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A Pragmatic ICT4D Approach to Environmental Ethics for Rural and Marginalised Areas (RMAs): The Perspicacity of Dwesa Community

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ABSTRACT The implementation of Information and Communication Technology for Development (ICT4D), as a fast growing anthropocentric phenomenon, can have severe implications on environmental conservation. In spite of this, access to ICTs is an essential component of the global knowledge economy. However, the urban based public sector institutions on which residents of RMAs depends for access to ICTs consumes enormous amounts of power and their wasteful usage of ICT resources is not properly controlled. This fast developing trend can be mitigated through the introduction of rules and codes related to the usage of ICT resources in RMAs to reduce pressure on their urban based public sector institutions. Several e-services have been implemented in the Dwesa Community and the perspicacity obtained reveals a non-anthropocentric attitude they have created in this RMA. The paper proposes a pragmatic ICT4D approach to environmental ethics.

INTRODUCTION

Climate change has become an issue of discussion across various disciplines and platforms. This demonstrates the intrinsic value of nature in human life. Furthermore, climate change depicts that the social development of the humankind should primarily consider the potential destruction of other species. This implies that climate change mandates that ICT4D must be defined within an environmental ethics framework.

Anthropocentric environmental theories argue that species and ecosystem should be morally respected for their utilitarian benefits to humanity. Taken together, all environmental ethical theories share a commitment to conserving and sustaining both individual species and entire ecosystems. The built environment for the human habitat should interfere as little as possible with the habits of other species (such as insects, plants, arachnids among others) while still allowing humans to flourish (Wang 2012). Humanity is increasingly responsible for the very existence of completely new environments. The technological power available is enormous and relentlessly growing (Floridi 2002). This technological advancement has, and continues to position humankind in charge of creating new environments that can either be anthropocentric or non-anthropocentric if not carefully engineered.

As it relates to the field of ICT4D, questions such as the following would be considered in the making of human development: *should we continue to centralise ICT resources in urban areas even if accessing them means more use of petrol-driven cars that pollute the environment? Should the urban based institutions continue to use personal computing devices such as desktops, laptops and netbooks, which are high on energy consumption, to process and deliver services to RMAs inhabitants?* It would be critical to consider these kind of questions in line with the concerns of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST). COMEST's concern holds that the revolution in science and technology has led to the concern that unbridled scientific progress is not always ethically acceptable. The commission further asserts that the need to establish common values and benchmarks, as well as to promote ethical principles and standards to guide scientific progress and technological development, is increasingly acute. This is particularly applicable to developing countries that do not equally enjoy benefits of scientific and technological advances (UNESCO 2006). This concern still finds resonance between advantaged urban areas and RMAs as the levels of scientific progress and technological development beneficiation between them varies with the RMAs enjoying the least if any.

In this paper, the perspicacity of the Dwesa community is presented to demonstrate two issues: *(1) How did this community benefit from*

the ICT4D projects rolled out to date? (2) How are such ICT4D projects ethically acceptable for preservation of the environment? This will enable us to use such understanding and perspicacity to define a pragmatic ICT4D approach that is sensitive to environmental ethics for RMAs of the developing countries.

The contents of this paper are arranged into five sections. Section one introduces the paper. In section two, the researchers explore works related to this research project and research background that has paved a way for the undertaking of this work. Under section three, the researchers present the situation of the Dwesa community; both pre- and post- ICT4D intervention. The researchers then draw a pragmatic approach in section four of this paper on the basis of the preceding sections. The researchers draw a conclusion in section five based on the outcomes of this research project and acknowledge our sources in section six. The following section presents the methodology of the study.

METHODOLOGY

The study was conducted in the Dwesa community, a mountainous rural village in South Africa. It is situated in the South Eastern coastal region of the Eastern Cape Province. In terms of the provincial demarcations, Dwesa Community falls under the Mbashe Local Municipality which is situated in the North Eastern part of the Amathole District Municipality. Dwesa is home to approximately 15 000 inhabitants living in 2000 households and speak isiXhosa as a language of communication (Palmer et al. 2002). As this community assembled on and between mountain hills, there is no substantial arable farming that can be made out of it despite that their livelihood depends on the little that they can grow. However, pastoral farming is more visible across households, and serves as the major advantage to this community. Although pastoral farming is more visible among the residents, it remains inadequate to uplift the socio-economic status of the residents in particular and the community in general.

