

**REENGINEERING SCIENTIFIC KNOWLEDGE SHARING WITH WEB 2.0:  
A CASE STUDY OF THE WORLD AGROFORESTRY CENTRE (ICRAF)**

**BY**

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Award of the Degree of Master of Science in Information Technology,  
School of Information Sciences**

**MOI UNIVERITY**

**ELDORET**

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## DECLARATION

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**DEDICATION**

I dedicate this work to my children Matthew, Mark, Paul and Debra. God's wisdom will lead them to study and show themselves approved.

## ABSTRACT

Despite the continuum of scientific knowledge generated by the World Agroforestry Centre for the public domain, there is evidence of the need for more innovative ways of accelerating the propagation of such knowledge to realize the organization's objectives. The purpose of this study was to investigate the extent of use of Web 2.0 tools by researchers and information and communication specialists at the World Agroforestry Centre (ICRAF) to accelerate the propagation of the Centre's scientific research. The overarching aim of this study was to assess the extent of use of Web 2.0 tools in accelerating the impact of scientific research at the World Agroforestry Centre (ICRAF) with a view to prototyping a multilingual Web portal (*Research 2.0 Portal*) featuring relevant Web 2.0 tools to accelerate and extend knowledge sharing to the various consumers of the World Agroforestry Centre's (ICRAF's) research. The specific study objectives were to determine the relevance of the various Web 2.0 tools for scientific knowledge sharing at the World Agroforestry Centre (ICRAF), to study the extent of use of Web 2.0 tools for knowledge sharing at the World Agroforestry Centre (ICRAF), to establish the challenges experienced by research scientists in the application and use of Web 2.0 tools and to prototype a web-based portal (*Research 2.0 Portal*) integrating relevant Web 2.0 tools to enhance knowledge sharing for the World Agroforestry Centre (ICRAF). The study was informed by the Social Network Analysis (SNA) or Organizational Network Analysis (ONA) theory. The research methodology entailed face-to-face interviews, participant observation, and a detailed analysis of online Web 2.0 tools. Purposive sampling was used to select respondents among the ICRAF researchers and Information and Communication Specialists and simple random sampling was used to sample the Web 2.0 tools. Data analysis was conducted using MS Excel to calculate percentages and generate analytical charts. A matrix evaluation of the features of existing Web 2.0 applications was done to determine the most suitable Web 2.0 applications for the World Agroforestry Centre's research. The output of the study is a prototype Web portal (*Research 2.0 Portal*) built on Drupal Content Management System on Microsoft ASP.NET 2.0 featuring relevant Web 2.0 tools to accelerate and extend knowledge sharing to the various consumers of the World Agroforestry Centre's scientific research. The Semantic Web (Web of Data) as an agent for research support using linked open data is suggested as an area for further research given the growing interest in making research data open access and shareable through Web services.

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It is my humble prayer that God will be gracious unto all who stood by me in the course of this project. God bless you all!

## CHAPTER ONE

### INTRODUCTION & BACKGROUND INFORMATION

#### 1.0 PREAMBLE

The term Web 2.0 was devised in 1999 to describe websites that use technology beyond the static pages of earlier web sites (O'Reilly, 2005). (Van der Vlist, 2007) describes Web 2.0 as the common trend behind most successful recent web applications in terms of innovative usage and integration of many different mature technologies and a means of finding new ways to make a number of existing technologies work together.

There is no single Web 2.0 technology since it is a combination of different technologies such as HTML, Cascading Style Sheets (CSS), JavaScript, XML, and server side programming (Bellinaso, 2006).

A comprehensive definition of Web 2.0 can be broken down into three components namely, the *Social layer*, the *Technical layer* and the *Architectural layer* of Web 2.0 (Van der Vlist, 2007).

The Social layer of Web 2.0 refers to the fact that the Web has now evolved to be collaborative and that content is created by users - making it a *Read/Write* web. The Technical layer of Web 2.0 refers to the technologies such as Ajax, CSS, ASP.NET, and Ruby on Rails, used to develop Web 2.0 applications whereas the Architectural layer refers to using the Web or Internet as a platform (Van der Vlist, 2007).

The following images illustrate some of the commonly used Web 2.0 applications available online:-



*Figure 1 - Illustration of Web 2.0 Tools*

*Source: (Internet images, 2010)*

The icons in Figure 1 (above) illustrate Web 2.0 tools. They represent *Twitter*, *Googleapps*, *MySpace*, *RSS feeds*, *Facebook*, *Digg*, *StumbleUpon*, *Delicious*, and *Youtube*.

### **1.1 WEB 2.0 IN SCIENTIFIC RESEARCH**

Due to their ease of implementation, Web 2.0 technologies are rapidly gaining popularity in scientific establishments to leverage scientific research. The capacity of Web 2.0 applications to reach out to a wide audience almost in realtime makes them particularly suitable for accelerating communication of scientific research globally (Waldrop, 2008).

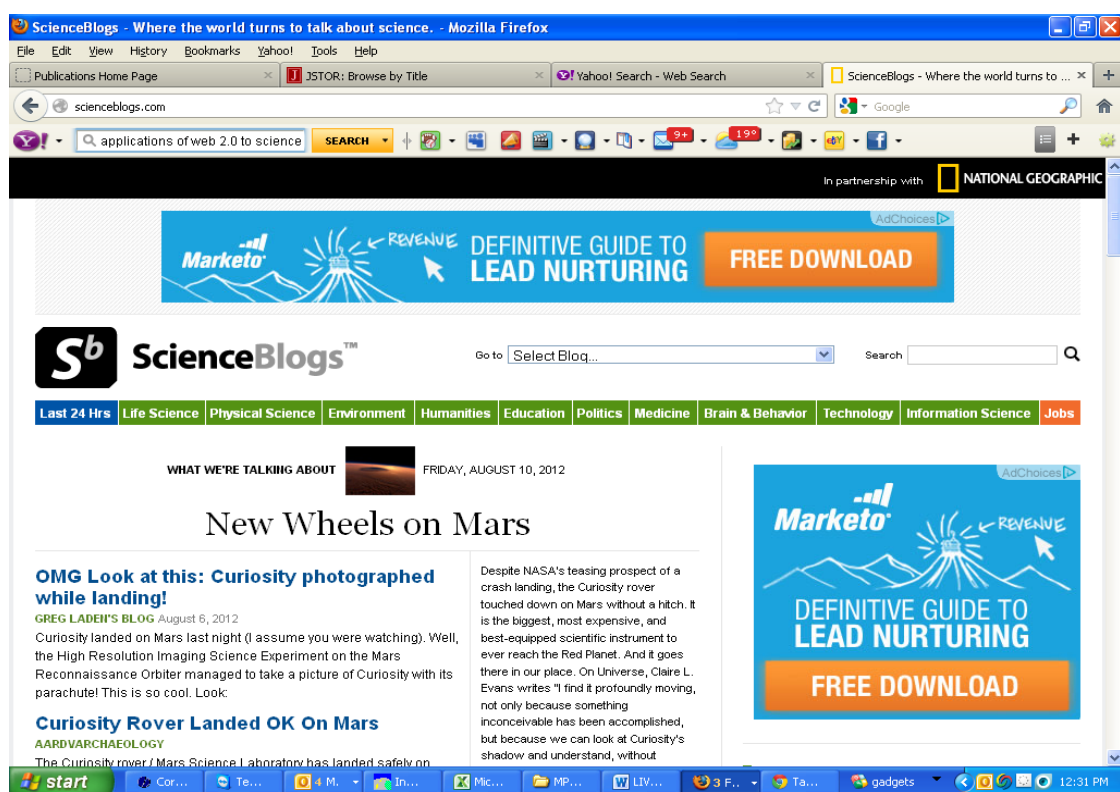
Examples of Web 2.0 applications in scientific research include the following:-



### 1.1.1 Medicine 2.0

Richard Smith in his Web article *"Medicine 2.0"* states that by providing a means of aggregating case histories on a vast scale, the Web can revolutionize diagnostic knowledge (Smith, 2008). This is an example of what *Science magazine*, the world's leading Science journal, has called Science 2.0 – *"using the networking power of the Internet to tackle problems with multiple interacting variables."*

### 1.1.2 Science Blogs



Source: (ScienceBlogs LLC, 2006)

Built on Web 2.0 technologies, Science Blogs is a portal for global dialogue, a digital science salon featuring the leading bloggers from a wide array of scientific disciplines. Science Blogs is currently the largest online community dedicated to Science. Science Blogs has content that cuts across the following disciplines (ScienceBlogs LLC, 2006):-

- Life Science
- Environment

- Physical Science
- Humanities
- Education
- Politics
- Medicine
- Brain & Behaviour
- Technology
- Information Science

Through ScienceBlogs bloggers can exercise their own editorial and creative instincts. Bloggers are selected based on their originality, insight, talent, and dedication and how they would contribute to the discussion at ScienceBlogs. ScienceBlogs aims at creating and continuing to improve discussion, and to ensure that the rich dialogue that takes place at ScienceBlogs resonates outside the blogosphere (ScienceBlogs LLC, 2006).

### **1.1.3 OpenWetWare**

OpenWetWare (OWW) is an effort to promote information sharing, know-how, and wisdom among researchers and groups who are working in Biology & Biological engineering. OWW, managed by the BioBricks Foundation, provides a place for labs, individuals, and groups to organize their own information and collaborate with others easily and efficiently. OWW ultimately aims at greater collaboration between member groups, while providing a useful information portal to the rest of the world (OpenWetWare, 2009).



*Figure 2 – Open Wetware*

*Source: (OpenWetWare, 2009)*

## 1.2 ORGANIZATIONAL BACKGROUND INFORMATION

The World Agroforestry Centre (ICRAF) headquarters in Nairobi, Kenya was established in 1978 as the focal point for regional hubs in six eco-regions namely, Eastern Africa, West and Central Africa, Southern Africa, South Asia, Southeast Asia, and Latin America (World Agroforestry Centre (ICRAF), 2008).

The World Agroforestry Centre is one of the fifteen centres supported by the Consultative Group on International Agricultural Research (CGIAR) which includes over fifty different government agencies, private foundations, international organizations and regional development banks (World Agroforestry Centre (ICRAF), 2008).

The Centre is guided by the broad developmental challenges pursued by the CGIAR, namely:-

- Poverty alleviation that entails enhanced food security and health
- Improved productivity with lower environmental and social costs, and
- Resilience in the face of climate change and other external shocks

### **1.2.1 Organizational Vision**

The World Agroforestry Centre's vision is a rural transformation in the developing world where smallholder households strategically increase their use of trees in agricultural landscapes to improve their food security, nutrition, income, health, shelter, energy resources and environmental stability (World Agroforestry Centre (ICRAF), 2008).

### **1.2.2 Organizational Mission**

The World Agroforestry Centre's mission is to generate science-based knowledge about the diverse roles that trees play in agricultural landscapes and to use its research to advance policies and practices to benefit the poor and the environment (World Agroforestry Centre (ICRAF), 2008).

### **1.2.3 Organizational Structure**

#### **1.2.3.1 Core Functions**

The World Agroforestry Centre's work is organized around six core scientific priorities known as the Global Research Priorities (GRPs) which form the means of organizing the centre's science and staff (World Agroforestry Centre (ICRAF), 2008).

The following are the Centre's six GRP's or Science Domains that address various themes relating to Agroforestry (World Agroforestry Centre (ICRAF), 2008):-

**GRP 1: Domestication, utilization and conservation of superior agroforestry germplasm**

This GRP aims at increasing farmers' access to improved germplasm of priority tree species and ensure better functioning of tree seed and seedling supply systems.

**GRP 2: Maximizing on-farm productivity of trees and Agroforestry systems**

This GRP aims at developing better understanding of and approaches for enhancing on-farm productivity through improved Agroforestry systems.

