Generally heavy filters against the overabundance of information, declining newspaper readership, continued reliance on television as the main news source for most people, and increased reliance on, and high selectivity among, internet news sources together limit depth of coverage and understanding of any issue. Moreover, the political economy of the media industry, with its ever-growing concentration of media ownership, and—arguably—consequent narrowing of the range of news and diversity of voices heard in mass communication channels does not offer individuals the breadth of views that may allow them to form a well informed opinion. More typically, people exist in rather homophilous socioeconomic-political-informational environments that are rather isolated from other, yet similarly homophilous, sections of society.</p>

This list of barriers to civic engagement discussed in Table 1.1 is certainly not complete, but highlights some that are critical to consider when designing communication campaigns that aim at mobilizing individuals to participate in civic action. Understanding these barriers more fully can give communication efforts a clearer focus and infuse them with a longer “shelf life” than the average 10-second sound bite or 10-month outreach campaign. The role communication can play and the strategies one may employ build on the recognition of these reasons for inaction.

1.4.5. *Mobilization*

Civic engagement depends critically on effective communication. Communicators frame the issue of concern; mobilize social or political actors and their opposition; and promote the solutions. They can sustain civic engagement through challenging times, help cross social divides, and assist in the deeper societal transformation ultimately needed to address this immense challenge.

For communication to play these roles effectively, i.e., to contribute to a desired social change such as engaging people in sustained civic action on climate change, communicators have to meet two interrelated challenges: (1) elevate the motivation to get involved, and (2) lower the barriers/resistance to that engagement or that change in behaviour. Mainstream communication efforts in the past, dominated as they were by physical scientists, environmental advocates, educators, and the media, typically emphasized the motivational side of this equation by giving people more information, scaring them, or appealing to their economic self-interest or moral self. Social scientists studying the impacts of these communication efforts, in turn, have focused on people’s attitudes, understanding, level of concern, and (abstract) support for government policy. Scientific insights on what people actually do, how their action or inaction relates to their sense of civic responsibility, or how people overcome the barriers they face, is still rather scant to date.

1.4.6. *Maintain training effects*

Looking over the past 20 years of research, what is remarkable is not how much remains uncertain, but how strong the scientific consensus on climate change has grown. At the same time, there remains a public impression—fed by climate contrarians and common media practices—that there still is scientific controversy over the basic notion of human-caused climate change. Scientists themselves share in the responsibility for this situation, partly because they frequently emphasize the unknown more than the known, and partly because they have taken pains to respond to every misinformation and misleading statement by climate contrarians. There is good reason to do so—misinformation should not be left standing unchallenged and opportunities to educate the public should not be missed. But this pattern has left the pro-environmental and scientific side on the defensive. It is always more powerful to define the frame than respond to someone else's.

What is needed now from scientists and other communicators to strengthen public resolve is at least threefold. First, they must continue to convey the state of the science and how the confidence in scientific understanding has grown over time. Second, they must never overstate the scientific confidence with which aspects of climate change are known. But to retain credibility while conveying confidence, communicators should lead with what is most certain, and discuss remaining uncertainties in light of what is well understood. Typically, people respond constructively to uncertainty when they have some bearings that help them navigate unknown territory. In fact, it is an unsubstantiated claim that we need to know everything for sure before we can act (decisions to go to war, to invest in the stock market or to act on medical diagnoses come to mind). Finally, communicators should provide context for the evolving scientific understanding of climate change, i.e., that it is the nature of science to always push back the frontiers of the unknown, and in the process, stumble upon findings that require revisions of what was previously thought to be known.

Perhaps more important than continuing to defend the science of climate change is moving toward communicating solutions. Once people are engaged and realize the challenge that climate change presents, they instinctively want practical solutions. Those

inclined to engage in civic action may be particularly predisposed to wanting to take or support actions. Citizens often do not know what solutions are feasible, important, or available, and that they cannot see their own role in tackling the problem. Thus, what is needed more now is information about practical solutions, help, support from others, encouragement, and empowerment. What is needed now is a sense of hope. Tapping into people's desires for a better future, their social identities and aspirations, and cultural values that promote individual and collective action and engagement for the greater good (e.g., ingenuity, responsibility, stewardship, being a good team player, and leadership) can all increase people's motivation besides the more instrumental reasons (such as personal economic gain, competitiveness, legal compliance, and so on).

To help individuals stay engaged on an easily overwhelming issue, sort through complex issues, understand difficult trade-offs, and change habitual thoughts and behaviours, communicators must identify and engage sources of social support. Typically, interpersonal and small-group dialogue can address these needs much better than mass communication received in the privacy of one's living room. Neighbourhood-based eco-teams, green-living projects on campuses, science cafés, church-based discussion groups and many other examples exist already in the United States and Canada that illustrate these insights. In such small settings, the power of social norms, accountability, identity, and personal ties is brought to bear on the barriers and resistance to change. They also allow individuals to be acknowledged and appreciated for their efforts, to serve as role models, and to provide very immediate positive feedback on one's actions.

2. NGO DRASTIC ROLE IN DEVELOPING COUNTRIES

2.1. The general role of NGOs

Non-governmental organisations (NGOs) have become very important in the field of international development through the last two decades. But the term NGO stands for a huge amount of different groups and organizations.

The World Bank for example defines an NGO as a „private organisation that pursue activities to relieve suffering, promote the interests of the poor, protect the environment, provide basic social services, or undertake community development“. In the document “Working with NGOs” the World Bank adds: “In wider usage, the term NGO can be applied to any non-profit organization which is independent from government. NGOs are typically value-based organizations which depend, in whole or in part, on charitable donations and voluntary service. Although the NGO sector has become increasingly professionalized over the last two decades, principles of altruism and voluntarism remain key defining characteristics.” [9]

World Bank distinguishes between two different categories of NGOs. First there are the operational NGOs that main work is to develop and implement new projects and ideas to force the development of countries in a broad range of field.

Secondly there are advocacy NGOs, which have the main work focus in defending or promoting specific causes, and try to influence the policies and practices of large organisations like the World Bank [9].

The operational NGOs are then again classified into three groups. The World Bank classifies operational NGOs into community-based organisations, national organisations and international organisations. The first group, the community-based organisations (CBOs), have their focus on a special population in a specific small area. The second group are the national organisation, which works in individual developing countries, and third, there are the international organisations, that mostly have their headquarters in a developed country, and work in different developing countries.

The reasons that organisations like the World Bank working with NGOs are manifold. The

World Bank named some reasons for working with NGOs which will be shown in the following paragraphs.

First reason is the high potential for implementing and testing new innovative. Through the often small size of the NGOs, there are much more flexible, what makes implementing and testing of new developing methods much easier. By this, new ways of development can first be tested and improved, before they will be used in a large scale [9].

Increasing the participation on the local level is another reason to get especially local NGOs on board for a project. The connection to the local people, that are most of the time given through the daily work of the NGOs with the local people, helps to create an ownership for the project, what can increase the chance for a successful project. Through the good networks and the knowledge of local circumstances and the attitude of the local population, it is easier to implement new things, and get a bigger acceptance of the new things from the people, what leads to a more successful outcome of the project [9].