This community was characterised by various forms of under development ranging from limited connectivity to electricity supply, minimal telecommunication infrastructure, poor quality of transport infrastructure, to most importantly; sub-standard education facilities before ICT infrastructure was deployed (Thinyane et al. 2006). The schools that existed were also under-funded, poorly-equipped, and under-staffed. Until late 2009, the majority of the households did not have direct access to either electricity or running water and the limited road (Gumbo et al. 2012). As a result of limited accessibility heavy vehicles such as buses, trucks and lorries to come in and out of this community to deliver services to the people. The residents had to travel by bus for over 60km to town in order to access public services such as health and social grants, as well as for other personal needs such as groceries, building materials, and for their traditional beading businesses. However, the status quo of this community has drastically changed following an ICT infrastructure deployment research initiative.

In 2005, the collaboration of various stakeholders headed by the University of Fort Hare and Rhodes University in conjunction with industry, government and the local community saw to the establishment of the Siyakhula Project (SP). The infrastructure was rough and basic, a local loop access network was deployed to the Dwesa-Cwebe area (Siebörger 2010). The Worldwide Interoperability for Microwave Access (WiMAX) technologies was used to build the local loop while Very Small Aperture Terminal (VSAT) technology is used to link the community to the Internet. In cognisant of the poor education background of the Dwesa community, ICT training has been a continuous exercise. It is so because computing infrastructure without training can lead to the underutilisation of the facilities. ICT holds the promise of providing a solution to most of these problems through the introduction of e-Commerce portals, e-Learning solutions, e-Government services and e-Health applications (Thinyane et al. 2006). It is through the Distributed Access Nodes (DANs) that are housed in five local schools that members of the community, young and old, learners and teachers, illiterate and literate are introduced to a thorough ICT training to increase computer literacy and decrease the digital gap.

RESULTS AND DISCUSSION

Prospects and Challenges of Contemporary Technologies

Understanding that there is public concern and debate on issues such as cloning, research

involving human beings, transplantation, nuclear energy, environmental pollution and global warming; ethics has been placed on the national and international agendas. Ethics is no longer solely the concern of scientists, engineers or health care professionals. It has therefore transcended the exclusive domain of experts, showing that science is first of all a public enterprise, a social activity and a cultural good (UNESCO 2006). In this academic spirit and with more emphasis, science and technology must be applied in cognisance of the social action and its subsequent causes and effects. This holds due to the fact that technology structures our experiences and shapes how we live and it has enormous ethical significance (Sandler 2009).

The fundamental nature of ethics is that it can tell us what we should do in any given circumstance without compromising the development of healthy ecosystems. Any ethically sound development initiative should steer sound sustainable development. It is contended that sustainable development means that our interest in the sound construction of the *infosphere*, the sphere of digital information, must be associated with an equally important, ethical concern for the way in which the latter affects and interacts with the physical environment, the biosphere and human life in general, both positively (for example, telework as a solution for traffic and fuel pollution) and negatively (for example, rising energy consumption, ICT generated waste, computer-related forms of illness).

The application of ICTs can be the most important factor ensuring inclusive global development unconventional from climate change effects. According to Prasad and Heeks (2011), "ICTs will play a crucial part in the development of climate change adaptive capacity in developing countries. They will do this in four ways: *(i) by combining existing data in new ways (ii) by enabling access to new data, information and knowledge (iii) by reducing costs of access to transactions and services, and (iv) by their productive role in ICT-based enterprise*". Further to this, it is asserted that despite the fact that ICTs are responsible for only a small part of worldwide greenhouse gas emissions – current estimates attribute around 2 percent of man-made emissions to ICT– this sector is the one with the fastest growing emissions (Mingay 2007; GeSI 2008). As a result, there is an increasing concern over the environmental impact of ICT, especially the climate change potential induced by ICT-related energy consumption. At the same time, there is a growing perception that ICT can also substantially reduce the environmental impacts of other sectors, in particular by increasing their energy efficiency. Due to ICT, all economic sectors can become more energy efficient – since ICT allows existing processes to be optimised or enables entirely new, more energy-efficient processes. The energy that could be saved by ICT-induced energy efficiency is estimated to be several times larger than the overall energy consumption of ICT itself.