**GRP 3: Improving tree product marketing for smallholders**

This GRP focuses on expanding smallholders' access to value chains for agroforestry tree products and improving their incomes and livelihoods through better marketing.

**GRP 4: Reducing risks to land health and targeting agroforestry interventions to enhance land productivity**

This GRP's aims at:-

- Developing methods of land health surveillance that provide information on where land problems exist and where the major risks are
- Quantifying and mapping major risks to land health in the tropics, target land management and agroforestry interventions to reduce and reverse these risks at different scales, and evaluate the cost-effectiveness and outcomes of intervention programmes
- Developing national capacity to use the methods and tools in land health surveillance.

**GRP 5: Improving the ability of farmers, ecosystems and governments to cope with climate change**

- GRP5 aims at improving the stability of farming systems and livelihood strategies of smallholder farmers in the face of current climate variability and long-term climate change.

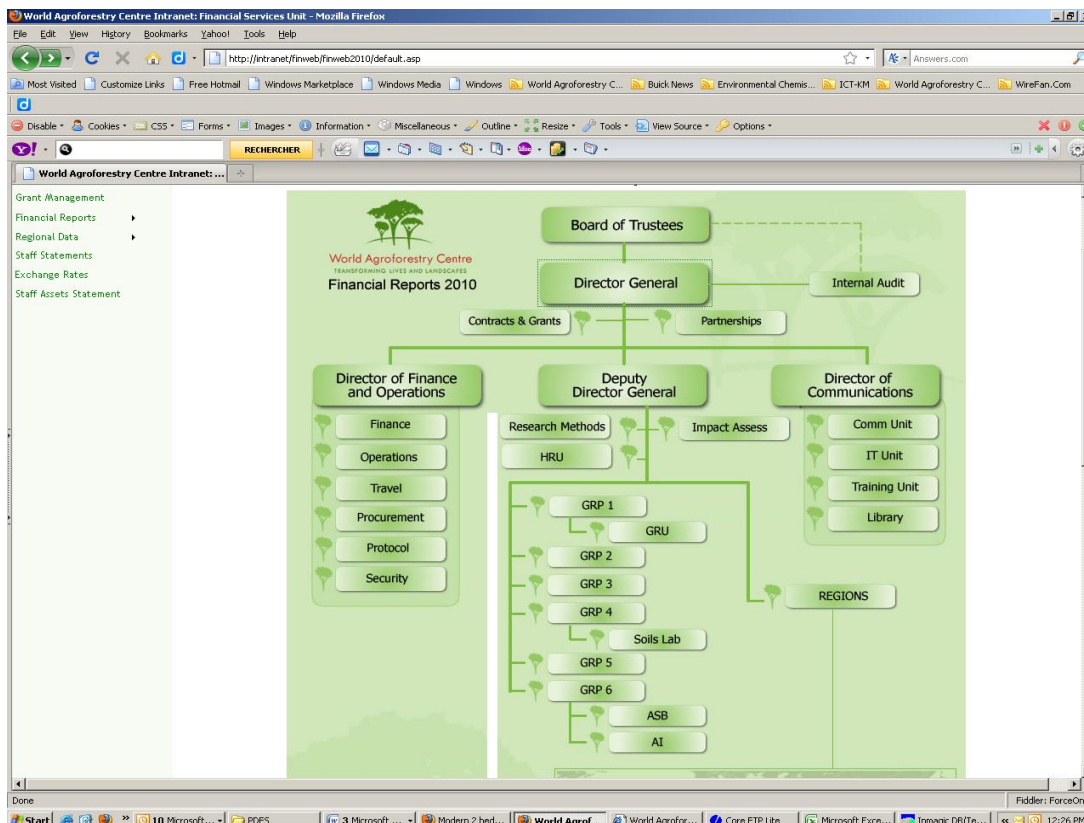
**GRP 6: Developing policies and incentives for multifunctional landscapes with trees that provide environmental services**

- This GRP's focus is to help formulate better policies and incentives for maintaining the multifunctionality of landscapes with trees

**1.2.3.2 Support Functions**

The above core organizational functions in the six regional offices benefit from the following support services:-

- |                               |                            |
|-------------------------------|----------------------------|
| i. Human Resources Unit (HRU) | vii. ICT Unit              |
| ii. Internal Audit            | viii. Operations Unit      |
| iii. Training Unit            | ix. Travel Unit            |
| iv. Contracts and Grants      | x. Financial Services Unit |
| v. Partnerships Directorate   | xi. Procurement            |
| vi. Communications Unit       | xii. Protocol              |
|                               | xiii. Security             |



**Figure 3 – World Agroforestry Centre Organizational Structure**

*Source: (World Agroforestry Centre (ICRAF), 2008)*

### 1.2.3.3 Organizational strategy

The World Agroforestry Centre (ICRAF) emphasizes four key areas in executing its strategy (World Agroforestry Centre (ICRAF), 2008):-

- ***Accelerating the use and impact of its research***

Using a knowledge-to-action framework, the Centre strengthens its efforts to produce research outputs that target specific users. This means that the organization's decisions are informed by quality of research conducted by its scientists.

- ***Enhancing science quality***

Through developing a set of principles and criteria ensuring quality science at various stages of the research process, starting with articulation of problems, engaging in the research process (mechanism), and finally achieving outcomes or impacts.

- ***Strengthening partnerships through:***

Placing greater emphasis on partnerships to enhance the extent and quality of engagement with diverse partners in both the developed world and the developing world and implementing a substantive part of its research agenda with partners, using mechanisms to reinforce synergy and complementarity to achieve desired outcomes.

- ***Enhancing operational efficiency through:***

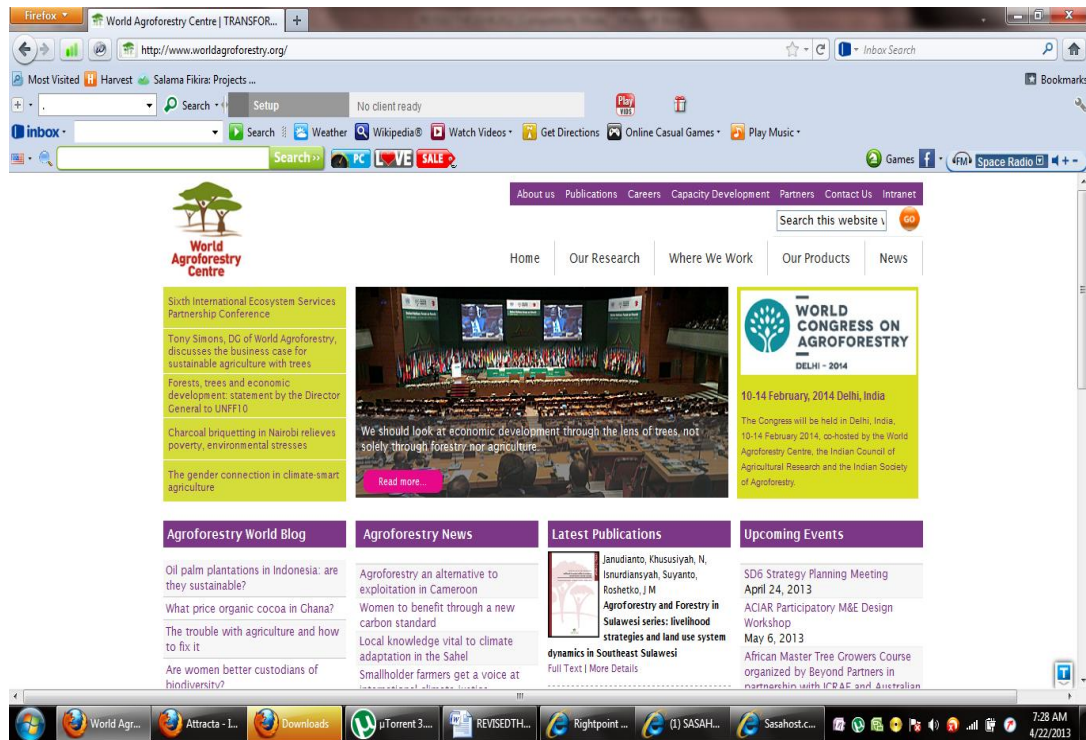
Investment in systems that enhance management operations, human resources, communications, monitoring and evaluation, resource mobilization, and risk management to ensure that all policies and procedures are consistent with the strategy.

### **1.3 ICT APPLICATIONS AT THE WORLD AGROFORESTRY CENTRE (ICRAF)**

This study is not an attempt at overhauling the current systems at the World Agroforestry Centre. It is an exploration of the potential of Web 2.0 tools to accelerate the propagation of the World Agroforestry Centre's science.



Figure 5 (below) is a snapshot of the World Agroforestry Centre's website followed by an outline of the main areas where ICT applications have impacted the World Agroforestry Centre.



**Figure 4 – The World Agroforestry Centre (ICRAF) Website**

*Source: (World Agroforestry Centre (ICRAF), 2010)*

### 1.3.1 Internal ICT Applications

The World Agroforestry Centre employs the Intranet built on Drupal Content Management System, and e-mail for internal communication and knowledge sharing.

The following corporate applications are implemented on the intranet:-

- Finance and Payroll System
- HR Leave application
- Library systems

- Travel System
- Procurement System
- ICT Helpdesk
- Image Database
- MS Outlook

Information on various projects undertaken by the organization's GRPs is also accessible to the regional staff through the intranet.



*Figure 5 - (World Agroforestry Centre (ICRAF), 2008)*

### 1.3.2 External ICT Applications

The World Agroforestry Centre uses the Internet and e-mail for external communication and knowledge sharing.

Through the institutional website the following resources can be accessed:-

- GRP Project information
- World Agroforestry partners
- Library Catalogue
- **Agroforestry Databases**

These are online databases with information relating to Agroforestry namely:-

- Species reference and selection guide for agroforestry trees
  - Seed suppliers directory
  - Botanic nomenclature and
  - Image database

- **Online Journals**

The World Agroforestry Centre facilitates access to online journals to scientists through subscription to EZproxy service. The EZproxy service is a web proxy server used by libraries to give access from outside the library's computer network to restricted-access websites that authenticate users by IP address. This allows library patrons at home or elsewhere to log in through their library's EZproxy server and gain access to bibliographic databases to which their library subscribes.

- **E-newsletter**

The World Agroforestry Centre has an electronic newsletter (*Transformations Bi-Weekly*) - for updating the staff on the latest institutional developments.

The newsletter is accessible online by registration and is for online knowledge sharing with ICRAF's multiple external stakeholders.

In its strategy document, The World Agroforestry Centre recognizes the potential of ICTs to positively contribute to its objectives (World Agroforestry Centre (ICRAF), 2008).

This study explores the Web 2.0 landscape to determine the extent to which ICRAF can benefit from integrating Web 2.0 tools to disseminate its science thereby enhancing the achievement of its four strategic objectives (World Agroforestry Centre (ICRAF), 2008) namely:-

- *Operational Goal 1: Increasing Enhancing science quality*
- *Operational Goal 2: Increasing operational efficiency*
- *Operational Goal 3: Building and maintaining strong partnerships, and*
- *Operational Goal 4: Accelerating the use and impact of our research*
- *Operational Goal 5: Greater cohesion, interdependence and alignment*

#### **1.4 STATEMENT OF THE PROBLEM**






The need for innovative propagation of scientific knowledge can be seen through efforts by International Development and Research Organizations to promote the use of Web 2.0 tools for scientific research. Examples include the ICT / Knowledge Management initiative by the Consultative Group on International Agriculture (CGIAR) and the Food and Agriculture Organization of the United Nations (FAO), and efforts by the International Association of Agricultural Information Specialists

(IAALD) to organize global workshops on Knowledge Sharing with Web 2.0 (ICT-KM Program of the CGIAR, 2004).