The good contact to the local people and the local authorities is also the reason why a project participation of NGOs increases the project uptake and the project reach. For reaching as many beneficiaries as possible, the good local connections of NGOs are highly important. The same can be applied for the reach of a project. Reaching the poor of the poorest can not be done by the big developing companies, because they don't have the resources and the local net to these people. Hence the local networks of the local working NGOs are quit important to reach as many different target groups as possible [9].

Involving local NGOs and CBOs in development projects often increases the sustainability of the project. This is caused by the long time presence of a project partner even after the normal project time is over. Through this and the fact that involving local authorities builds a kind of ownership to the locals, the outcomes of the projects are mostly much more sustainable.

During projects the leading organisation, often have to make decisions on the overall direction of a project, aiming to the "overall optimal good" [9]. Giving the decision maker another perspective on the situation, different from the view of the government and private companies, helps the decision maker to get a more complete picture of the

situation [9]. The NGOs could play a major role in a project cycle are shown in Table 2.1. This provides an entire summary of the points mentioned before.

Table 2.1. NGO Roles in the project Cycle [9].

Stage in Project Cycle	Potential NGO Involvement
Project Identification	<ul style="list-style-type: none"> ○ provide advice/information on local conditions ○ participate in environmental and social assessments ○ organize consultations with beneficiaries/affected parties ○ transmit expressed needs/priorities of local communities to project staff ○ implement pilot projects
Project Design	<ul style="list-style-type: none"> ○ consultant to government, to local communities or to the project leader ○ assist in promoting a participatory approach to project design ○ channel information to local populations
Financing	<ul style="list-style-type: none"> ○ co-financing (in money or in kind) of a project component ○ source of funds for activities complementary to the proposed financed project
Implementation	<ul style="list-style-type: none"> ○ project contractor or manager (for delivery of services, training, construction, etc.) ○ promote community participation in project activities ○ financial intermediary role ○ supplier of technical knowledge to local beneficiaries ○ advisor to local communities on how to take advantage of project-financed goods or services ○ implementer of complementary activities ○ beneficiary of an NGO funding mechanism established by the project
Monitoring and Evaluation	<ul style="list-style-type: none"> ○ NGO contracted to monitor project progress or evaluate project results ○ facilitate participatory monitoring and evaluation ○ independent/unsolicited monitoring and evaluation

2.2. Case studies for the successful work of NGOs in developing of solid waste management

Case Study 1: Implementing the Urban Waste Expertise Program (UWEP) in Bamako, Mali

The UWEP was funded by the Dutch Ministry of External Affairs, and implemented by WASTE, a Dutch NGO with great knowledge in waste management in developing countries. The project was divided into three phases. First phase was all about collecting information about the local conditions and the local waste management processes (UWEP 1). Therefore four specific cities were picked as pilot areas. In the second phase, called UWEP-Plus, was focused on developing an approach out of the lessons learned from the first phase of the project. The result was an approach called Integrated Sustainable Waste Management (ISWM). This approach was then applied and validated in five additional cities, which gives a total amount of nine case study areas distributed all over the world.



Figure 2.1: The ISWM model, with the three dimensions: Stakeholders, technical elements of the waste management system, and the sustainability aspects.

During the first phase of the project, several actions were implemented. In the first step, a

mobilisation of stakeholders was carried out, to get all parties involved in waste management into the project team.

Afterwards an inventory of the local situation and a problem identification as carried out, with a following formulation of pilot project proposals. Five Pilot Projects (PP) were carried out:

- Developing of alternative technology for household waste collection
- Construction of an experimental station for solid waste treatment
- Construction of a treatment station for wastewater and latrine sludge
- Conduction of an intensive community mobilisation
- The use of organic waste in urban and peri-urban agriculture (A separate founded project but sometimes stated as five pilot project)

PP #1 was established through the first phase of UWEP; in the frame of it a motorised collection vehicle was developed which passed all the planned tests.

PP #2 and #3 began during first project phase, but can not be completed, caused by insufficient funds. But both were continued and nearly completed in UWEP-Plus.

The status of the first four pilot projects at the end of UWEP 1 was (for each one of them):

PP1 state at the close of UWEP I: Tests had taken place in Commune IV. SNV agreed to take over technology development work in Commune I.

PP2 state at the close of UWEP I: No movement, due to problems with finding a site that was approved and allocated by the municipality.

PP3 state at the close of UWEP I: No movement, due to problems with finding a site that was approved and allocated by the municipality.

PP4 state at the close of UWEP I: Completed, disseminated at various occasions, summarised in Working Document 13, served as example for other donors.

The results of PP #4, a study about community participation in waste management, were collected and summarised in a working document: "Implication des populations défavorisées dans les actions d'assainissement dans le district de Bamako, Capitalisation d'une expérience de recherche-action en Commune IV", D. Traoré, M. Keita, B. Sacko, 2001, Maria S. Muller.

After the UWEP 1 comes near to the end, the parties involved in the project planned to prepare a proposal for a project named UWEP II. Through some changes in the structure and the focus of the donating organisations, this proposal could not be finished successfully. So a small add-on to the project was developed called UWEP-Plus, that continued UWEP 1 as a second phase of the project.

The main goals of the second phase, the UWEP-Plus, were:

- Building of capacities of local actors
- Development of appropriate models
- Establishment of functional systems

Another goal for the project in Bamako was the finishing of the pilot projects started by UWEP 1 but not finished, caused by some financial problems.

After finishing the project, the situations in Bamako before and after the project were evaluated. Especially in respect to the three UWEP-Plus goals.

Capacities of local actors:

Before the project starts, the local residents were not well organised. There were just a few persons in charge of organising the waste management, and everything was organised in a hierarchical structure. The cooperation between the different links of the system was not well implemented, and an involvement of the local communities was not present.

The situation now (2011) is quite different; the cooperation between the stakeholders was improved through the creation of multi-stakeholder platforms which ensures open channels for communication between the stakeholders. Through this, the interests of the population is also increased, by giving all organisations, governmental and non-governmental the chance to stand for their points.

Appropriate Models

Waste management was a top-down approach, with a strong focus on the technical issues, and treating the clients as objects, not subjects. Even if there were so called public-private partnerships, everything was hierarchical and one-way. The textile-dyeing industry was a good example for the situation. The local government wanted to ban the industry out of the city. So a law in this direction was implemented in 2001.

At the end of the UWEP project, the waste management has shifted from the top-down approach to a more mature and service orientated urban service, where users and providers are in a continuous dialog and transparent relationship. The problem with the textile-dyeing industry was not completely solved, but the experiments with the dye waste result in an intermit of the plans to move the industry out of the city.

Establishment of functional system

The waste management has become more and more a problem for the city of Bamako caused by the increasing amounts of produced waste. The capacities of the local technical service are with only 10 vehicles for the whole city are limited. Even with the involvement of a local cooperation, that was encouraged to play a bigger role in the waste management, the problem was not solved, caused by the top-down regulation.

Even after the increased collected amount of solid waste, waste water and sludge, the problem was not solved, because the disposal capacities were not high enough.

During the UWEP project, several facilities to overcome the upcoming problems were built. A waste water treatment station, a solid waste sorting plant, and a composting station. For the collection, two prototypes of a motorised collection vehicle were developed [10].