In Palmer et al.'s study (2002), it is revealed that municipalities are believed to be interested in local energy sources, increasing their share of renewable energy, and/or self-sufficiency as well as taking steps towards the energy positive performance of buildings, neighborhoods and entire cities. However, they have a lack of know-how about how to do this and where to start, especially when access to financing is limited. Technology can support this by providing guidelines, tools, data sharing platforms and data mining opportunities. ICT can also provide decision support systems, benchmarking tools, performance estimation and the analysis of sustainability impacts (economic, environmental, and social impacts) with easy-to-understand visualisation of analyses and impacts. Three important aspects are emphasized: (i) being the long overdue need for the ICT to provide energy efficient support systems for municipalities; (ii) the impact of ICT intervention to bolster the economic aspect of municipalities and most interestingly, to promote environmental and social relations; and (iii) ICT has the potential to effect significant energy savings through smart use. Difficult logistics of the travel and transportation industry are easily solved by ICTs through shrinking distances and increasing efficiency. ICT allows a strategic shift to core services through economic de-materialisation. Above all it can reduce, manage and monitor energy consumption and the carbon footprint of buildings and infrastructure.

Pragmatic ICT4D Approach

Since its inception, the Dwesa ICT4D project involved and continues to involve three main role players in the form of the ICT infrastructure (**I**), ICT personnel (**P**) and Community of Dwesa

(**C**) as presented in Figure 1, the Dwesa ICT4D Venn diagram, below:

Figure 1 presents an in-depth overview of the Dwesa ICT4D project and how the role players come together to make the project a success story for this community, the universities involved and the country at large. As presented in Figure 1, **I** is constituted by various infrastructures and technologies in the form of WiMAX, Wireless Fidelity (Wi-Fi), Computer Labs, etc. It further depicts that **P** involves technicians, developers, researchers, trainers; etc who are the personnel intended to sustain and develop the project. **C** involves the ordinary residents of the Dwesa community of all ages and genders as the target group for this project.

The three role players come together in four different ways as depicted by ***IP***, ***PC***, ***IC*** and ***IPC*** respectively in that sequence. **IP** is a result of ICT infrastructure and Personnel coming together and yield services such as e-Government, e-Commerce, e-Judiciary, e-Health, etc. **PC** is a joint product of the ICT personnel and Dwesa Community for the benefit of this community through skills development such as basic computer literacy, internet, e-mailing and database creation to mention but a few. **IC** is achieved through ICT infrastructure deployment to the Dwesa Community and thus yielding community development initiatives that include social development, economic development, illiteracy eradication, and knowledge dissemination among others aspects. Finally, the coming together of the three role players in this project at results in **IPC** where projects of environmental, educational, economic and social interest are advanced and achieved.

The focus of this research lies in **IPC** where projects of environmental interest are collectively undertaken by the three role players in this project. Figure 2 depicts the holistic pragmatic ICT4D approach to environmental ethics for RMAs as implemented and experienced in the Dwesa ICT4D project. The project consists of the ICT infrastructure which enabled the deployment of the local loop network. The ICT infrastructure consists of the WiMAX, VSAT, Computers Labs, and Servers among other technologies. It is through WiMAX technologies that the local loop network was successfully built. VSAT technologies connect the Dwesa community to the internet. The community members make use of computer labs to access available resources. Servers to facilitate and provide services to cli-