Despite the wealth of scientific knowledge generated by the World Agroforestry Centre into the public domain, there is evidence of the need for more innovative ways of accelerating the propagation of such knowledge to realize the organization's objectives. The World Agroforestry Centre's Strategy 2008-2015 clearly supports this concern (World Agroforestry Centre (ICRAF), 2008).

An exploration of the Web 2.0 landscape reveals some Web 2.0 tools with a high bias towards scientific research, making it necessary to expose researchers to such relevant tools so as to broaden the scope of targeted consumers of the World Agroforestry Centre's research in order to accelerate dissemination of Agroforestry research in line with one of the organization's strategic objectives.

Currently the World Agroforestry Centre's application of Web 2.0 tools to facilitate knowledge transfer is limited to the following tools: -

- Facebook 
- Twitter 
- Slideshare 
- Flickr 
- Youtube 

- Institutional blog

The adoption of relevant Web 2.0 tools by the World Agroforestry Centre (ICRAF) would highly benefit the organization in terms of rapid knowledge sharing due to the immense network effects of Web 2.0 tools. Absence of this solution will result in more time to reach out to various targeted knowledge consumers and less capacity for collaboration with interested external users.

## **1.5 AIM OF THE STUDY**

The aim of this study was to assess the extent of use of Web 2.0 tools in accelerating the impact of scientific research at the World Agroforestry Centre (ICRAF) with a view to prototyping a multilingual Web portal (Research 2.0 Portal) featuring relevant Web 2.0 tools to accelerate and extend knowledge sharing to the various consumers of the World Agroforestry Centre's scientific research.

### **1.5.1 Specific Objectives of the Study**

The specific objectives of this study are as follows:-

1. To determine the relevance of the various Web 2.0 tools for scientific knowledge sharing at the World Agroforestry Centre.
2. To study the extent of use of Web 2.0 tools for knowledge sharing at the World Agroforestry Centre.
3. To establish the challenges experienced by research scientists in the application and use of Web 2.0 tools.

4. To prototype a web-based portal (Research 2.0 Portal) integrating relevant Web 2.0 tools to enhance knowledge sharing for ICRAF.

## **1.6 RESEARCH QUESTIONS**

The research for this study shall be informed by responses to the following general questions:-

1. What are the main features of Web 2.0 tools useful to Agroforestry Research? Who are the consumers of the World Agroforestry Centre's research?
2. How is scientific knowledge or information transmitted within and outside the World Agroforestry Centre?
3. Are the current Web 2.0 tools adequate and relevant for Agroforestry Research? What tools are used for scientific knowledge and information sharing?
4. What are the challenges experienced by ICRAF staff in the application of Web 2.0 tools to their research?
5. How can Web 2.0 technologies be implemented to accelerate the propagation of World Agroforestry Centre's (ICRAF's) scientific research?

## **1.7 STUDY ASSUMPTIONS**

1. The study assumes that adoption of appropriate Web 2.0 technologies will contribute to improved propagation of the World Agroforestry Centre's scientific research.

2. The study further assumes that given their professional background, Information and Communication Specialists are the right professionals to create an awareness of the applications of new ICT tools such as Web 2.0 tools at the World Agroforestry Centre.

## **1.8 SIGNIFICANCE OF THE STUDY**

The main motives behind this study are as follows:-

1. The world's state of advancement has been influenced by breakthroughs in scientific research. In theory, this study is expected to contribute positively to scientific research by recommending relevant means of improving the sharing of scientific information.
2. Web 2.0 applications are rapidly gaining popularity in many spheres. Hence, in theory it is worth investigating how these tools can be employed in scientific research constructively.
3. Practically, the study will contribute to an improvement in the use of Web 2.0 tools in sharing scientific research at the World Agroforestry Centre by researchers.
4. In terms of policy implications, it is envisaged that the results of the study can be replicated in other research establishments.



## **1.9 SCOPE AND LIMITATIONS OF THE STUDY**

### **1.9.1 Scope of the Study**

The study investigates the extent of usage of and features of Web 2.0 tools to determine their relevance to the World Agroforestry Centre (ICRAF) in order to prototype a Web 2.0 Portal integrating relevant Web 2.0 tools.

### **1.9.2 Study Limitations**

“Every ten years or so a new technology arrives that changes the way we think about application development” (Liberty, 2005). This observation clearly indicates that technology is highly dynamic and the technologies under investigation in this study can be rendered obsolete by more superior tools within a short period. This implies that there has to be constant monitoring of the Web 2.0 landscape to see if any obsolete tools can be dropped or new ones adopted.

Browser upgrades and Web 2.0 development technologies are likely to affect the relevance of existing Web 2.0 tools.

## **1.10 CHAPTER SUMMARY**

This chapter looked at the organizational context of the World Agroforestry Centre in terms of its core business, and the prevailing role of ICT in meeting the institutional strategic objectives. It is clear that despite the use of ICT in the organization, there is need to leverage the strategic objective of accelerating the impact of the organization’s scientific research. One of the best means of achieving this objective is through networking which can be achieved through Web 2.0 technologies. The

following chapter looks at some pertinent literature and the theoretical framework relating to the means of achieving this objective.

## **1.11 DEFINITION OF TERMS**

### **Ajax**

Short form of Asynchronous JavaScript and XML, Ajax is a group of interrelated web development techniques used on the client-side to create interactive web applications or rich Internet applications, and retrieve data from a server asynchronously in the background without interfering with the display and behavior of the existing web page. All Web 2.0 tools are based on this design principle.

### **Agroforestry 2.0**

Agroforestry 2.0 refers to the collection of online web 2.0 tools relevant to Agroforestry research and which are developed using AJAX or Web 2.0 techniques.

### **ASP.NET 2.0**

A Web application framework developed and marketed by Microsoft to allow programmers to build dynamic Web sites, Web applications and Web services and is the successor to Microsoft's Active Server Pages (ASP) technology. ASP.NET is built on the Common Language Runtime (CLR), allowing programmers to write ASP.NET code using any supported .NET language e.g. C# (C Sharp) and Visual Basic.

**Web content syndication**

Web content *syndication* refers to making web feeds available from a site in order to provide other people with a summary or update of the website's recently added content (for example, the latest news or forum posts).

**Folksonomy**

A folksonomy is the result of personal free tagging of information and objects (anything with a URL) for one's own retrieval. The tagging is done in a social environment (shared and open to others). The value in this external tagging is derived from people using their own vocabulary and adding explicit meaning, which may come from inferred understanding of the information or object.

**Knowledge sharing**

The activity through which knowledge (information, skills, or expertise) is exchanged among people (friends, or members of a family), a community or an organization

**Technophobia**

The fear or dislike of advanced technology or complex devices, especially computers

**Research 2.0 Portal**

A multilingual Web 2.0 portal integrating relevant Web 2.0 tools and methods to accelerate propagation of scientific research

**Social Network Analysis (SNA)**

Also known as Organizational Network Analysis (ONA) and is the mapping and measuring of relationships and flows between people, groups, organizations, computers, web sites, and other information or knowledge processing entities.

**Web 2.0**

Web 2.0 describes the changing trends in the use of the World Wide Web technology and web design that aim to enhance creativity, communications, secure information sharing, collaboration and functionality of the web.

**Web Portal**

A web site that brings together information from diverse sources in a unified way; usually each information source gets its dedicated area (a portlet) on the page for displaying information.

**Widget**

A small application with limited functionality that can be installed and executed within a web page by an end user. It just occupies a portion of a webpage and does something useful with information fetched from other websites and displayed in place. Other terms used to describe web widgets include: portlet, web part, gadget, badge, module, snippet and flake.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.0 INTRODUCTION**

This chapter provides an extensive review of literature on the study's theoretical framework as well as on Web 2.0 technologies. The theoretical framework (SNA) and examples of its applications are explained in detail including some empirical studies relating to the theory, culminating with a demonstration of how the theory applies to the World Agroforestry Centre (ICRAF)'s case. The subject of Web 2.0 is also elaborated by first giving a historical perspective, then exploring its technical aspects which include the four levels of Web 2.0 tools, features of Web 2.0 tools, and Web 2.0 application development technologies and finally additional applications of Web 2.0 tools.

#### **2.1 THEORETICAL FRAMEWORK**

##### **2.1.1 Social Network Analysis (SNA)**

This study is based on the theory of Social Network Analysis (SNA) or Organizational Network Analysis (ONA) as used by Management consultants in relation to their business clients. SNA is the mapping and measuring of relationships and flows between people (such as World Agroforestry Centre staff), groups (such as the World Agroforestry Centre's global research priorities), organizations (such as the World Agroforestry Centre's partners), computers (such as those on the ICRAF intranet), web sites, and other information or knowledge processing entities (Krebs, 2006)

The *nodes* in the network are the people and groups while the *links* show relationships or flows between the nodes. SNA provides a visual analysis of human relationships. There can be many kinds of ties between the nodes (Krebs, 2006).

In its simplest form, a social network is a map of all the relevant ties between the nodes being studied. The network can also be used to determine the social capital – the value that an individual gets from the social network. These concepts are often displayed in a social network diagram, where nodes are the points and ties are the lines (Bell, 2007). Figure 7 is a sketch of the World Agroforestry Centre's Social Network Map.

Social network analysis has emerged as a key technique in modern sociology, anthropology, sociolinguistics, geography, social psychology, communication studies, information science, organizational studies, economics, and biology as well as a popular topic of speculation and study (BBC News, 2012).

### **2.1.2 SNA Attributes**

Social network analysis is an analytic approach to a paradigm, with its own theoretical statements, methods, social network analysis software, and researchers. Analysts reason from whole to part; from structure to relation to individual; from behavior to attitude. They either study *whole networks* (also known as *complete networks*), all of the ties containing specified relations in a defined population, or *personal networks*, also known as *egocentric networks* or the ties that specified people have, such as their "personal communities" (Passmore, 2004).

The shape of a social network helps determine a network's usefulness to its individuals. Smaller, tighter networks can be less useful to their members than networks with lots of loose connections (weak ties) to individuals outside the main network. More open networks, with many weak ties and social connections, are more likely to introduce new ideas and opportunities to their members than closed networks with many redundant ties. In other words, a group of friends who only do things with each other already share the same knowledge and opportunities (Passmore, 2004).

A group of individuals with connections to other social worlds is likely to have access to a wider range of information. It is better for individual success to have connections to a variety of networks rather than many connections within a single network. Similarly, individuals can exercise influence or act as brokers within their social networks by bridging two networks that are not directly linked – this is called filling structural holes (Scott, 1991).

The power of social network analysis stems from its difference from traditional social scientific studies, which assume that it is the attributes of individual actors—whether they are friendly or unfriendly, smart or dumb, etc.—that matter. Social network analysis produces an alternate view, where the attributes of individuals are less important than their relationships and ties with other actors within the network. This approach has turned out to be useful for explaining many real-world phenomena, but leaves less room for individual agency, the ability for individuals to influence their success, because so much of it rests within the structure of their network (Passmore, 2004).

### **2.1.3 Applications of Sna**

#### **2.1.3a Corporate Interactions**

Social networks have been used to examine how organizations interact with each other, characterizing the many informal connections that link executives together, as well as associations and connections between individual employees at different organizations. For example, power within organizations often comes more from the degree to which an individual within a network is at the center of many relationships than actual job title. Social networks also play a key role in hiring, in business success, and in job performance. Networks provide ways for companies to gather information, deter competition, and collude in setting prices or policies (Podolny, 1997).

#### **2.1.3b Public Health**

Social network analysis has also been used in epidemiology to help understand how patterns of human contact aid or inhibit the spread of diseases such as HIV in a population (Passmore, 2004).