2.3. Recommendations

For a successful implementation of a municipal solid waste project in developing- or emerging countries it is important, to have some key points in mind.

Before starting any action and planning for a new project, an extensive knowledge of the local conditions are required. Without understanding the mentality of the local people, and the structure of the government as well as the given structures of solid waste management, it is nearly impossible, to develop a sustainable and successful project.

Knowledge about the waste types and quantities are prerequisites to start a successful project. Also the existing facilities for treating the waste, like recycling stations, landfills and material recovery facilities have to be known [11]

All stakeholders involved in the local solid waste management should be involved in all

phases of the Project. To ensure that, a kick of workshop where all parties are questioned to identify the concerns and objectives which every stakeholder can support, are a good way to get contact to local NGOs and other institutions.

Figure 2.2 shows a way to develop a waste management plan for developing countries.

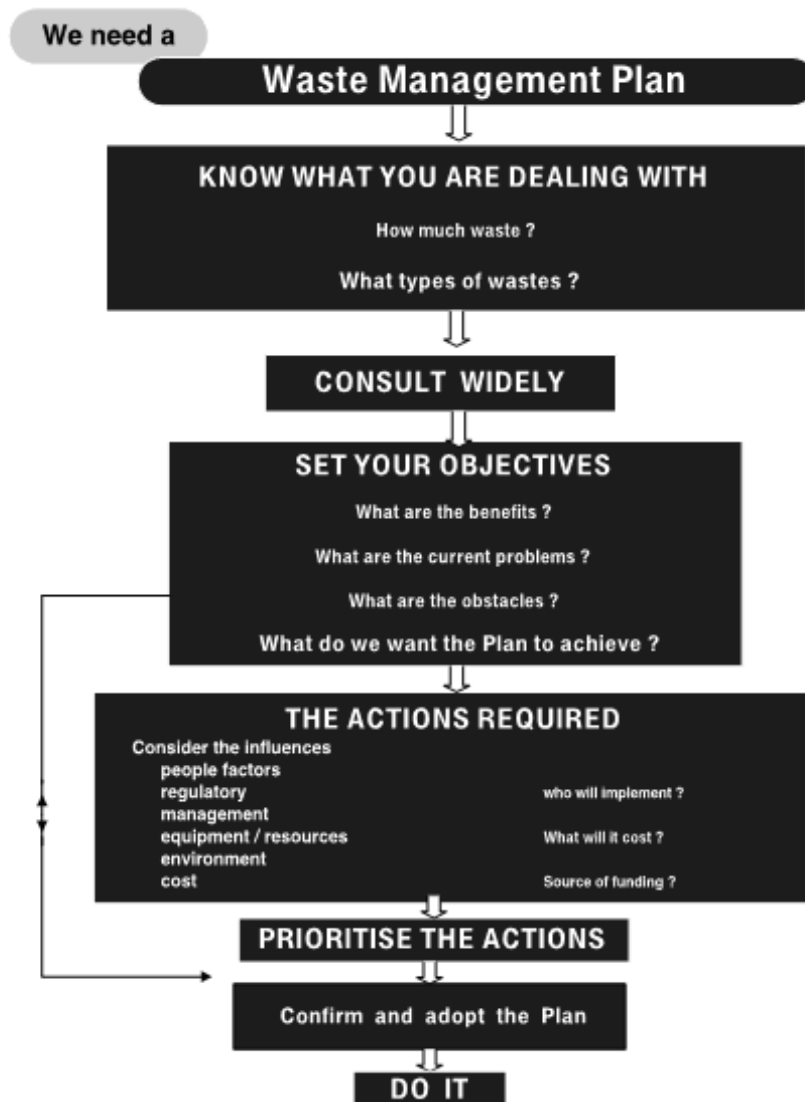


Figure 2.2: Pathways to a Waste Management Plan [13]

Combined with the aims and goals from Table 2.1, taken from the Conceptual Framework for Municipal Solid Waste Management in Low-Income countries [12] it is possible to develop a sustainable and functional waste management system.

The main focus and the overall aim of developing a municipal solid waste management system must be, as stated in Table 2.1, to establish a sustainable MSWM system which

meets the needs of all citizens, including rich and poor people.

Table 2.1: Goals and aim for a solid waste management system [12]

Goals					
To promote the health and well-being of the entire urban population	To protect the quality and sustainability of the urban environment	To promote the efficiency and productivity of the urban economy	To generate employment and income		
Overall Aim					
To establish sustainable MSWM systems which meet the needs of all citizens, including the poor					
Strategic Objectives					
Political	Institutional	Social	Financial	Economic	Technical
Determine MSWM goals and priorities	Devolve responsibility and authority for MSWM to local governments	Orient MSWM to the real needs of people, including the poor, women & children	Establish practical and transparent cost accounting and budgeting systems	Promote economic productivity & development through adequate MSWM service	Achieve low life-cycle cost of waste management facilities and equipment
Define clear roles and jurisdiction for MSWM	Establish effective municipal institutions for MSWM	Encourage proper waste handling patterns by the population	Mobilise adequate capital investment resources	Environmentally sound waste collection, recovery and disposal	Technology that facilitates user and private sector collaboration
Establish an effective legal and regulatory framework	Introduce appropriate management methods, procedures and service targets	Raise people's awareness of MSWM problems and priorities	Raise sufficient revenues for recurring expenses —ensure adequate O&M	Ensure long-term economic effectiveness of MSWM systems	Ensure that technical systems effectively limit environmental pollution
	Build municipal capacity for MSWM	Mobilise community participation in local waste management	Improve the efficiency and reduce costs of MSWM service	Promote waste minimisation and material efficiency	
	Increase efficiency and through private sector involvement	Protect health and socio-economic security of waste workers		Generate employment and incomes in waste management	
	Extend lower cost MSWM service through community participation				
Strategic Issues					
Relative priority of collection services in relation to safe waste disposal	Optimal distribution of functions and responsibilities?	Adaptation of waste management services to the needs of poor households and women	Failing incentive of local institutions to use available cost accounting methods	Trade-off between low-cost waste service and environmental protection	Coherence of technical systems in spite of differing requirements and decision makers
Priority attributed to waste minimisation —reduction and recovery	Devolution of MSWM responsibility in spite of limited local government capacity	Effectiveness of awareness building or direct community involvement	Use of collected revenues for the intended MSWM purposes	Control of industrial and hazardous waste in spite of small, scattered sources	Estimation of life-cycle costs of technical alternatives
Meeting the service needs of irregular and illegal settlements	Involving local governments in system planning and development	Equity of MSWM service access to the poor	Incorporating incentives for cost reduction and efficiency	Trade-off between efficiency of waste service and employment creation	Appropriate standards for sanitary landfill design and operations
Mix of instruments for waste management: regulations, incentives and/or motivations	Responsiveness of waste management to real needs and demands	Collaboration with and support of informal waste workers			
Contribution of ESAs to MSWM policy formulation	Raising the professional standing of waste managers				

With a focus on the role of NGOs in this field of development, the job of NGOs is to work between the local private households, and the government. A NGO originating from communities in which they also work in, can mostly increase the efficiency of a solid waste management system by increasing people's awareness. And also through the proximity to the user of the planned system, the knowledge of the biggest needs is comprehensive [11].