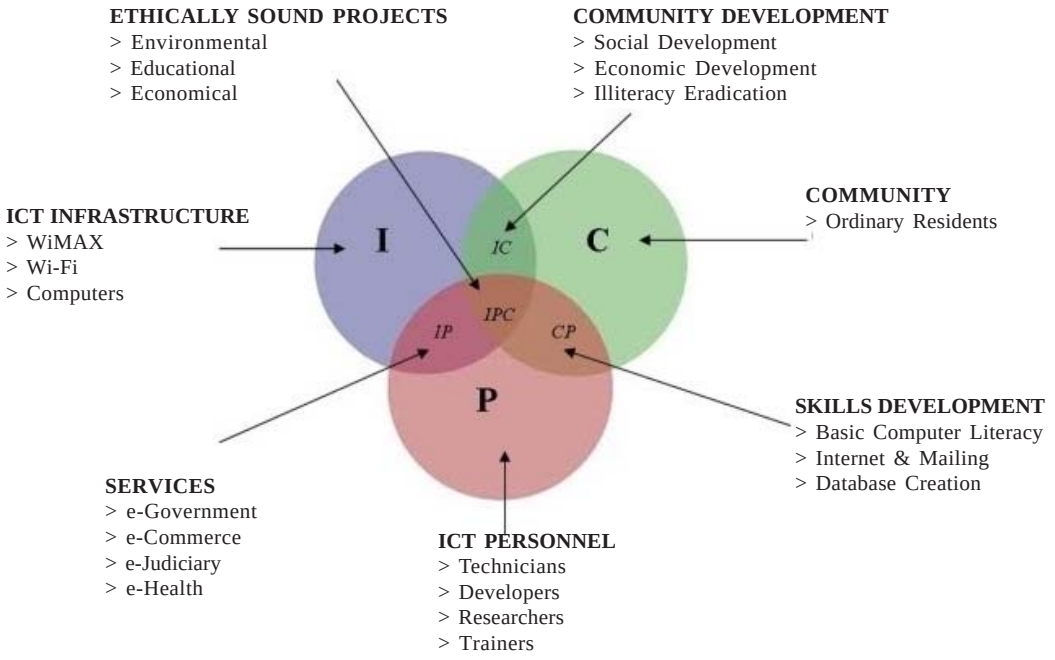

Fig. 1. Dwesa ICT4D Venn diagram
Source: Author

ents are also deployed in the computer labs. The ICT infrastructure to be sustained and implemented to its full capacity requires different types of personnel behind its full operationality.

The University of Fort Hare Telkom Centre of Excellence and Rhodes University provides all the necessary ICT personnel to the project. ICT infrastructure is vulnerable to all sorts of technical faults and these two Universities, from time to time, provide technicians whenever a need arises. To keep the project up-to-date and relevant to the ever advancing ICT world, both student researchers and professional researchers from the aforementioned Universities conduct research with the aim of ensuring that the projects responds to the needs of the communities. Moreover, systems, services and applications are developed from these two Universities to enhance the ICT capacity of the ICT4D project. These are developed with the intention of bringing urban based services from which they are marginalised to the palm of their hands and fingertips. As a result of this rationale, e-Service portals have been developed and deployed to the Dwesa network.

A shopping portal has been set up for the Dwesa community. The system, called the Dwesa Rewarding Program (DRP) enables customers buying online to get points for some of the activities carried out on the shopping portal known as the Dwesa e-Commerce portal. It also allows customers to negotiate and make offers whilst purchasing and get rewarded for buying online. The novelty of the system is in its flexibility and adaptability. One achievement of this system is the establishment of negotiation rules which allows fairness in rewarding customers. This should in turn lead to increased sales on the e-Commerce platform in marginalised areas and subsequently increased effectiveness of ICT4D for socio-economic development (Jere 2009). A research project on developing and implementing an e-Judiciary service was undertaken. The primary objective of this project was to develop a web application to support traditional justice administration in the Dwesa community. Due to the lack of a proper legal environment in this community, the e-Judiciary service acts as a portal for safe-keeping of judicial information. Such a system also serves as a platform for the administration of minor offences that are solved by the traditional courts. Furthermore, it provides a better working environment for traditional judicial leaders and eliminates the difficulty of accessing legal information by the rest of the community. Through the availability and use of the service, community members' understanding and knowledge of judiciary operations and services in their community is enhanced (Scott 2010).