#### **2.1.3c Security / Mass Surveillance**

SNA may also be an effective tool for mass surveillance - for example the Total Information Awareness (TIA) program also known as Terrorism Information Awareness program which was terminated in the year 2003, was a massive data-mining project on strategies to analyze social networks to determine whether or not U.S. citizens were political threats. Hence, in today's world SNA can be a useful tool in combating terrorism (Mack, 2002).



### **2.1.3d Research & Innovation**

Diffusion of innovations theory explores social networks and their role in influencing the spread of new ideas and practices. Change agents and opinion leaders often play major roles in spurring the adoption of innovations, although factors inherent to the innovations also play a role (Passmore, 2004).

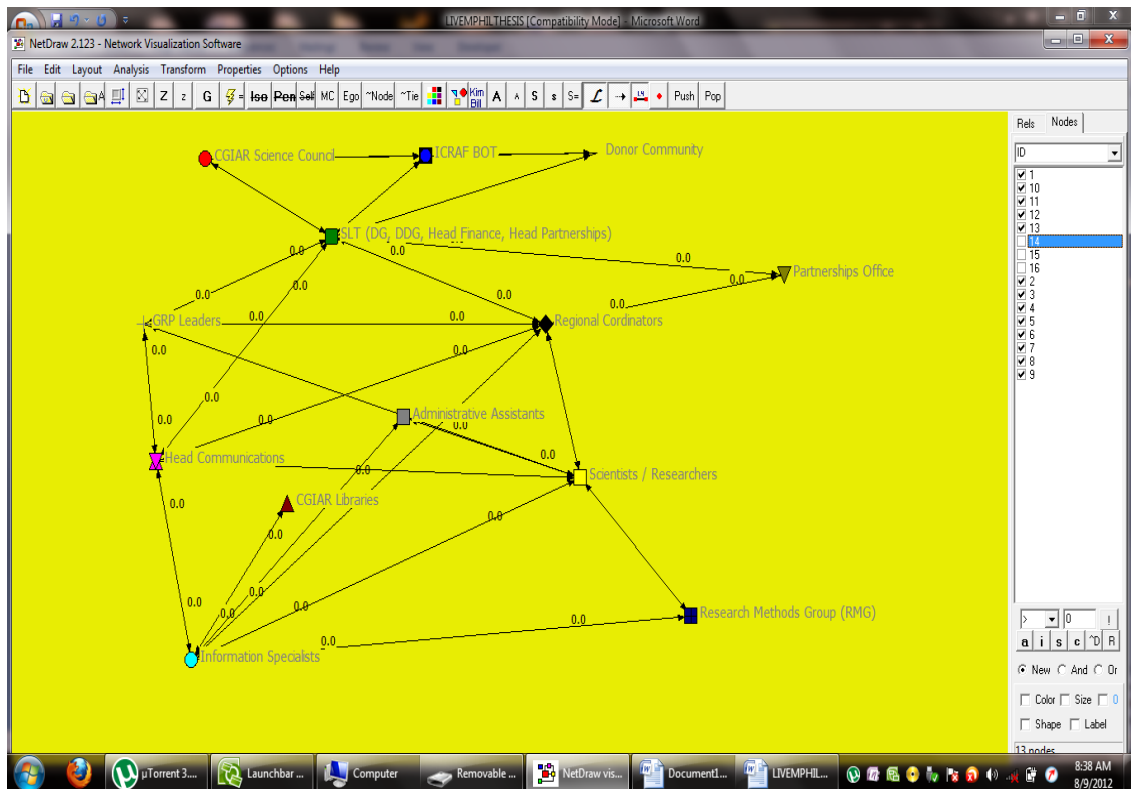
### **2.1.3e Guanxi**

*Guanxi* (pronounced as *gwan-shee*) is a central concept in Chinese society (and other East Asian cultures) that can be summarized as the use of personal influence in social networks. Chinese businesses typically do not begin a relationship with someone they do not know. If one business party has *guanxi* with another there is reciprocation of social exchanges and favours. Gifts are used to maintain the balance in or to strengthen the relationship. Businesses entering the Chinese market are generally advised to go with a local partner in order to succeed (Wellman, 2002). While on the one hand this approach to networking has advantages in terms of the business gains it affords, it may on the other hand easily be perceived as an act of corruption on the part of the interested parties.

### **2.1.4 Social Network Mapping**

Network analytic software is used to represent the nodes (agents) and edges (relationships) in a network, and to analyze the network data. Network analysis tools allow researchers to investigate large networks like the Internet, disease transmission, etc. These tools provide mathematical functions that can be applied to the network model (Passmore, 2004).

Visual representation of social networks is important to understand the network data and convey the result of the analysis. Network analysis tools are used to change the layout, colors, size and advanced properties of the network representation.



**Figure 6 - Social Network Map Of The World Agroforestry Centre Generated Using Netdraw SNA Tool**

## 2.1.5 Empirical Studies on SNA

### 2.1.5a Dunbar's Number

Robin Dunbar (Professor of evolutionary anthropology at Oxford University) suggested that the typical size of a social network is constrained to about 150 members due to possible limits in the capacity of the human communication channel.

The rule arises from cross-cultural studies in sociology and especially anthropology of the maximum size of a village (*ecovillage*) (Passmore, 2004).

It is theorized in evolutionary psychology that the number may be some kind of limit of average human ability to recognize members and track emotional facts about all members of a group. This number may, however be due to the need to economize on relations or the need to sideline the useless entities or "free riders" in the network, since it is easy in large groups to take advantage of the benefits of living in a community without contributing to those benefits.

#### **2.1.5b Granovetter's Study (Strength of Weak Ties)**

Mark Granovetter (1973) found that more numerous weak ties can be important in seeking information and innovation. Cliques have a tendency to more homogeneous opinions as well as sharing many common traits. This homophilic tendency was the reason for the members of the cliques to be attracted together in the first place. However, being similar, each member of the clique would also know more or less what the other members knew. To find new information or insights, members of the clique will have to look beyond the clique to its other friends and acquaintances. This is what Granovetter called the "the strength of weak ties". Clearly, it is from Granovetter's study on the "*strength of weak ties*" that the power of modern day Web 2.0 tools is drawn (Granovetter, 1973).

#### **2.1.5c Milgram's Experiment: The Small World Phenomenon**

The small world phenomenon is the hypothesis that the chain of social acquaintances required to connect one arbitrary person to another arbitrary person anywhere in the world is generally short. The concept gave rise to the famous phrase "*six degrees of*

*separation*” after a 1967 *small world experiment* by psychologist Stanley Milgram (Kleinfield, 2002).

In Milgram's experiment, a sample of US individuals were asked to reach a particular target person by passing a message along a chain of acquaintances. The average length of successful chains turned out to be about five intermediaries or six separation steps. The method (and ethics as well) of Milgram's experiment was later questioned by an American scholar, and some further research to replicate Milgram's findings had found that the degrees of connection needed could be higher.

Academic researchers continue to explore this phenomenon as Internet-based communication technology has supplemented the phone and postal systems available during the times of Milgram. An electronic *small world* experiment at Columbia University found that about *five to seven degrees of separation* are sufficient for connecting any two people through e-mail (Watts, 2003).

## **2.1.6 Application of the Sna Theory to the World Agroforestry Centre’s Case**

### **2.1.6a Mapping the Relevant Ties**

NetDraw Social Network Analysis software was used to generate a social network map of the World Agroforestry Centre as shown in Figure 7. The nodes represent the various entities within ICRAF and the ties are the relations between the nodes.

### **2.1.6b Combining Gemeinschaft and Gesellschaft Principles**

Using Ferdinand Tönnies’ principle in section 2.1.2, ICRAF can be viewed as a hybrid organization where social groups can exist as personal and direct social ties

that either link individuals who share values and beliefs (*gemeinschaft*) or communities, or impersonal (formal) social links (*gesellschaft*) or companies.

#### **2.1.6c Strength of Weak Ties**

Since Mark Granovetter's study shows that more numerous weak ties can be important in seeking information and innovation and cliques have a tendency to more homogeneous opinions as well as sharing many common traits, the SNA theory as expounded by Granovetter (Granovetter, 1973) finds application for World Agroforestry Centre's case.

#### **2.1.6d Filling Structural Holes**

According to Scott (Scott, 1991), individuals can exercise influence or act as brokers within their social networks by bridging two networks that are not directly linked – a phenomenon called filling structural holes.

## **2.2 THE WEB 2.0 PARADIGM**

Web 2.0 describes the changing trends in the use of the World Wide Web technology and Web design that aim to enhance the following aspects (O'Reilly, 2005):-

- Creativity
- Communications
- Secure information sharing
- Collaboration and
- Functionality of the Web.

The subject of Web 2.0 is worth investigating considering that about a decade ago the Internet had 9.5 million websites and 150 million people online. E-mail was a relatively new phenomenon, but now there has been a rapid adoption of a new

technology because not only is everyone using e-mail, instant chat, Facebook, Flickr, and Twitter, but over 1.6 billion people now engage with over 1 trillion unique URLs on the web (Quantcast, 2010) and the figures are on the rise.

## 2.2.1 Historical Perspective of Web 2.0

According to the *Google* search engine's graphical analysis, the concept of Web 2.0 started picking up in the 1980s and has grown rapidly with a lot of research interest from the year 2004 to date (Timetoast, 2010). Figure 8 below (from Google Timeline) is an illustration of the global Web 2.0 research trends.

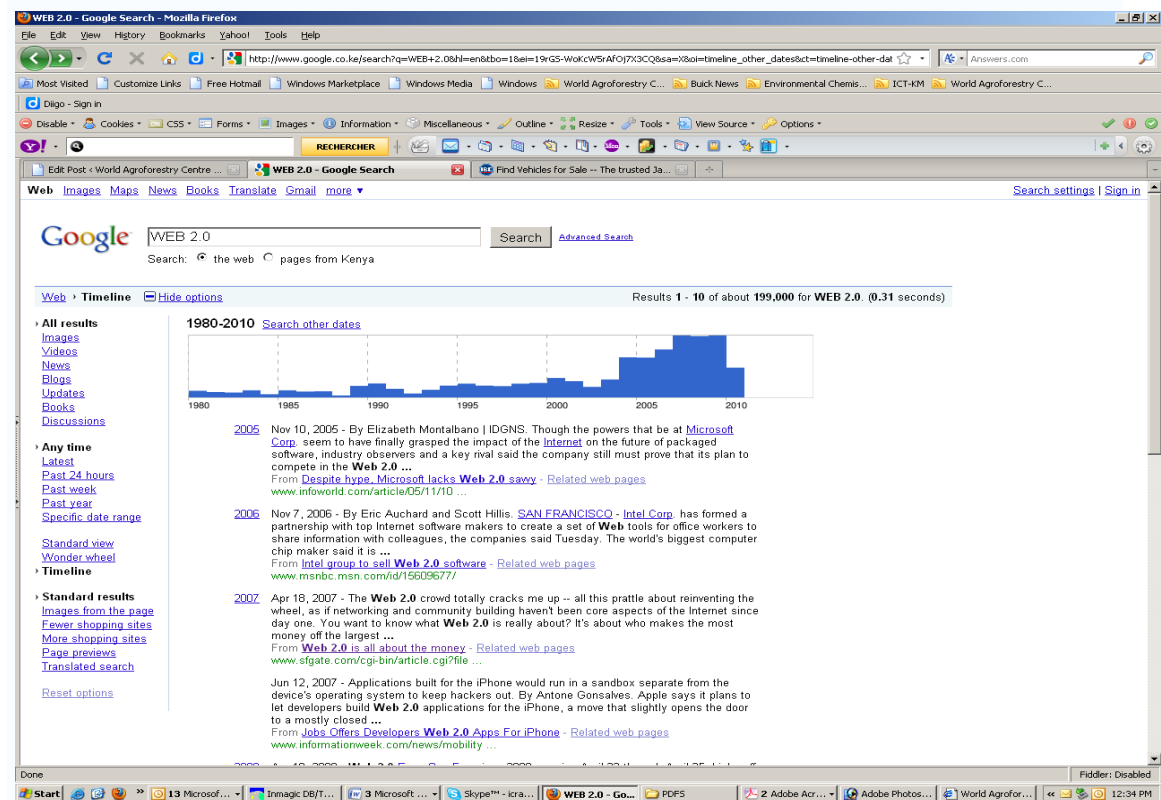


Figure 7 - (Google Timeline of Web 2.0 Research Trends, 2009)

Web 2.0 concepts have led to the development and evolution of web culture communities and hosted services, such as social-networking sites, video sharing sites, wikis, blogs, and folksonomies (Graham, 2005).