3. LOCAL COMMUNITIES POTENTIALS

Most of the waste generated in developing African, Caribbean and Pacific (ACP) countries is from the homes (domestic wastes). This implies that the waste are either generated in the kitchen, backyard garden, or from the general cleaning of the houses including house or compound sweeping/cleaning

Some of the waste generated in this circumstances including paper wrappings, plastic bags, food waste, tin cans (from canned foods), wastes from vegetables/leaves, fish or meat entrails, blood and bones, leftover food that often spoil because of lack of food preservation facilities (Freezing and other food preservation means)

Some of the domestic wastes also include glass and plastic bottles from alcoholic and non alcoholic beverages consumed in homes, glass plates and bowls, disposables from restaurants (plastic spoons and aluminium foils/wrappings).

Waste management options include the collection, transport, processing or disposal, managing and monitoring of waste materials.

The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics.

Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources.

The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances, and tried to reduce the harmful environmental impacts of each through different methods.

Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers.

3.1. Role of women in domestic waste management in the homes

In all the aforementioned situations, women and children play a very critical role in generating and management of such wastes.

The kitchen bins are often emptied by the women or the children. The first simple tricks of sorting the waste could often start in the homes with the women and children deciding

whether they want to put the wastes from the kitchen and general house sweepings in the same bin or into separate bins

This is the first step in the proper management of the wastes from domestic sources, which is the most common source of waste in the developing countries. If they decide to do simple sorting into two bins- for example everything that rots goes into one bin and the rest goes to the second bin. The two bins could be colour coded- green for everything that rots and blue for everything else.

At the transit points, where the women and children go to throw away the wastes, they also have the option of depositing the two types of waste in two separate piles in the transit point, or put all in one mixed pile. Similarly, they could choose to throw the waste into the drainage or into rivers and brooks.

In many settlements, the wastes are sent into the drainage or rivers and brooks

The women and children can also often keep a compost heap at their backyard; in this case the wastes that rot would be placed in such a waste heap.

The other bins in which waste that do not rot often contain a lot of recyclable materials.

Some of the materials can easily be reused; example plastic bottles can be used for keeping vegetable oil, cooling drinking water in the kitchen fridge or can be given away or sold to women who use them to put ginger beer in their freezers

Plastic bags can be reused to go to the market to buy and transport foodstuff home (a practice often promoted in developed world in shopping malls/supermarkets like Tesco. In Sierra Leone and many developing countries, one can save money by reusing plastic bags.

In many other ACP countries, the cost of the plastic carrier bags is inbuilt in the cost of the stuff one buys from the shops so that there is no incentive for reusing old plastics, because new plastics are provided to shoppers at no additional cost

Aluminium Tin cans, electric cables and other metal tins have all now found a use in the scrap metal trade in Sierra Leone and many developing countries in the ACP, so if these are not sorted in the homes, surely they are removed from the waste heap either at the transit points, or at the dump sites by scavengers (see next chapter 3.2).

3.2. Livelihoods opportunities in waste management

ACP countries are often characterised by high unemployment rates and street beggars are a common sight.

Another common sight in ACP countries is widespread poverty, hunger and street trading. As a result of the widespread poverty, coupled with high unemployment, many local residents in the cities of developing countries often resort to buying used stuff, which are often cost less than half the new ones.

The above fact is supported by the prevalence of used cars, electrical appliances and clothes in the streets of Freetown and many other major cities in ACP countries.

Sale of used clothes, and electrical appliances form a major livelihood option for the many unemployed in Freetown.

Because they do not have permanent places to put their wares during the day to sell, the youths have turned to the business of selling such used items at night along the street, sometimes even at night.

Most of the used items sold second hand in the streets of major cities in third world countries breakdown easily and were thrown into dump sites.

Today items thrown away into dump sites are recovered by poor unemployed youths who in turn either remove spares of the whole appliances and sell them to car repair shops, Radio, TV and freezer mechanics, or remove all metallic parts from the discarded appliance.

Scavengers: People who engage, either full time or part time in the business of recovering discarded appliances/items from dumpsites or wastes transit points.

In the context of waste management, the term refers to the recovery of materials that are either recyclables or reusable. In Sierra Leone, particularly in Freetown, scrap metals trade have resulted in almost any bit of metal that has been disposed of in our dumpsite is now recovered and sold to scrap metals exporters. In another development, auto and electrical

spare parts are now recovered and sold to auto and electrical/electronic mechanics or repair workshops (Figure 3.1).

Metallic parts that cannot be used in repair workshops are used by blacksmiths to make simple farm tools/implements. Aluminium and copper tins/wires are melted and molded into cooking pots and other utensils (Figure 3.2).

Plastic shoes, bottles/containers are recovered and either reused locally or exported to Guinea, where it is recycled.

The above developments have resulted into a situation whereby, the types and volumes of materials ending up in dumpsites in Freetown have greatly reduced. This does not only have positive effects on the waste management drive of Freetown and many other cities in the developing world, but major livelihood options for the poor and homeless, who do not have any other way of surviving.

The dangerous part of it though is that these scavengers go about in the dumpsites without any form of protection- no protective clothing, shoes, gloves or gas masks. These vulnerable poor people are therefore exposed to many hazards like inhaling infectious bacteria and exposure to sharp objects.



Figure 3.1. Wastes from automobiles recovered and sold to car repair shops.



Figure 3.2. Metal tins recovered from dumpsites and sold to scrap metal exporters or used to make local implements such as hoes, cutlasses and hurricane lamps.

Many of the scavengers are homeless and have chosen to permanently live in the dumpsites as their homes and are therefore constantly in contact with infectious materials and poisons (figure 3.3.).



Figure 3.3. Scavengers' sorting materials recovered from the dumpsite close to their 'dumpsite homes'.



Figure 3.4. Some of the materials sorted out of the dump ready for sale to regular customers who come to visit the scavengers in the dumpsite.

Scavengers recover plastic bottles and sell them to a local factory which uses them for bottling beverages. Peak milk tins are used by the scavengers to make hurricane lamps which are sold for the equivalent of 30 US cents (see Figure 3.5).



Figure 3.5. Peak milk tins recovered from the dumped waste is used to make hurricane lamps and sold to some Freetown and rural residents who do not have electricity in their homes.



Figure 3.6. Plastic shoes are recovered and sold to fishermen and the fishermen in turn used them as floats in their fishing nets.

*PART II- Green city: best practices addressing to governmental and/or local
authorities and WM programmes policy makers*

3

Developed by Chris Kobal

4. INTRODUCTION

The term Green City and/or sustainable city refers to a city which has implemented a successful environmental action to improve the lively hood of its inhabitants in terms of air quality, electricity use, and transportation habits. In the USA five broad categories are used to rank and compare cities for their green-ness:

- Electricity: Cities score points for drawing their energy from renewable sources such as wind, solar, biomass and hydroelectric power, as well as for offering incentives for residents to invest in their own power sources, like roof-mounted solar panels.
- Transportation: High scores go to cities whose commuters take public transportation or carpool. Air quality also plays a role.
- Green living: Cities earn points for the number of buildings certified by the U.S. Green Building Council, as well as for devoting area to green space, such as public parks and nature preserves.
- Recycling and green perspective: This measures how comprehensive a city's recycling program is (if the city collects old electronics, for example) and how important its citizens consider environmental issues.