A system aimed at curbing the realities of poor infrastructure and lack of proper health care facilities such as health clinics and hospitals in this community was developed to provide access to information within the domain of health. The availability of ICTs in a rural community can provide the community with a number of beneficial solutions to their problems as they maximise the potential of knowledge sharing and delivery. The knowledge acquired was then used in the development and implementation of a semantic web-based e-Health portal as part of the SLL project.

The e- Health portal shares and delivers western medical knowledge, traditional knowledge and indigenous knowledge to its users (Hlungulu 2010). Furthermore, a system aimed at bringing a collection of government services electronically to the rural public, making them more available and efficient, was also developed. Four software modules, based on open source standards, have been developed and integrated to form a single, dynamic web component. The e-Government functionality formulates a communication channel for the government to reach out to the most remote parts of South Africa such as Dwesa (Jakachira 2009). The RMAs are unsurprisingly and usually marginalised from the services provided by these electronic systems owing to their geographical location as these services tend to be centralised in urban areas.

Obviously, municipalities are administered in towns and cities. It is very rare, if it exists, to find a municipality managed in the RMAs more especially in South Africa. They are normally based in towns. Consequently, this makes urban areas to appeal to host several public service institutions such as municipal offices (government), hospitals, home affairs offices, shopping malls, police stations, and other social services. This societal setup forces all residents of that particular municipality to travel to town in order to access such services. Some of them stay as far as 60 kilometers and more from their towns and require public transport such as buses to travel to and from town whenever a need arises.

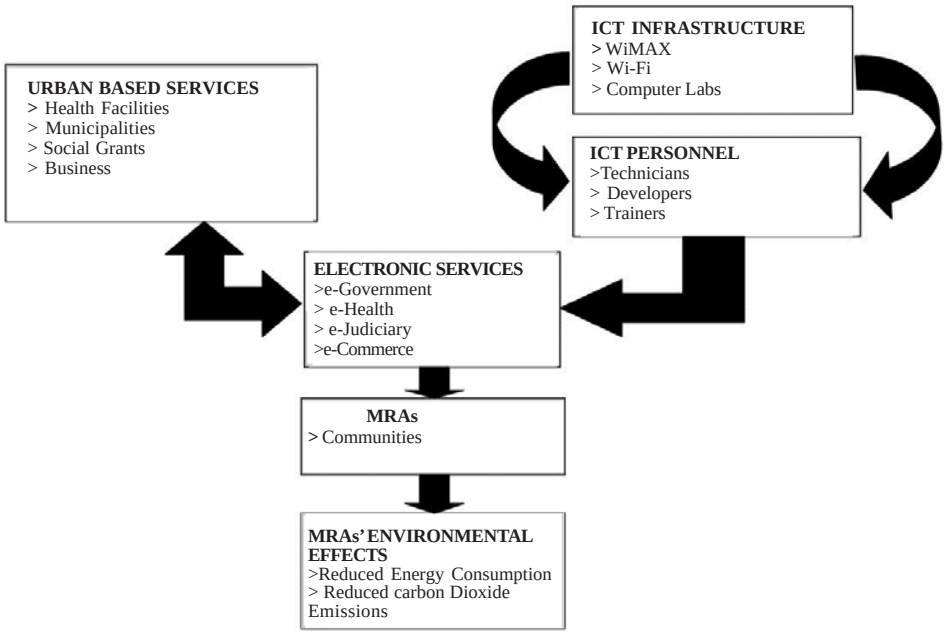

Fig. 2. A pragmatic ICT4D logical approach diagram
Source: Author

Figure 2, as presented under this section also depicts RMAs as a component of the broader pragmatic ICT4D approach to environmental ethically sound ICT4D implementation. The rationale behind the ICT infrastructure and personnel invested by the aforementioned Universities is two-fold. Firstly, the rationale is to develop the community using ICT. Secondly, to enable the community to contribute towards the socio-economic development of the country in which they live. The e-Services are developed to meet this twofold rationale. E-Services such as e-Health and e-Judiciary contribute to the development of the community whereas e-Services and systems such as e-Government and e-Commerce are meant to enable the community to fully participate and contribute to the broader local socio-economic development. The approach catapults the community to a position where it is ready to be developed and develop in return. In this digital age, to sensitise a community to science and technology in general is to conscientise such a community about itself, the surrounding communities and the role it should play for itself and its surrounding community.