The term Web 2.0 first became notable after the O'Reilly Media Web 2.0 Conference held at San Francisco, USA, in October 2004. Although the term suggests a new version of the World Wide Web, it does not refer to an update to any technical specifications, but to changes in *the ways* software developers and end-users *utilize* the Web (DiNucci, 1999).

Tim O'Reilly, a Web 2.0 authority notes that “*Web 2.0 is the business revolution in the computer industry caused by the move to the Internet as a platform, and an attempt to understand the rules for success on that new platform.*” He regards Web 2.0 as the way that business embraces the strengths of the web and uses it as a platform (O'Reilly, 2005).

Tim Berners-Lee, inventor of the World Wide Web, has questioned whether one can use the term in any meaningful way, since many of the technological components of Web 2.0 have existed since the early days of the Web. An example is the HTTP protocol which is widely used for information transfer across the World Wide Web.

During the first Web 2.0 conference, O'Reilly and John Battelle summarized the themes of Web 2.0. They argued that the web had become a platform, with software above the level of a single device, and with data as a driving force. According to O'Reilly and Battelle, *architecture of participation* where users can contribute website content creates network effects (O'Reilly, 2005).

O'Reilly summarizes Web 2.0 tools into four categories which he refers to as the four levels in the hierarchy of Web 2.0 sites (O'Reilly, 2005):

## **2.2.2 The Four Levels of Web 2.0 Hierarchy**

### **2.2.2.1 Level-3 Applications**

These are the most Web 2.0 - oriented, and exist only on the Internet, deriving their effectiveness from the inter-human connections and from the network effects that Web 2.0 makes possible and grow in effectiveness in proportion as people make more use of them. O'Reilly gives the following as examples (O'Reilly, 2005):

- eBay
- Craigslist
- Wikipedia
- delicious
- Skype
- dodgeball, and
- AdSense

### **2.2.2.2 Level-2 Applications**

These can operate offline but gain advantages from going online. O'Reilly cites Flickr, which benefits from its shared photo-database and from its community-generated tag database (O'Reilly, 2005).

### **2.2.2.3 Level-1 Applications**

These operate offline but gain features online. O'Reilly cites the following as examples (O'Reilly, 2005):-

- Writely (now Google Docs and Spreadsheets) and
- iTunes (because of its music-store portion)



#### 2.2.2.4 Level-0 Applications

These work as well offline as online. O'Reilly gives the following examples of mapping applications using contributions from users (O'Reilly, 2005):-

- MapQuest
- Yahoo! Local
- Google Maps

Non-web applications like e-mail, instant-messaging clients, and the telephone fall outside the above hierarchy. Users can own the data on a Web 2.0 site and exercise control over that data. These sites stand in contrast to older traditional websites which limited visitors to viewing and whose content only the site's owner could modify. Bart Decrem, founder and former CEO of Flock, calls Web 2.0 the "*participatory web*" and regards the Web-as-information-source as Web 1.0 (Decrem, 2007).

According to (Best, 2006), the characteristics of Web 2.0 are as follows:

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Rich user experience</li> <li>• User participation</li> <li>• Dynamic content</li> </ul> | <ul style="list-style-type: none"> <li>• Metadata</li> <li>• Web standards and</li> <li>• Scalability</li> </ul> |
|---|--|

Further characteristics, such as openness, freedom and collective intelligence by way of user participation, can also be viewed as essential attributes of Web 2.0 (Greenmeier, 2008).

### 2.2.3 Web 2.0 Features

Web 2.0 websites typically include some of the following features that Andrew McAfee used the acronym **SLATES** to refer to them (McAfee, 2006):

- **Search:** The ease of finding information through keyword search which makes the platform valuable.
- **Links:** Guides to important pieces of information; the best pages are the most frequently linked to.
- **Authoring:** The ability to create constantly updating content over a platform that is shifted from being the creation of a few to being the constantly updated, interlinked work. In wikis, the content is *iterative* in the sense that the people undo and redo each other's work. In *blogs*, content is *cumulative* in that individual posts and comments are accumulated over time.
- **Tags:** Categorization of content by creating tags that are simple, one-word descriptions to facilitate searching and avoid rigid, pre-made categories.
- **Extensions:** Automation of some of the work and pattern matching e.g. Amazon.com recommendations whereby inputs about a customer's interests are used to generate a list of recommended items through recommendation algorithms.
- **Signals:** The use of RSS (Rich Site Summary or Really Simple Syndication) technology to update consumers with any changes of the content by sending e-mails to them.

## 2.3 WEB 2.0 TECHNOLOGY OVERVIEW

The sometimes complex and continually evolving technology infrastructure of Web 2.0 consists of (McAfee, 2006):-

- Server software
- Content syndication
- Messaging protocols
- Standards-oriented browsers with plugins and extensions, and
- Various client applications

### 2.3.1 Client Side Technologies

(Pairepairit, 2007) enumerates the client side or web browser technologies used in Web 2.0 development as follows:-

- Asynchronous JavaScript and XML (AJAX)
- Adobe Flash
- Adobe Flex framework

Ajax programming uses JavaScript to upload and download new data from the web server without undergoing full page reloads and this is what makes Web 2.0 tools efficient in terms of information sharing (Pairepairit, 2007).

The data fetched by an Ajax request is typically formatted in XML or JSON (JavaScript Object Notation) format - two widely used structured data formats. Since both of these formats are natively understood by JavaScript, they can be used to transmit structured data in web applications. When this data is received via Ajax, the JavaScript program dynamically updates the web page based on the new data, allowing for a rapid and interactive user experience (Pairepairit, 2007).

Using these techniques, Web designers can make their pages function like desktop applications. GoogleDocs uses this technique to create a Web-based word processor (Pairepairit, 2007).

### **2.3.2 Server-Side Technologies**

On the server side, Web 2.0 uses many of the same technologies as Web 1.0. The following new server-side languages are commonly being used to develop Web 2.0 applications (Pritchard, 2008):-

- ASP.NET
- Cold Fusion
- Perl
- Python
- Ruby on Rail
- Java Server Pages (JSP)
- and
- PHP

Drupal Content Management System built on ASP.NET 2.0 has been used to build **Research 2.0 Portal** - the prototype Web 2.0 Portal for this study.

In the early days of the Internet, there was little need for different websites to communicate with each other and share data. In the new "participatory web", however, sharing data between sites has become an essential capability (Garrett, 2005).

In order to share its data with other sites, a website must be able to generate output in machine-readable formats such as XML, RSS, and JSON. When a site's data is available in one of these formats, another website can use it to integrate a portion of that site's functionality into itself, linking the two together. When this design pattern is implemented, it ultimately leads to data that is both easier to find and more thoroughly categorized, a hallmark of the philosophy behind the Web 2.0 movement (Garrett, 2005).

## **2.4 OTHER APPLICATIONS OF WEB 2.0 TECHNOLOGIES**

### **2.4.1 Higher Education**

Universities are using Web 2.0 to reach out to and engage with the young generation (generation Y) and other prospective students (Committee of Inquiry into the Changing Learner Experience, 2009).

### **2.4.2 Government 2.0**

(Eggers, 2005) notes that Web 2.0 initiatives are being employed within the public sector, giving more currency to the term Government 2.0. Government 2.0 is an

attempt to integrate the social networking and interactive advantages of Web 2.0 approaches into the practice of government.

Government 2.0 can provide more effective processes for service delivery for individuals and businesses. Integration of tools like wikis, development of government-specific social networking sites, use of blogs, multimedia sharing, podcasts, RSS feeds, data mashups and open data such as agricultural data available online through the Kenya National Bureau of Statistics, are all helping governments provide information to citizens in many useful ways.

### **2.4.3 Public Diplomacy 2.0**

Web 2.0 initiatives have been employed in public diplomacy for the Israeli government. The country is believed to be the first to have its own official blog, MySpace page, YouTube channel, Facebook page and a political blog (Israel Ministry of Foreign Affairs, 2008).

### **2.4.4 Discussion**

The Social Network Analysis representation of people as nodes in the network and relationships as the ties or links provides only an approximation of the prevailing situation. This implies that the SNA theory cannot always be applied as a precise prediction of how a given network will behave in future. This is because human beings are dynamic and their interactions are likely to change with time and sometimes within short periods, so representing their relationships with ties and nodes may not always reflect the true picture.

## **2.5 CHAPTER SUMMARY**

In conclusion it can be said that although they do not give a precise representation of the prevailing situation, Web 2.0 tools are suited to implementing the Social Network Analysis theory due to their capacity to link millions of people across the globe. This chapter looked at the attributes of social networking and tried to relate them with the features of Web 2.0 (Social Networking tools). Real life applications of Social Networking were examined as well as how the SNA theory can be applied to the case of the World Agroforestry Centre. A gap was identified in terms of research on relevant Web 2.0 for scientific research. The question that remains is to determine which tools to implement, based on their relevance to the research objectives of the World Agroforestry Centre.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.0 INTRODUCTION**

This chapter is a description of the research methodology employed to arrive at the results that led to the study conclusions and recommendations including the design of the prototype web portal (Research 2.0 Portal).

The research methodology consists of the research design, study location, study population, study sample, sampling procedures, data collection instruments, reliability and validity of research instruments, ethical considerations, data analysis and systems development methodology.

#### **3.1 RESEARCH DESIGN**

Research design is the plan for obtaining research participants (subjects) in order to collect information from them. It consists of a description of what is to be done with the subjects with a view to reaching conclusions about the research problem (research hypothesis or research question) (Welman & Kruger, 2001).

This research uses a case study research design to obtain a clear picture of the status of Web 2.0 adoption and use at the World Agroforestry Centre (ICRAF). It employs the interview and participant observation techniques for data collection and prototyping for system development methodology. In case studies, a critical case can be defined as having strategic importance in relation to the general problem (Flyvbjerg, 2006). A critical case allows the following type of generalization, *'If it is*



*valid for this case, it is valid for all (or many) cases.'* In its negative form, the generalization would be, *'If it is not valid for this case, then it is not valid for any (or only few) cases.* In the context of this study the generalization would be *'If it is valid for the World Agroforestry Centre (ICRAF), it is valid for other CGIAR centers.*

The case study design was considered appropriate for this study because of the researcher's in-depth knowledge of the organization which provided an opportunity to conduct the research based to a large extent on his knowledge of the organization.

### **3.2 JUSTIFICATION FOR USING THE CASE STUDY RESEARCH**

Much of what is known about the empirical world has been produced by case study research (Flyvbjerg, Case study, 2011). ICT Case studies in research and development have been widely used, for instance the IEEE Xplore digital library of the Institute of Electrical and Electronic Engineers whose content is predominantly ICT returned a total of 79,000 research articles on ICT case studies, the ScienceDirect and SciVerse website contained a total of about 25,000 peer-reviewed articles on ICT case studies, equally Springer publishers database returned a total of 25,000 peer-reviewed articles on ICT case studies, while the International Telecommunications Union website lists global ICT case studies by subject and by country (International Telecommunications Union (ITU), 2011), UNDP lists a total of 33 ICT case studies on the subject of agricultural economics on its official website (United Nations Development Programme (UNDP), 2010), and Microsoft Corporation has a website dedicated to case studies categorized according to industry, business need and IT issue (Microsoft Corporation, 2010).