It would be appropriate to have something similar in place as per the above. A green and sustainable city is a community of residents, neighbours, workers, and visitors who strive together to balance ecological, economic, and social needs to ensure a clean, healthy and safe environment for all members of society and for generations to come.

1. MOTIVATION

To ensure a viable future, the City must take a leadership role and address the impacts placed on the environment by urbanization and a growing populace. These impacts include air and water pollution, climate change, and habitat loss.

1.1. City council

The City has to take a number of significant actions to become a green city. Some examples include:

- Adoption of an Environmental Charter.
- A determination and commitment to be an environmentally friendly city.
- Adoption of a Green City Action Plan.
- Environmental initiatives.
- Adoption of ordinance creating an Environmental Advisory Commission.
- A policy making body.
- Adoption of a Green Building Program.
- Structures blend in with the Environment, both buildings and park areas.
- Adoption of a resolution in support of Green Cities.
- Points scoring initiatives and privileges of awards scheme.
- Endorsement of the United Nations Green Cities Declaration and Urban Environmental Accords

A number of actions that involve enactment of legislation to specifically deal with this:

- A recommendation to prohibit the distribution of single-use plastic carryout bags for consumer use;
- The establishment of a charge on single-use paper carryout bags was unanimously approved by City Council;
- Spot fines for litter bugs;
- Heavy fine for corporate bodies with long term waste storage in their yards that can attract unhealthy environment;
- Proper waste collection transportation, etc.

1.2. Local authorities

Local level governments usually cover a larger area than the city councils. In many cases they are rural level organizations. But they too are tasked with the responsibility of collecting and managing solid waste produced within their area of influence. As with the cities, the same would apply to them in their area of influence.

1.3. Government

On a national scale, the Government has to take a number of significant actions also to support and encourage provinces and cities to adopt and take ownership of the green country mentality for its citizens. As for cities above but on a national scale, some examples include.

- Adoption of an Environmental Charter:
- Recognition that development must embrace environmental protection in parallel
- Adoption of a Green Country Action Plan.
- Progressive list of environmental initiatives.
- Adoption of ordinance creating an Environmental Advisory Commission.
- To make policy recommendations in support of goals and objectives and to monitor and guide the plan.
- Adoption of a Green Building Program
- Green roofs and trees planting
- Adoption of a resolution in support of Green Cities
- Would include recycling operations.
- Endorsement of the United Nations Green Cities Declaration and Urban Environmental Accords

For example, all government construction contracts would require that the contractor agrees to adopting methods of construction that would minimize negative impacts on the environment. A breach of this agreement would constitute a breach of the contract.

PART III- Case studies & best practices (WM)

Developed by Romeela Mohee, A. Mudhoo

1. BACKGROUND

Natural resources are being depleted at faster rates than ever; this highlights the need for global audits and actions to reverse the depletion. Coordinated efforts by various organizations are essential to quantify reserves and demands in such audits in order to enable the development and implementation of strategies for sustainable recovery, usage, and recycling of natural resources. Audits in several industries need to be performed to put forward analytical and technical methods and policies for sustainable recovery, usage and recycling of resources in those industries. Scenario analysis can help to provide better future directions for industries whilst eco-industrial parks could improve the efficiency of usage of available resources and waste products through synergies among different industries on a regional basis. Sustainable manufacturing within industries such as micromachining, cement and leather could further reduce consumption of natural resources. New technologies in mineral recovery could help to recover valuable minerals present in concentrates generated by various processes such as reverse osmosis of sea water, chemical processing of minerals, and domestic and industrial wastewater treatments. It is imperative that the efforts by various organizations toward sustainable management of natural resources should compliment each other to minimize duplication; furthermore policy makers should play greater roles in developing and implementing policies and procedures to support such sustainable development oriented approaches simultaneously throughout the world in a coordinated and proactive manner for the short and long term future. The following sections present several successful efforts deployed in many countries to assess the potential for recycling a wide variety of wastes. The main findings and lessons learnt in these country reports are also summarized.

2. CASE STUDIES

2.1. Social, cultural and structural influences on household waste recycling: A UK context

The household-recycling rate in the Borough of Burnley, England in 2001/2002 was only half the national average of 12%. A research by Martin et al. (2006) employed both

quantitative and qualitative surveys in order to ascertain whether householders' attitudes to recycling were contributory factors to the generally poor recycling performance and to investigate other social, cultural and structural influences. The Borough has a large Asian–British population concentrated in two deprived wards where recycling rates are particularly low, so special attention was given to ascertaining their attitudes towards recycling. The quantitative survey comprised a postal questionnaire sent to a random sample of 360 households drawn from the electoral register. The qualitative survey consisted of group interviews with the Asian–British population at local community centres and focus groups attended by volunteers from the quantitative study. The findings suggested that householders were very willing to participate in recycling, as shown by the almost 80% claiming to recycle paper, but that local recycling services are too unreliable and inconvenient to allow them to do so comprehensively. Asian–British attitudes to recycling were found to be no different to those of the wider population, with their low participation being linked to the higher priorities imposed upon them by economic deprivation. The findings were broadly in line with those of the literature in that recycling participation tended to be higher among more affluent and older people, but lower among less affluent and younger households, probably due in part to the availability of both storage space and time, with the implication that the Borough's preponderance of terraced housing militates against a high recycling rate. Policy recommendations to local authorities included the provision of bespoke recycling services to suit the variety of residential conditions across the UK, and the provision of regular feedback to householders regarding recycling services and performance. Further research needs were identified for non-recyclers and to explore how householders' underlying psychological, cultural and social attitudes to recycling impinge upon recycling and participation rates [13].

2.2. Expert-based scenarios for strategic waste and resource management planning—Construction & Demolition waste recycling in Switzerland

Recycling of construction and demolition (C&D) waste is a promising option to conserve

scarce landfill capacities, to reduce environmental impacts related to final disposal and to save primary mineral resources. In Switzerland, recycling of C&D waste is well established, but the high recycling rate is considered a labile equilibrium with respect to mid to long-term developments such as an increase in the generated amounts of C&D waste and a shift in the demand patterns from civil engineering (CE) to structural engineering (SE). In light of the uncertainties related to the developments of the mineral construction material (MCM) market, Spoerri et al.[14] have presented an expert-based formative scenario analysis (FSA) aiming to elaborate possible future states for the “C&D waste recycling” system in the Canton of Zurich for the year 2020. The study integrated the knowledge of 20 experts representing different stakeholders of the Swiss construction industry and C&D waste management, reinforcing collaboration among them. Three types of consistent scenarios were identified. They differed in quantity of C&D waste and the demand for recycled material, and thus, in the recycling rates which could be ascribed to different constellations of market relevant factors. The study identified potential barriers and related strategic orientations in order to assure the recycling of C&D waste in the mid- and long-term future. Furthermore, the study showed how FSA could be used as a purposeful means for strategic planning in regional waste management [14].