Finally, Figure 2 under this section also depicts the RMAs' environmental effects as a final product of several building block factors of the society that are directly engineered by the communities. Such environmental effects include reduced energy consumption, reduced carbon dioxide emission and reduced e-Waste. These are subsequent environmental effects of an ICT4D approach that is implemented to uphold environmental ethics in RMAs.

The implication of this pragmatic ICT4D approach to environmental ethics for RMAs as depicted in Figure 2 is that the environmental effects are a result of an attitude to either embrace or oppose the environmental ethics accidentally or deliberately when implementing ICT4D. Such environmental effects can either be negative or positive depending on the attitude of the ICT personnel behind the ICT4D project. Furthermore, the implication is that communities can be influenced by the ICT personnel behind the rolling out of ICT4D in their communities. This then positions the ICT personnel as a crucial factor in the entire process of implementing ICT4D systems and services. It has been

the case with the Dwesa ICT4D project where ICT personnel has played a profound role in ensuring minimised community actions towards causing environmental damages. However, it becomes a process for the ICT personnel to get to achieve this analogy.

The process begins with identifying the appropriate technologies to create a local loop network for the RMAs. The appropriate technologies have to take into account factors such as the geographical location, the topography, and distance between DANs which in this case are the schools, power supply, and resource security. The geographical location of the RMAs should be considered such that the ICT4D intervention should have a profound impact on the socio-economic status of the inhabitants. This means that the intervention should be done to target the neediest community for it to have meaningful impact. Overlooking this factor would result in a waste of scarce but expensive resources. Furthermore, a consideration of the topography of the community remains critical for the implementation of some networks.

Technologies such as WiMAX requires what is referred to as Line-of-Sight (LOS) service. In WiMAX the concept of LOS service refers to a scenario wherein a signal travels over a direct and unobstructed path from the transmitter to the receiver. A LOS link requires that most of the first Fresnel zone is free of any obstruction. If this criterion is not met, then there is a significant reduction in signal strength. The Fresnel clearance required depends on the operating frequency and the distance between the transmitter and receiver locations (Crozier and Klein 2003). ICT personnel must consider the distance between DNAs as some technologies such as WiMAX provide large distances of coverage of up to a maximum of 50 kilometers under LOS conditions. This means, the distance between the DANs under LOS must not exceed the 50 kilometer distance. They must be located within a 50 kilometer range so as to ensure strong coverage.

Furthermore, power supply in RMAs is usually a pressing concern as the lack of access to electricity can be a challenge for ICT infrastructure in most communities. In such situations, the ICT personnel must consider solar power for rural based electrification. However, some RMAs do have access to electricity meaning the process of ICT4D project implementation can be quite smooth although back-up power supply such as Universal Power Supply (UPS) would be required to back up the network. Finally, the ICT personnel would not want to mobilise the entire ICT infrastructure just to expose them to acts of vandalism and theft. Therefore, they must also consider the security of the ICT infrastructure they intend to deploy. This then means the ICT personnel should be as diverse as possible to consider all the requirements and aspects of the project.

The project would definitely require personnel of different expertise ranging from technicians, researchers, developers to managers. Technicians prove to be crucial especially during the setup, implementation and maintenance of the project as they are the people with relative practical understanding of the theoretical principles. The advantage of implementing this project through Universities with ICT related fields is that the provisioning of ICT personnel such as technicians comes at a lower cost. The price is lower simply because the university produces the technicians internally and own-up to the technical aspect of the project. So is the case with the researchers, developers and managers. Postgraduate studies, ranging from honours to postdoctoral studies, produce the researchers and developers required.

The kind of research the postgraduates undertake can have a direct impact on the advancement of the project. Research areas can range from expansion of ICT infrastructure to provision of services of different kinds. Furthermore, developers can also develop web and mobile applications for the community to utilise. Relevant managers and administrators to ICT4D can also be appointed from within the university workforce. University workforce consists of qualified personnel holding masters and doctoral ICT related qualifications. These qualified personnel can facilitate and supervise research projects that can bridge the gap between urban and rural areas and provide access for RMAs to urban based services.