Although some argue that a case study is such a narrow field that its results cannot be extrapolated to fit an entire question it can be argued that in ICT case studies are normally used to present a good picture of the existing and expected systems to elicit enough data for justifying the need for the research, to obtain test data, and to identify the system requirements.

The truth probably lies between the two and it is probably best to try and synergize the two approaches as is the case in this study.

### **3.3 CASE SELECTION AND STRUCTURE**

When selecting a subject for a case study, researchers use information-oriented sampling, as opposed to random sampling. *Outlier cases* (those which are extreme, deviant or atypical) may reveal more information than the typical representative cases. A case may also be selected as a *key case*, because of the inherent interest of the case or the circumstances surrounding it (Flyvbjerg, Case study, 2011), or it may be chosen because of the researchers' in-depth local knowledge; where researchers have this local knowledge they are in a position to “soak and poke” as Fenno puts it, and thereby offer reasoned lines of explanation based on this rich knowledge of setting and circumstances.

Three types of cases may thus be distinguished:

1. Key cases
2. Outlier cases
3. Local knowledge cases

Whatever the frame of reference for the choice of the subject of the case study (key, outlier, local knowledge), there is a distinction to be made between the *subject* and the *object* of the case study.

The subject is the “practical, historical unity” through which the theoretical focus of the study is being viewed. In this case the subject is the *World Agroforestry Centre (ICRAF) scientific, and support staff* under investigation. The object is the theoretical focus – the analytical frame, which in the context of this study is the *Application of Web 2.0 technology* to scientific research.

### **3.4 STUDY LOCATION**

Although this study was conducted at the World Agroforestry Centre (ICRAF) headquarters, Nairobi (Kenya) it was mentioned in section 1.2 that it has six regional offices in other parts of the world namely, Eastern Africa, West and Central Africa, Southern Africa, South Asia, Southeast Asia, and Latin America. Hence, some of the information necessary for the study was received from the regional offices.

### **3.5 STUDY POPULATION**

Population is the study object which may be the number of individuals, groups, organizations, human products and events or the conditions to which they are exposed. The population size is normally indicated by the letter *N* such that if the population size is 1000, it is represented as  $N = 1,000$  (Welman & Kruger, 2001). Since this study was investigating the extent of use of Web 2.0 tools at the World Agroforestry Centre as well as the features of existing Web 2.0 tools to make

recommendations on the adoption of relevant tools, the study population consisted of the following members or elements:-

**Table 3.1 - Study Population**

<b>OBJECT</b>	<b>POPULATION (N)</b>
Information Specialists	20
Research Scientists	90
Web 2.0 Tools	226
<b>TOTAL</b>	336

Information Specialists that are part of Communications unit include librarians, web specialists, editorial and publishing staff. Most of the World Agroforestry Centre's Communications unit staff (eight) is based at the headquarters (Eastern Africa) with one to three communications staff in each of the regional offices – three (3) in Southeast Asia, two (2) in West and Central Africa, one (1) in Latin America, one (1) in Southern Africa.

The scientists or researchers who contributed to this study were a selection from ICRAF's six research units known as Global Research Priorities (GRPs). The most prolific researchers in terms of publication outputs were targeted as appropriate subjects for this study.

### 3.6 STUDY SAMPLE

Because the population size normally makes it impractical and uneconomical to involve all members of a population in a research project, it is necessary to rely on data obtained for a sample of the population. A random selection of subjects was made purposefully based on the researcher's in-depth knowledge about the organization. The sample size is indicated by  $n$  (Welman & Kruger, 2001). Table 3.2 illustrates the sizes of the different categories of the study sample.

**Table 3.2: Study Sample**

<b>OBJECT</b>	<b>SAMPLE SIZE (<math>n</math>)</b>	<b>% OF TOTAL POPULATION</b>
Information Specialists	12	60
Research Scientists	15	17.7
Web 2.0 Tools	120	53.10
<b>TOTAL</b>	<b>147</b>	<b>43.75%</b>

#### 3.6.1 Sampling Procedures

(Welman & Kruger, 2001) notes that in order to constitute the study sample a distinction can be made between two types of sampling techniques. These two techniques are:-

- **Probability samples** which include: simple random samples, stratified random samples, systematic samples, and cluster samples.

- **Non-probability samples** which include: accidental or incidental samples, purposive samples, quota samples, and snowball samples

Purposive sampling was used to select both Information Specialists and Research Scientists who were the human subjects of investigation for this study. Information Specialists include World Agroforestry Centre staff that is part of the Communications Unit or Administrative Assistants of the various GRPs because they collaborate with the Communications Unit in the management of research outputs.

The reason why certain Information Specialists and Research Scientists were chosen was because of their roles in terms of managing research outputs. For instance, Information and Communication Specialists are the ones entrusted with determining the best communication strategies for organizations; hence generally they are the most appropriate people to interview about the information dissemination mechanisms at their disposal and how they intend to improve on them.

Among researchers, there are those who are prolific in terms of research outputs, hence it was assumed that they are likely to be making use of a variety of online resources for their work and it was thought that their knowledge of new knowledge sharing techniques had to be evaluated in order to determine the impact of Web 2.0 tools based on their experiences so that recommendations can be made for other researchers.

### **3.6.1.2 Sampling Web 2.0 Tools**

The sample for the Web 2.0 tools was obtained from the Internet. Simple random sampling was used to select one hundred and twenty (120) Web 2.0 tools that were the subject of investigation on the features of Web 2.0 tools. A random list of 226 Web 2.0 tools was prepared and 120 of them were selected randomly so that each of them had an equal chance of being selected. Hence, the results of analyzing the 120 Web 2.0 tools can be said to be representative of the 226 tools. The justification for selecting the 120 tools is that the larger the sample, the more accurate the results and the less the error margin.

## **3.7 DATA COLLECTION INSTRUMENTS**

Once a decision is made on a particular research design a consideration of the most appropriate data-collection method has to be made in the light of the research problem and the particular population in question (Welman & Kruger, 2001). This study employed three types of data collection instruments namely: -

- **Interview Schedule**
- **Web 2.0 Evaluation Matrix**
- **Observation schedule**

### **3.7.1 Interview Schedule**

The first data collection instrument was an interview schedule administered to the World Agroforestry Centre Information Specialists and Research Scientists as per the samples presented on table 3.2. The use of the interview schedule was considered appropriate to address the qualitative aspect of the study because an interview schedule can be used to solicit in-depth responses from the respondents

which in this case were necessary in order to describe the prevailing status of Web 2.0 tools usage at the World Agroforestry Centre. The interview process provided the scope for clarification of misunderstood questions and answers which was important in adding value to the descriptive narration of respondents' feedback.

### **3.7.2 Web 2.0 Evaluation Matrix**

The second data collection instrument was a Microsoft Excel data capture and evaluation form which was used to collect information about the features of online Web 2.0 tools. This form was referred to as the Web 2.0 Evaluation Matrix and it was used to rate the sampled Web 2.0 tools on a scale of 0 to 7 in order to rank them on the basis of their scores using the five characteristics of Web 2.0 tools (SLATE) mentioned in section 2.2.3 and two additional criteria (**Relevance and User Interface Design**) introduced on the basis of attaining the research objectives of this study.

Each of the seven criteria was given a rating of between 0 and 1. Hence a Web 2.0 tool scoring maximum for each feature would have an aggregate score of 7 representing 100%. Within each criterion some evaluative notes were captured and used for the descriptive narratives on Web 2.0 tools according to this study's literature review.

The Internet was used to create accounts of one hundred and twenty (120) Web 2.0 tools available online on the *Addthis* widget – a social bookmarking toolbar. The accounts were created in order to login and study the relevance and the features of the



web 2.0 tools by supplying standard keywords from the AGROVOC online multilingual thesaurus in the field of environmental science.

### **3.7.3 Observation Schedule**

In the final analysis, all measuring and data collection procedures are based on systematic observation. Systematic observation means that it should be replicable, in other words, that independent observers should also be able to observe and report the same phenomena (Welman & Kruger, 2001). The participant observation schedule was used to supply additional information from the researcher's local knowledge given his background as an Information Specialist at the World Agroforestry Centre (ICRAF).

The participant observation schedule comprised of observations on the use of Web 2.0 tools by Researchers and Information Specialists, Information needs of researchers, the extent of integration of Web 2.0 tools on the World Agroforestry Centre's website and intranet.

### **3.8 PILOT STUDY**

Before administering the actual interview, a pilot study was conducted among a similar number of respondents as those on the study sample, although these were not the same as those interviewed in the actual interview. The pilot study was important to gauge the participants' abilities to interpret the questions correctly and give feedback that can easily be standardized for analysis.

### **3.9 VALIDITY AND RELIABILITY OF THE RESEARCH INSTRUMENTS**

#### **3.9.1 Validity**

Validity determines whether the research truly measures what it was intended to measure or how truthful the research results are. Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others (Joppe, 2000). The validity of research instruments for this study was determined by sharing them with colleagues who are experts in the field under investigation and their comments were incorporated into the finalized documents.

#### **3.9.2 Reliability**

Reliability is the extent to which results are consistent over time and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable (Joppe, 2000). The reliability of the research instruments for this study was ensured by conducting a pilot study as explained in section 3.9 before conducting the actual survey.

### **3.10 DATA PRESENTATION, ANALYSIS AND INTERPRETATION**

This study involved both qualitative and quantitative techniques. The qualitative methodology was used to analyze data from the interview schedule whereas the quantitative one was used to analyze the Web 2.0 Evaluation Matrix.

Feedback from the interview questions was subjected to a thorough content analysis in order to categorize responses thematically according to the research questions. This thematic categorization is reflected in the section on Data Analysis and Presentation of Findings.

The quantitative analysis of the Web 2.0 Tools Evaluation Matrix was done using Microsoft Excel 2010 using standard mathematical functions such as counts, summation, and numerical sorting.

### **3.11 DATA ANALYSIS**

#### **3.11.1 Interview Analysis**

The interview questions addressed the research questions and feedback from respondents was analyzed using percentages on statistical charts and narrated verbatim in order to categorize responses thematically to ultimately address the study objectives. The thematic categorization is reflected in the section on Data Analysis and Presentation of Findings.

A Likert-type scale (Likert, 1932) was used to categorize the responses in order to generate data for quantitative analysis to be used to come up with recommendations.

Data gathered from respondents were then used to determine the relevant Web 2.0 tools for World Agroforestry Centre's research.

#### **3.11.2 Web 2.0 Evaluation Matrix Analysis**

The Web 2.0 Evaluation Matrix was used to rate the sampled Web 2.0 tools on a scale of 0 to 7 in order to rank them on the basis of their scores using the five characteristics of Web 2.0 tools (SLATE) mentioned in section 2.2.3 and two additional criteria (**Relevance and User Interface Design**) introduced on the basis of attaining the research objectives of this study.

Each of the seven criteria was given a rating of between 0 and 1; a score of 0 if the feature is not met, 0.5 if it is partly met and 1 if it is fully met. Hence a Web 2.0 tool scoring maximum for each feature would have an aggregate score of 7 representing 100%. Within each criterion some evaluative notes were captured and used for the descriptive narratives on Web 2.0 tools according to this study's literature review.

The Internet was used to create accounts of one hundred and twenty (120) Web 2.0 tools available online on the *Addthis* widget – a social bookmarking toolbar. The accounts were created in order to login and study the relevance and the features of the web 2.0 tools by supplying standard keywords derived from the AGROVOC online multilingual thesaurus in the field of environmental science.