2.3. Solid waste management in Abuja, Nigeria

The new city of Abuja provided an opportunity to avoid some of the environmental problems associated with other major cities in Africa. The status of solid waste management in Abuja had been reviewed and recommendations for improvements were made by Imam et al. [15]. The existing solid waste management system was found to be affected by unfavourable economic, institutional, legislative, technical and operational constraints. A reliable waste collection service was needed and waste collection vehicles needed to be appropriate to local conditions. More vehicles were required to cope with increasing waste generation. Wastes needed to be sorted at source as much as possible, to reduce the amount requiring disposal. Co-operation among communities, the informal sector, the formal waste collectors and the authorities was also found to be necessary if

recycling rates were to increase. Markets for recycled materials needed to be encouraged. Despite recent improvements in the operation of the existing dumpsite, a properly sited engineered landfill should be constructed with operation contracted to the private sector. Wastes dumped along roads, underneath bridges, in culverts and in drainage channels needed to be cleared. Small-scale waste composting plants could promote employment, income generation and poverty alleviation. Enforcement of waste management legislation and a proper policy and planning framework for waste management were also required. Unauthorized use of land must be controlled by enforcing relevant clauses in development guidelines [15].

2.4. Investigating households attitude toward recycling of solid waste in Malaysia

Omran et al. [16] investigated householders' attitudes to the recycling of solid wastes in one part of northern Malaysia, namely Alor Setar town, Kedah State. A postal questionnaire survey was administered to households in Alor Setar town in selected areas of high, middle and low incomes. 389 responses were obtained, a response rate of 86.4%. A personal interview with an official of the Municipal Council of Alor Setar was conducted in order to identify the current situation of solid waste recycling and household participation as well as obtaining views on the recycling campaigns carried out by the Malaysian government in 1993 and 2000. Participation in recycling of household waste relied on the level of awareness and understanding of recycling. Improved education and increasing the accessibility of recycling facilities were found to be the best means of promoting positive attitudes to recycling attitude, partly because they helped to remove barriers preventing households from recycling. Households in Alor Setar town have identified some of the effective strategies that could be initiated by the government to increase the rate of recycling in Malaysia which would also encourage them to participate in recycling. One of these strategies was providing recycling bins in every residential area [16].

2.5. Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria

The population of Lagos, the largest city in Nigeria, increased seven times from 1950 to 1980 with a current population of over 10 million inhabitants. The majority of the city's residents are poor. The residents make a heavy demand on resources and, at the same time, generate large quantities of solid waste. Approximately 4 million tonnes of municipal solid waste (MSW) is generated annually in the city, including approximately 0.5 million of untreated industrial waste. This is approximately 1.1 kg/cap/day. Efforts by the various waste management agencies set up by the state government to keep its streets and neighbourhoods clean have achieved only minimal success. This is because more than half of these wastes are left uncollected from the streets and the various locations due to the inadequacy and inefficiency of the waste management system. Whilst the benefits of proper solid waste management (SWM), such as increased revenues for municipal bodies, higher productivity rate, improved sanitation standards and better health conditions, cannot be overemphasized, it is important that there is a reduction in the quantity of recoverable materials in residential and commercial waste streams to minimize the problem of MSW disposal. Kofoworola (2007) recently examined the status of recovery and recycling in current waste management practice in Lagos, Nigeria. Existing recovery and recycling patterns, recovery and recycling technologies, approaches to materials recycling, and the types of materials recovered from MSW are reviewed. Based on these, strategies for improving recovery and recycling practices in the management of MSW in Lagos, Nigeria were suggested [17].

2.6. Comparison of municipal solid waste management in Berlin and Singapore

A comparative analysis of municipal solid waste management (MSWM) in Singapore and Berlin was carried out by Zhang et al. (2010) in order to identify its current status, and highlight the prevailing conditions of MSWM. An overview of the various aspects of MSWM in these two cities has been provided, with emphasis on comparing the legal, technical, and managerial aspects of MSW. Collection systems and recycling practiced

with respect to the involvement of the government and the private sector, are also presented. Over last two decades, the city of Berlin has made impressive progress with respect to its waste management. The amounts of waste have declined significantly, and at the same time the proportion that could be recovered and recycled has increased. In contrast, although Singapore's recycling rate has been increasing over the past few years, rapid economic and population growth as well as change in consumption patterns in this city-state has caused waste generation to continue to increase. Landfilling of MSW plays minor role in both cities, one due to geography (Singapore) and the other due to legislative prohibition (Berlin). Consequently, both in Singapore and Berlin, waste is increasingly being used as a valuable resource and great efforts have been made for the development of incineration technology and energy recovery, as well as climate protection [18].

2.7. Life cycle of buildings, demolition and recycling potential: A case study in Turin, Italy

One of the most challenging issues presently facing policymakers and public administrators in Italy concerns what to do with waste materials from building dismantling activities and to understand whether, and to what extent, the ever-increasing quantity of demolition waste can replace virgin materials. Blengini (2009) presented the results from a research programme that was focused on the life cycle assessment (LCA) of a residential building, located in Turin, which was demolished in 2004 by controlled blasting. A detailed LCA model was set-up, based on field measured data from an urban area under demolition and re-design, paying attention to the end-of-life phase and supplying actual data on demolition and rubble recycling. The results have demonstrated that, while building waste recycling is economically feasible and profitable, it is also sustainable from the energetic and environmental point of view. Compared to the environmental burdens associated with the materials embodied in the building shell, the recycling potential is 29% and 18% in terms of life cycle energy and greenhouse emissions, respectively. The recycling potential of the main building materials was made available in order to address future demolition projects and supply basic knowledge in the *design for*

dismantling field [19].

2.8. Electronic waste recycling in China

Informal recycling is a new and expanding low cost recycling practice in managing Waste Electrical and Electronic Equipment (WEEE or e-waste). It occurs in many developing countries, including China, where current gaps in environmental management, high demand for second-hand electronic appliances and the norm of selling e-waste to individual collectors encourage the growth of a strong informal recycling sector. Chi et al. (2011) have recently gathered information on informal e-waste management, took a look at its particular manifestations in China and identified some of the main difficulties of the current Chinese approach. Informal e-waste recycling is not only associated with serious environmental and health impacts, but also the supply deficiency of formal recyclers and the safety problems of remanufactured electronic products. Experiences already show that simply prohibiting or competing with the informal collectors and informal recyclers is not an effective solution. New formal e-waste recycling systems should take existing informal sectors into account, and more policies need to be made to improve recycling rates, working conditions and the efficiency of involved informal players. A key issue for China's e-waste management is how to set up incentives for informal recyclers so as to reduce improper recycling activities and to divert more e-waste flow into the formal recycling sector [20].

2.9. Maximizing recycling participation to reduce waste to landfill: a study in Hobart, Tasmania, Australia

Small to medium-sized enterprises (SMEs) in Hobart, Tasmania, Australia face numerous barriers to recycling participation. The study by Parsons and Kriwoken (2010) first investigated the volumes and types of waste produced by SMEs. Significant barriers were then identified and key motivators to recycle examined. Using the Australia New Zealand Standard of Industrial Classification, stratified sampling of SMEs ($n = 436$) was undertaken. Inadequate storage space, paucity of readily available information on recycling services

and the lack of staff allocated to sort and recycle were identified as major barriers. Cardboard, paper and plastic waste were produced in large volumes with only a small percentage being recycled and these were identified as target areas for local government. Recommendations included the appointment of a dedicated recycling officer to maximize recycling participation for the reduction of waste to landfill and to undertake further research on minimizing recycling costs [21].