Urban areas remain critical for the development of both the urban and rural based people. However, the urban based people tend to develop faster as opposed to the rural based people because the degree of access to services based in urban areas varies. It is less costly for the urban based people to access services offered

by the municipalities, governmental institutions such as health, social grants and magistrates, amongst others because they are pretty closer to the institutions which offer such services. It is less costly for urban based people in a sense that they can only walk or travel relatively short distances. This makes it less costly not only to their pockets but broadly to the effects of their actions as they use less petrol or no petrol at all for this exercise. However, rural based people have no choice but to use more petrol to access such services. The institutions use more petrol or form of energy to deliver services to the RMAs' inhabitants because of the distance between them. In many RMAs, the roads connecting them to urban areas are usually rough gravel roads leading to the use of heavy vehicles for this purpose of service delivery. Such heavy vehicles are also heavy on fuel and emit large amounts of carbon dioxide. Therefore this increases the cost of accessing urban based services for RMAs. The cost is higher in a sense that the people of RMAs are compelled to pay more and there are also environmental effects. However, this trend can be mitigated or minimised through ICT4D intervention.

ICT4D intervention, as it is the case with the Dwesa ICT4D project, can help digitise certain services offered by the urban based institutions. People in the RMAs can still access the urban based services without the cost of travelling by sitting at home and use electronic applications and services. Services such as buying electricity, paying TV licenses, checking the availability of tablets and medicines at hospitals, booking a doctor, reporting of criminal activities and clarifications on the judicial system among other services can be electronically done and thus save the environment from carbon dioxide emissions. In turn, the people of RMAs can also provide their services electronically to their clients as it is the case with the Dwesa inhabitants for the developed e-Commerce portal.

Furthermore, ICT4D intervention in this form reduces pressure on the urban based institutions to increased energy consumption. The inhabitants of Dwesa tend to access and interact with services offered by urban based institutions electronically. This provides a substitute to an old scenario wherein the inhabitants would have to go to town in large numbers, raise demands to access specific services and thus increase energy consumption. Through the ICT4D intervention in Dwesa, the inhabitants can also use their personal communication devices to access urban based services electronically. This can lead them to adhere to environmental ethics and thus contribute towards preserving the environment for all species.

CONCLUSION

On the basis of the perspicacity of Dwesa ICT4D project analysed above, a conclusion is subsequently drawn based on analysis of Figures 1 and 2, presented under the previous section depicting the Dwesa ICT4D Venn Diagram and a pragmatic ICT4D logical approach diagram respectively. A pragmatic ICT4D approach to environmental ethics for RMAs as guiding principles towards preservation of the environment through ICT4D was implemented. The perspicacity of Dwesa community has led to an understanding that RMAs can positively contribute towards the preservation of the environment.

RECOMMENDATIONS

In the case of the Dwesa community, the coming together of the ICT infrastructure, ICT personnel and RMAs as central factors for ICT4D project implementation forms the basis for ICT to minimise its impact on the environment. Their coming together should produce systems and applications that substitute the systems that have already been proven to have contributed to environmental damage such as climate change. Furthermore, as depicted in Figure 2, where ICT personnel plays a very critical role in the process of ICT4D implementation in Dwesa; a conclusion is hereby drawn that ICT personnel must be mandated, as a matter of principle, with a task of ensuring two important aspects: (i) ICT personnel must identify the appropriate ICT infrastructure that can be sustained in RMAs. Such ICT infrastructure should be sustainable to ensure that its availability is prolonged and does not compel communities to revert back to old ways of doing things upon its unavailability. (ii) ICT, through electronic applications and services, should enable the RMAs to contribute towards the preservation of the environment. This should be realised irrespective of whether or not the RMAs will be brought to the understanding of their contribution in this regard. The implementation of local and envi-

ronmental-centered ICT-based services could positively contribute to the preservation of the environment. The more the RMAs' inhabitants use the e-Services provided to them as a link to urban based services, the more there is reduced energy consumption in urban based institutions that provide such services.

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