### **3.11.3 Participant Observation Schedule Analysis**

The participant observation schedule was used to supply additional information from the researcher's local knowledge given his background as an Information Specialist at the World Agroforestry Centre (ICRAF). This local knowledge is meant to emphasize the findings from the other two data collection methods.

A thematic presentation of the observable aspects pertaining to this study was done in tabular form. The participant observation schedule comprised of observations on the use of Web 2.0 tools by Researchers and Information Specialists, Information needs of researchers, the extent of integration of Web 2.0 tools on the World Agroforestry Centre's website and intranet.

### 3.12 SYSTEM PROTOTYPING

Software prototyping which refers to the activity of creating incomplete versions of software applications was used. It can occur in software development and is comparable to prototyping in other fields, such as mechanical engineering or manufacturing. A prototype typically simulates only a few aspects of, and may be completely different from, the final product (Grimm, 1998).

Prototyping has the following benefits (Grimm, 1998):-

- The software designer and implementer can get valuable feedback from the users early in the project.
- The client and the contractor can compare if the software made matches the software specification according to which the software program is built.
- It also allows the software engineer some insight into the accuracy of initial project estimates and whether the deadlines and milestones proposed can be successfully met.

A prototype is an early sample or model built to test a concept or process or to act as a thing to be replicated or learned from. It is a term used in a variety of contexts, including semantics, design, electronics, and software programming. A prototype is designed to test and try a new design to enhance precision by system analysts and users. Prototyping serves to provide specifications for a real, working system rather than a theoretical one (PC World, 2012).

The following procedures were employed in prototyping Research 2.0 Portal:-

### **3.12.1 Identification / analysis of the basic requirements**

Determination of the basic requirements including the input and output information desired. Details, such as security, can typically be ignored.

### **3.12.2 System modeling / development of the initial Prototype**

The initial prototype is developed that includes only user interfaces.

### **3.12.3 Review**

The customers, including end-users, examine the prototype and provide feedback on additions or changes.

### **3.12.4 Prototype revision and enhancement**

Using the feedback both the specifications and the prototype can be improved. Negotiation about what is within the scope of the contract/product may be necessary. If changes are introduced then a repeat of steps 3 and 4 may be needed.

In developing this prototype, the system requirements were derived from the results of the data analysis from the interview results. The main components of the system were identified and an activity diagram was designed to describe the operational workflows of the components of Research 2.0 Portal. The components were the users of the system, the system objects (databases and user controls and the relevant Web 2.0 tools integrated into the portal), and the processes. The Unified Modeling Language (UML) on Microsoft Visual Studio 2010 was used to develop the activity diagram showing the overall flow of activities within the system. UML was used as a modeling tool because it is a recognized standard for system modeling and it facilitates communication among developers working in remote locations due to its ability to produce standardized symbols for application development.

### **3.13 ETHICAL CONSIDERATIONS**

#### **3.13.1 Voluntary Participation**

Voluntary participation in research requires that people not be coerced into participating in research. This study was conducted after obtaining voluntary consent from the interviewees.

#### **3.13.2 Informed Consent**

The principle of informed consent is closely related to that of voluntary participation. Informed consent means that prospective research participants must be fully informed about the procedures involved in research and must give their consent to participate. Ethical standards also require that researchers not put participants in a situation where they might be at risk of harm as a result of their participation – the harm being either physical or psychological.

### **3.14 CHAPTER SUMMARY**

This chapter looked at the methodology of conducting the research and issues relating to the research. It was established that the benefit of prototyping as a method of system development is that the system designer and implementer can get valuable feedback from the users early in the project. The client can compare if the system made matches the required specification, according to which the software program is built (Grimm, 1998).

## CHAPTER FOUR

### DATA PRESENTATION, ANALYSIS AND INTERPRETATION

#### 4.0 INTRODUCTION

This chapter is a thematic presentation of findings according to the study objectives.

Three complementary means of data presentation for this study were employed:-

- Tabulation of results including the matrix for evaluating Web 2.0 tools
- Microsoft Excel charts
- Descriptive narration of interview data

#### 4.1 MATRIX EVALUATION OF WEB 2.0 TOOLS

The first objective of this study was to examine the features of existing Web 2.0 tools.

A matrix evaluation (Appendix III) of the features of 120 Web 2.0 tools out of a total of 226 tools was conducted based on the SLATE criteria (Search, Links, Authoring, Tags, Extensions) mentioned in section 2.2.3 as devised by Andrew McAfee (McAfee, 2006).

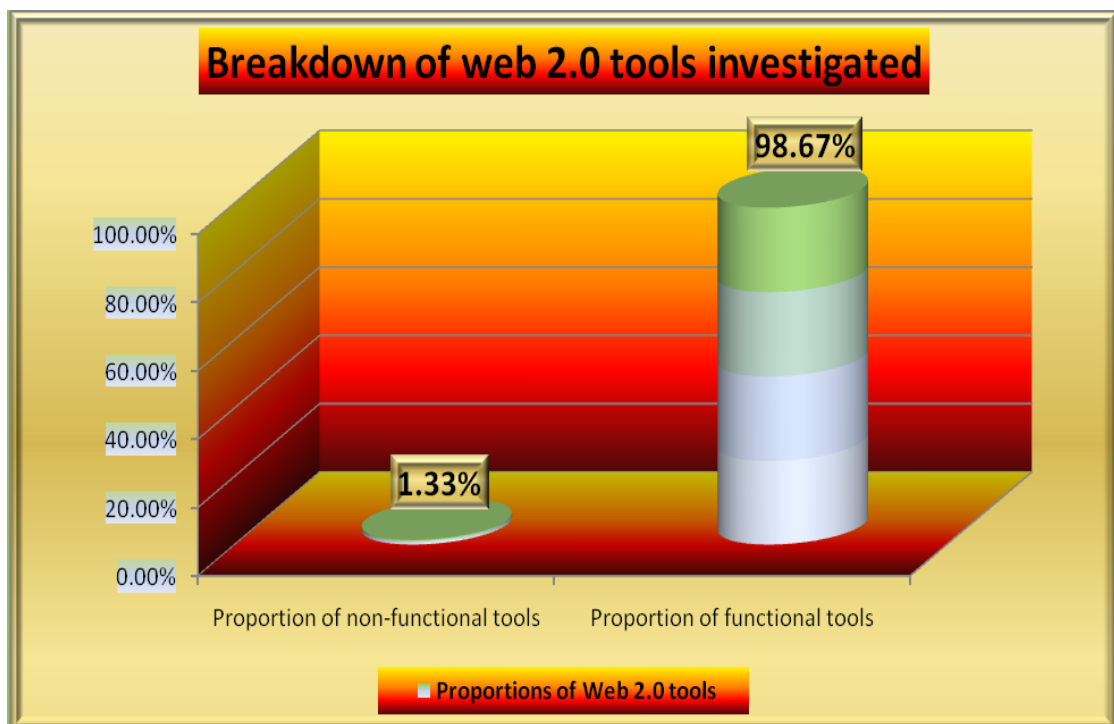
Two additional criteria were introduced to determine the appropriate tools for adoption in the context of the World Agroforestry Centre resulting into a total of seven criteria. The two additional criteria are **Relevance** and **User interface design** of the tools under investigation.

Each of the seven criteria was rated between 0 and 1. The suitability of each tool is therefore, rated on a maximum score of 7.0 points. As per the Microsoft Excel Worksheet analysis, the following results were obtained:-



#### 4.1.0 Functional Versus Non-Functional Tools

Out of the total population of 226 Web 2.0 tools it was discovered that some of them were no longer working or the services had been terminated, while others were functioning as expected. The ones not working were categorized as non-functional while the working ones were called functional tools. The proportion of non-functional tools (3) out of the total population of Web 2.0 tools (226) makes up only 1.33% of the Web 2.0 tools leaving the bulk of the tools (98.67%) as functional. Figure 9 (below) illustrates this.



**Figure 8: Breakdown of Web 2.0 Tools Investigated**

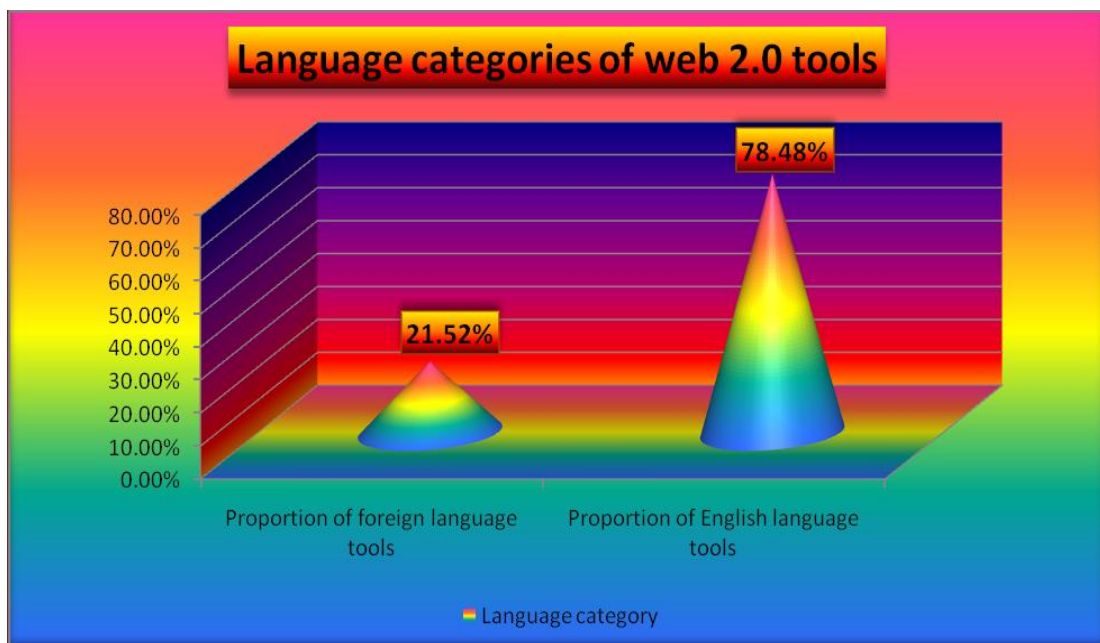
#### 4.1.1 Language Categories

Language is an important aspect in realizing the World Agroforestry Centre's strategic objective of *accelerating the impact of its scientific research* bearing in mind that the organization operates in six regions across the globe where the English language predominates besides other native languages. Since English is the

predominant language of communication for the World Agroforestry Centre, this section looked at the total scores for the evaluated tools and sorted them in descending order and the following results were obtained:-

- Twenty six (26) or 21.52% of the Web 2.0 tools are foreign language tools which projects to forty eight (48) tools out of the total 226 Web 2.0 tools.
- Ninety five (95) or 78.48% of the tools are either English language tools or have content that is predominantly in English language meaning that one hundred and seventy five (175) out of the total 226 tools have content that is predominantly in English language meaning.

These results show that the proportion of Web 2.0 tools (about 80%) investigated is sufficient for evaluation in order to draw conclusions on their adoption as innovative means of sharing scientific research. This proportion translates to 96 out of the sampled 120 tools and one hundred and eighty one (181) of the total 226 tools.