2.10. Evaluation of dry solid waste recycling in Mashhad city, Iran

The recycling for recovery and reuse of material and energy resources undoubtedly provides a substantial alternative supply of raw materials and reduces the dependence on virgin feedstock. Farzadkia et al. [22] recently assessed the potential of dry municipal solid waste recycling in Mashhad city, Iran. Several questionnaires were prepared and distributed among various branches of the municipality, related organizations and people. The total amount of solid waste generated in Mashhad in 2008 was 594 800 tons with per capita solid waste generation rate of 0.609 kg person⁻¹ day⁻¹. Environmental educational programmes via mass media and direct education of civilians were implemented to publicize the advantages and necessity of recycling. The amount of recycled dry solid waste was increased from 2.42% of total dry solid waste (2588.36 ton year⁻¹) in 1999 to 7.22% (10 165 ton year⁻¹) in 2008. The most important fractions of recycled dry solid waste in Mashhad included paper and board (51.33%), stale bread (14.59%), glass (9.73%), ferrous metals (9.73%), plastic (9.73%), polyethylene terephthalate (2.62%) and non-ferrous metals (0.97%). It could be concluded that unfortunately the potential of dry solid waste recycling in Mashhad has not been considered properly and there is a great effort to be made in order to achieve the desired conditions of recycling [22].

2.11. Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia

Saeed et al. (2009) have presented a forecasting study of municipal solid waste generation (MSWG) rate and potential of its recyclable components in Kuala Lumpur (KL), the capital

city of Malaysia. The generation rates and composition of solid wastes of various classes such as street cleansing, landscape and garden, industrial and constructional, institutional, residential and commercial were analyzed. The past and present trends were studied and extrapolated for the coming years using Microsoft office 2003 Excel™ spreadsheet assuming a linear behaviour. The study showed that increased solid waste generation of KL is alarming. For instance, the amount of daily residential SWG was found to be about 1.62 kg/capita; with the national average at 0.8–0.9 kg/capita and was expected to be increasing linearly, reaching to 2.23 kg/capita by 2024. This figure seemed reasonable for an urban developing area like KL city. It was also found that, food (organic) waste was the major recyclable component followed by mix paper and mix plastics. Along with estimated population growth and their business activities, it has been observed that the city was still lacking in terms of efficient waste treatment technology, sufficient fund, public awareness, maintaining the established norms of industrial waste treatment etc. Hence, it was recommended that the concerned authority (DBKL) should view this issue seriously [23].

2.12. Mining waste disposal at Lihir Gold Mine, Papua New Guinea

Mining in its broadest sense is the process of obtaining useful minerals from the earth's crust. A mineral is generally defined as any natural accruing substance of definite chemical composition and consistent physical properties. An ore is a mineral, or combination of minerals from which a useful substance, such gold, can be extracted and marketed at a price that will recover the costs of mining and processing, and yield a profit. Mining in developing countries remains controversial since a huge impact on the cultural climate, the physical environs and the socio-economic status of the local people can result. Mining operations and their mining waste disposal methods are considered one of the main sources of environmental degradation. Social awareness of this problem is of a global nature and government actions to stem the damage to the natural environment have led to numerous international agreements and laws directed toward the prevention of activities and events that may adversely affect the environment. Papua New Guinea (PNG) is well

endowed with mineral resources and it offers one of the most biologically diverse habitats in the world. On the other hand, the country suffers from a chronic lack of funds with which to properly manage and use its resources. The global economic and environmental climate has progressively changed in recent years. There is growing pressure on mining companies to clean up their toxic tailings. The Lihir Gold Mine is an example of a multinational mining operation that presents its own social, economic and physical environmental impacts. This paper discusses the problem of mine waste disposal at this mine. The rural communities of PNG depend heavily on nature to sustain their livelihood. Introduction of mining activities in remote areas of PNG affects a lot of people. Waste disposal from process plants and sediment runoffs from open cut mines are dumped into rivers and oceans. Smothering of riverbeds and ocean floors, heavy metal contamination and acid mine drainage are consequences of mine waste disposal into the environment. Toxicity of heavy metals is generally chronic rather than acute, so diseases associated with them are evident only over a long period of time. People's main concerns come from observable changes in say a river – discolouration, odour, taste or feel – rather than chemical quantification of some scientific phenomenon unknown to villagers.

Regarding Lihir management strategies to manage mining waste, there are 3 categories of waste to be disposed of at the mine site, (1) dumping of waste rock at sea, (2) submarine tailing deposition (STD) after processing. STD as an entity will be discussed below followed by a specific discussion on cyanide, the solvent used in processing, and (3) stockpiling of low-grade ore for later processing. Whilst not truly an immediate waste, the stockpile of rock will sit for up to 25 years and will have an effect on water concentrates of heavy metals as it is under the influence of water and weather during this time [24].

2.13. EVIAVE for planning and decision-making tool, Venezuela

Landfills in Venezuela have serious problems regarding their location, design and operation. In fact, basic waste disposal is one of the main weaknesses of the municipal waste management in this country. The Venezuelan Ministry of Environment and Renewable Resources has studied and identified the negative impacts of operating

landfills, but no program has been implemented to determine the cause–effect relation of these impacts or to design strategies to counteract with the serious environmental and health risks generated. The EVIAVE methodology can be successfully used for landfill diagnosis, and shows how this type of landfill diagnosis was applied in Venezuela. For our research study, we carried out both a quantitative and qualitative evaluation of the environmental problems generated by 22 landfills in Venezuela. The study from Zamorano et al. (2009) study was based on the following environmental indexes: Landfill Environment, Environmental Risk, Environmental Value, and Probability of Contamination. For the purposes of their study, it was first necessary to adapt EVIAVE to the legal system and social context in Venezuela. The results obtained confirmed the applicability of this methodology to Venezuelan landfills. EVIAVE was found to be an effective planning tool that provided crucial information for the development of action plans, which would improve landfill operation, and help make decisions pertaining to their closure, sealing and eventual recovery [25].

2.14. Waste management in Ethiopia

Waste management is a growing public concern in Ethiopia. In many cities of the country, waste management is poor and solid wastes are dumped along roadsides and into open areas, endangering health and attracting vermin. Access to sanitation is also among the lowest in the world. Sixty percent of the population still practice open field defecation. Only 12 percent (8% in the rural and 29% in the urban) of the population use improved sanitation facilities. Urban households are more than three times as likely as rural households to have access to improved toilet facilities. However, studies conducted by Research Inspired Policy and Practice Learning in Ethiopia and the Nile Region (RIPPLE) in the SNNPR indicate a substantial increase in the number of household latrines since the deployment of Health Extension Workers. It shows an increase in a few years, from 16% to 94% coverage in Mirab Abaya Woreda and 10% to 69% in Alaba Special Woreda. Nevertheless, these studies indicate hand washing facilities and practice to be still poor. Recently, a cross sectional study was conducted in Kersa Demographic Surveillance and

Health Research Centre (KDS-HRC) project site in April 2008. The study subjects were randomly selected 444 households. Data were collected through interview and observation. The majority of the households, (66%) disposed solid wastes in open dumps and only 6.9% of the households had temporary storage means for solid waste. About 98.4 % of the respondents revealed that the responsibility of waste management is left for women and girls. Only 36.4% households had latrines and almost all were simple unsanitary traditional pits. From those households with latrine the habit of hand-washing after defecation was reported to be only about 5.1%. The habit of hand washing after defecation is significantly associated with the educational status of the respondents ($P<0.01$) In this study community household management of waste was found to be in poor condition. Health-workers and local authorities must pay special emphasis to improve these conditions. Further in-depth studies should also be encouraged to look for improved interventions [26].

2.15. Waste Management in Freetown, Sierra Leone

Management of waste in Freetown poses costly and annoying problems (including low service coverage – averaging 40%, insufficient budgets, highly inadequate equipment, substantial inefficiencies such as high costs, low quality service, low labour productivity, poor public attitudes, and widespread illegal dumping). With respect to waste management, a direct relationship exists between a city's population size and both the percentage of waste removed and rate of household enjoying regular waste collection.

In a study carried out by Sood (2004) [27] for the Government of Sierra Leone, it was estimated that over 745 tons day⁻¹ (averaging 0.45 kg person⁻¹ day⁻¹) of garbage is generated in the Freetown municipality, of which, biodegradable organic waste, mostly from residential areas and vegetable markets, accounts for over 84%. Construction, demolition debris and yard wastes are not included in this estimate as these are highly variable and skew quantity assessments. Freetown served as safe haven for thousands of people from the provinces during the war and suffered a corresponding increase in the rate of generation of waste with very little waste management facility as such facilities

were vandalized or completely destroyed. Solid waste management in Freetown has been under variable organizations, with each change further deteriorating the system, bringing it on the verge of collapse. Freetown Waste Management Company (FWMC) is struggling to manage the wastes, hence, the need for the intervention of potential investors/donors to ameliorate this waste management problem by helping address this problem sustainably for the betterment of the lives of all Freetown residents. Streams of waste are characterized by their sources, the types of waste produced, and the composition and generation rates; therefore, knowledge of these characteristics is required in order to design and operate appropriate waste management systems, hence, the need for the Sierra Leone Government or FWMC to set limits on certain physical characteristics and properties for waste classifications; having significant implications for the collection and disposal of various waste streams, since any material deemed hazardous must be handled with specific protocols. The total quantities and characteristics of waste streams generated are yet unknown, with uncategorized refuse, poorly collected, dumped at the two city's insanitary landfills, hence exposing FWMC workers, scavengers, etc., to the dangers of hazardous waste. This appalling garbage situation needs efficient corrective measures or serious rehabilitation; otherwise it will adversely impact the living conditions of the people, further endangering their environment and health [28].

2.16. Water recycling and reuse in EUREAU countries: Trends and challenges

EUREAU is a non-profit Union of National Associations of Water Suppliers and Wastewater Services from EU and EFTA countries. EUREAU countries depend on appropriately treated wastewater to protect the environment and ensure that freshwater is available for all applications. Water recycling and reuse through surface and groundwater bodies is common practice and public health is protected through potable water standards. The reuse of water for non potable applications or potable substitution has been proven internationally in water stressed regions to be a drought proof source of water and one of the most effective water scarcity solutions. This paper presents successful examples wastewater reclamation and reuse in Europe.

Water recycling and reuse status in Europe - Although treated wastewater has been an important means of augmenting river flows in Europe and the subsequent use of such water for a range of purposes constitutes indirect reuse of wastewater, it is becoming increasingly attractive to use reclaimed or treated wastewater more directly. In addition, reclamation of wastewater is attractive in terms of sustainability since wastewater requires disposal if it is not to be reclaimed. There are several cities in northern Europe that rely on indirect potable reuse for 70% of their potable resource during dry summer conditions. The AQUAREC project has identified over 200 water reuse projects in Europe out of 3,300 water reclamation projects globally. The review considered seven geographical regions: (a) North and (b) Latin America, (c) Europe, (d) Mediterranean Region and Middle East, (e) Sub-Saharan Africa, (f) Oceania, and (g) Japan. Japan has the largest number of reuse project (over 1,800), followed by the USA (over 800), which is the largest producer, with a volume of reused water estimated at close to 6.5 Mm³/d. Almost 100 sites were identified in the Mediterranean and Middle East area, with more than 50 in Latin America and 20 in Sub-Saharan Africa.

The future of water recycling and reuse in EU - The future of water reuse in EU could be summarized with these objectives:

- Accurate anthropogenic water cycle educational material is available on the internet.
- The need for water reuse and the benefits are comprehensively recognized as a normal water resource management practice and not just as a water scarcity solution.
- Water quality guidelines and best practice are attached to the UWWTD. EU has in place the regulatory and institutional framework tailored to suit local needs to take advantage of the water recycling and reuses opportunities to safely maximize water efficiency. The framework includes a clear definition of the benefits for all segments of the anthropogenic water cycle. It proves that water reuse is a horizontal or cross cutting application that pulls together the normally segregated disciplines of potable water and wastewater treatment for public health and environmental protection.
- New projects are being implemented using the guidelines and knowledge and

experience from existing projects.

- The benefits of Soil Aquifer Treatment (SAT) are accepted as a sustainable advanced wastewater treatment process that can play an important role in a multi-barrier indirect reuse system as demonstrated on three US projects which show that the groundwater recharged with reclaimed water is of potable quality due to the SAT.

Some examples of efficient reclamation and reuse of wastewater in EUREAU countries are the following:

Cyprus - In Cyprus the wastewater generated by the main cities, about 25 Mm³/y, is planned to be collected and used for irrigation after tertiary treatment. Because of the high transportation cost, it is anticipated that most of the recycled water, about 55–60%, will be used for amenity purposes in hotel gardens, parks, golf courses, etc. A net volume of about 10 Mm³ is conservatively estimated to be available for agricultural irrigation. The cost of recycled water is low, about 0.07 €/m³. This will reportedly allow irrigated agriculture to be expanded by 8–10% while conserving an equivalent amount of water for other sectors.

Germany - Berlin has operated like many large cities/river basins with a partly closed water cycle for hundreds of years through a combination of careful wastewater treatment and the benefits of soil aquifer treatment through bank filtration to produce potable water from the aquifers. The NASRI research project (www.kompetenz-wasser.de) was set up to study the fate of pathogens and organics, geochemical processes and the hydraulics of bank filtration and artificial recharge systems at laboratory, semi technical and field scale. The outstanding feature of this project is the multi-stakeholder involvement which includes the water utility with local universities and the environmental regulator.

Belgium - The IWVA Torreele indirect potable water reuse through dune infiltration and aquifer recharge project is providing 40% of the potable water demand. This is an outstanding achievement for one of our smallest but highly innovative European water operators. The unusual aspect of this project is their high level of communication and involvement with the community prior to, throughout the project and during the three

years of operation. This has reinforced a high level of trust and acceptance of indirect potable reuse within the community. IWVA also have a commitment to search out international experience and share their experience at leading conferences in most parts of the world [29].

The greatest challenge in promoting, implementing and developing fruitful recycling programs is building a network of experts, waste management champions and Government capacity in the global market so that justifiable projects can be implemented.

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