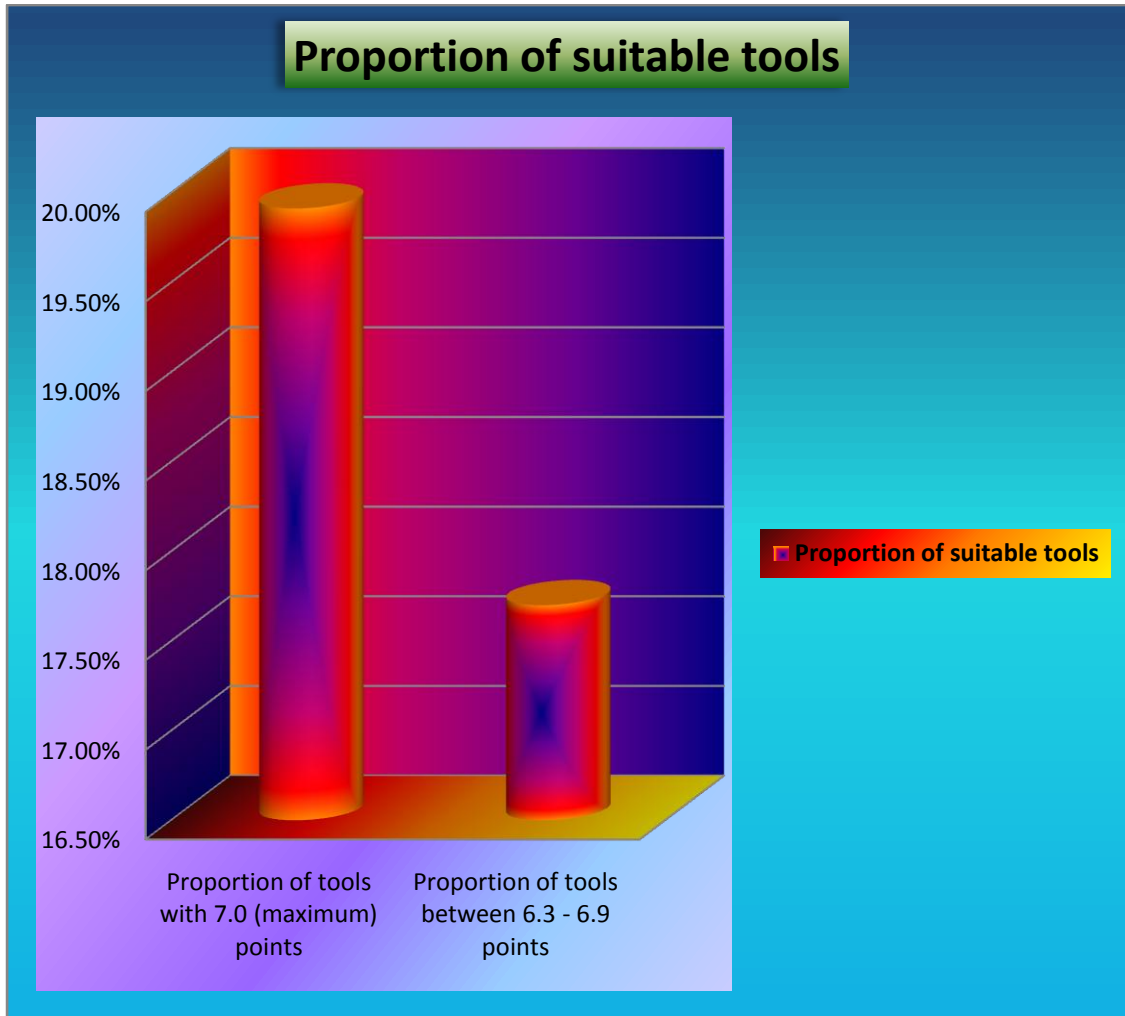
**Figure 9: Breakdown of Web 2.0 Tools According to Language**

#### 4.1.2 Web 2.0 Tools Relevant to Agroforestry

The second objective of this study was to determine the relevance of the various Web 2.0 tools for scientific knowledge sharing at the World Agroforestry Centre. During the interview sessions one of the researchers noted that “*relevance of any new technology is very crucial to its adoption*”.

Relevance of the tools was determined by querying them with controlled vocabulary on various aspects of the science of Agroforestry such as *Climate change, Land health, Germplasm, Biodiversity, Environmental services* and many more. The ninety five (95) English language tools were then filtered for the best scores. The best scores were set at not less than 90% of the aggregate score – i.e. 6.3 points and above. This criterion resulted into the following results:-

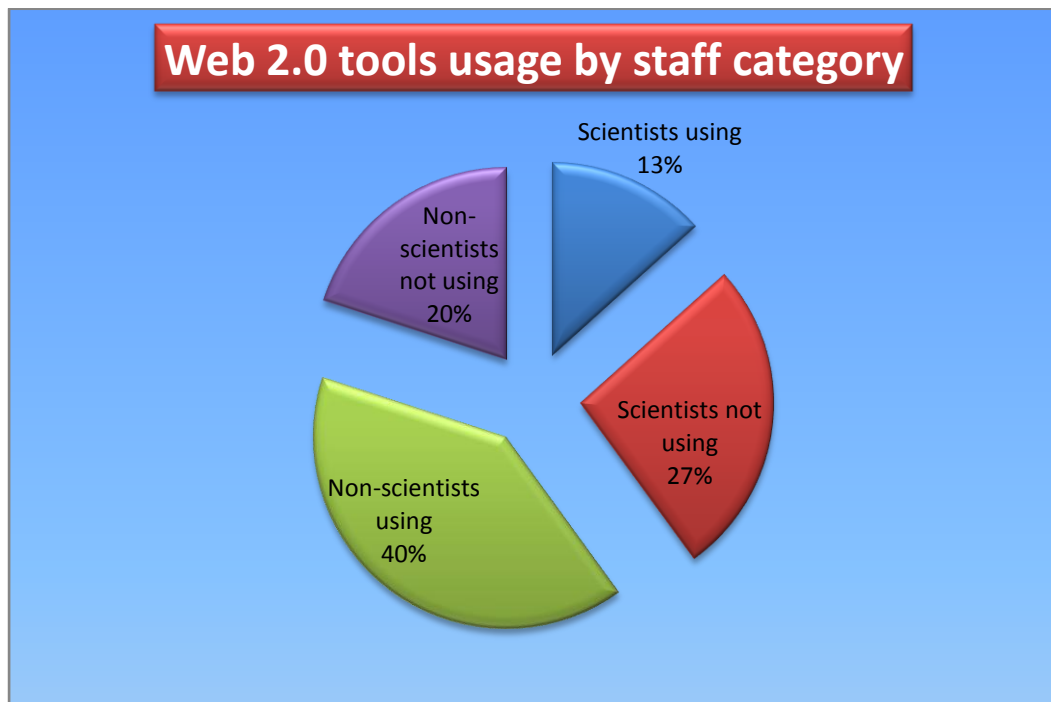
- Twenty four (24) or 19.91% of the Web 2.0 tools had an aggregate score of 7 points (100% score ) which proportionately translates to forty five (45) out of the total 226 Web 2.0 tools
- Twenty two (22) or 17.70% of the tools had an aggregate score of between 6.3 and 6.9 points (at least 90% score) which proportionately translates to forty (40) out of the total 226 Web 2.0 tools
- The rest of the tools (48) or 39.82% of the tools had an aggregate score of less than 6.3 points (<90%). This translates to 90 out of the total population of 226 Web 2.0 tools



***Figure 10: Proportion of Suitable Web 2.0 Tools***

The foregoing statistics reveal that forty six (46) of the sampled 120 Web 2.0 tools (which translates to 85 out of the total population of 226 Web 2.0 tools) had a score of more than 90%. Hence, it is reasonable to suggest that Web 2.0 tools can be adopted to leverage scientific research at the World Agroforestry Centre.

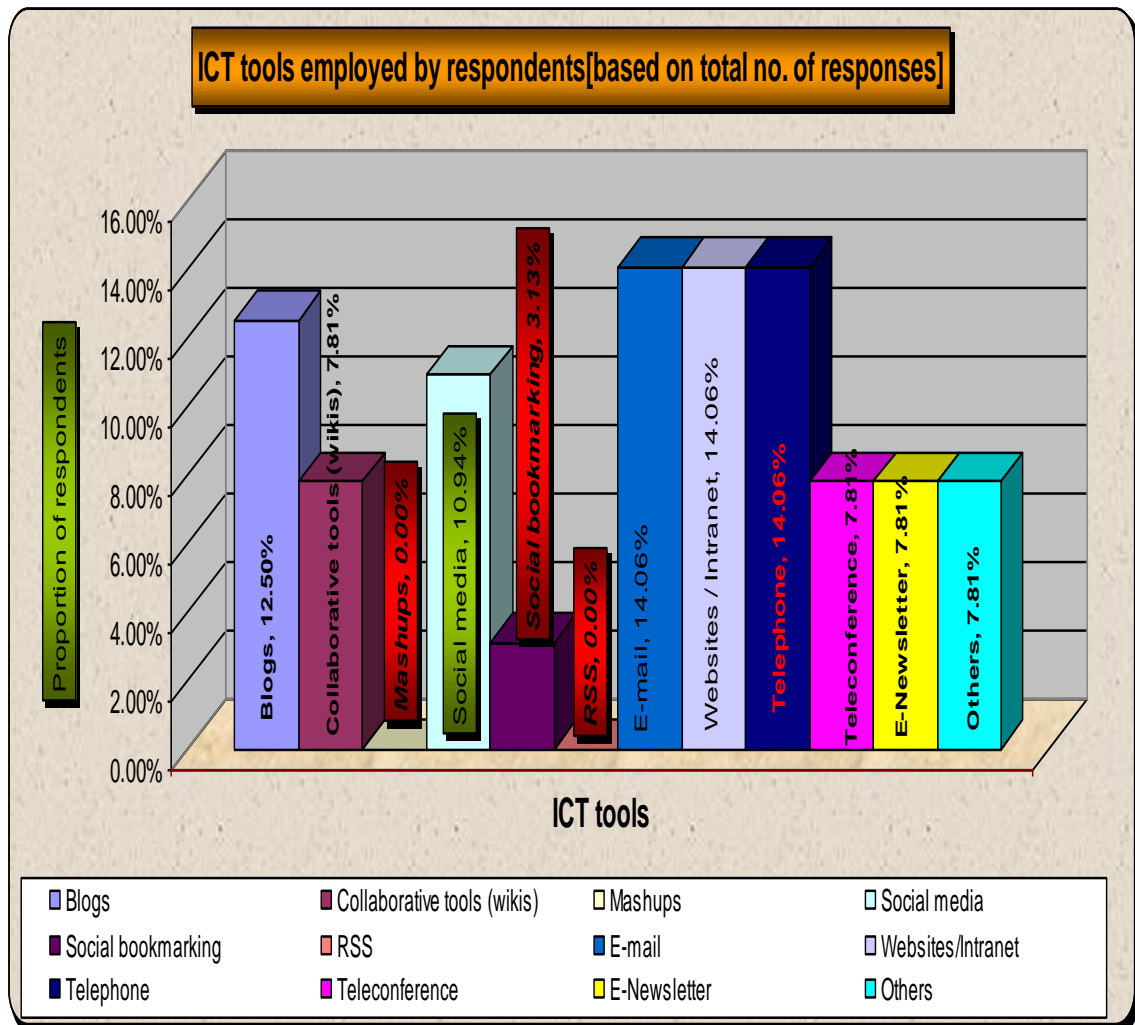
### 4.1.3 Extent of Use of Web 2.0 Tools



**Figure 11: Web 2.0 Tools Usage by Staff Category**

From the interview, it was apparent that majority of the interviewees making use of Web 2.0 tools are non-scientists. These were mainly staff handling communication-related tasks since most researchers did not seem familiar with the Web 2.0 concept and also thought that such tools were not necessary for their work. This aspect is related to the aspect of relevance (section 4.1.2) as one of the interviewed researchers had this to say: *“Most scientists are not using these tools because they have not experienced the impact they may have on their work”*. These remarks clearly indicate to us that the usefulness of the tools would be enough justification for researchers to adopt them for their work.

#### 4.1.3a Proportions of use of Types of Web 2.0 Tools



*Figure 12: ICT Tools Employed Based on the Total Number of Responses*

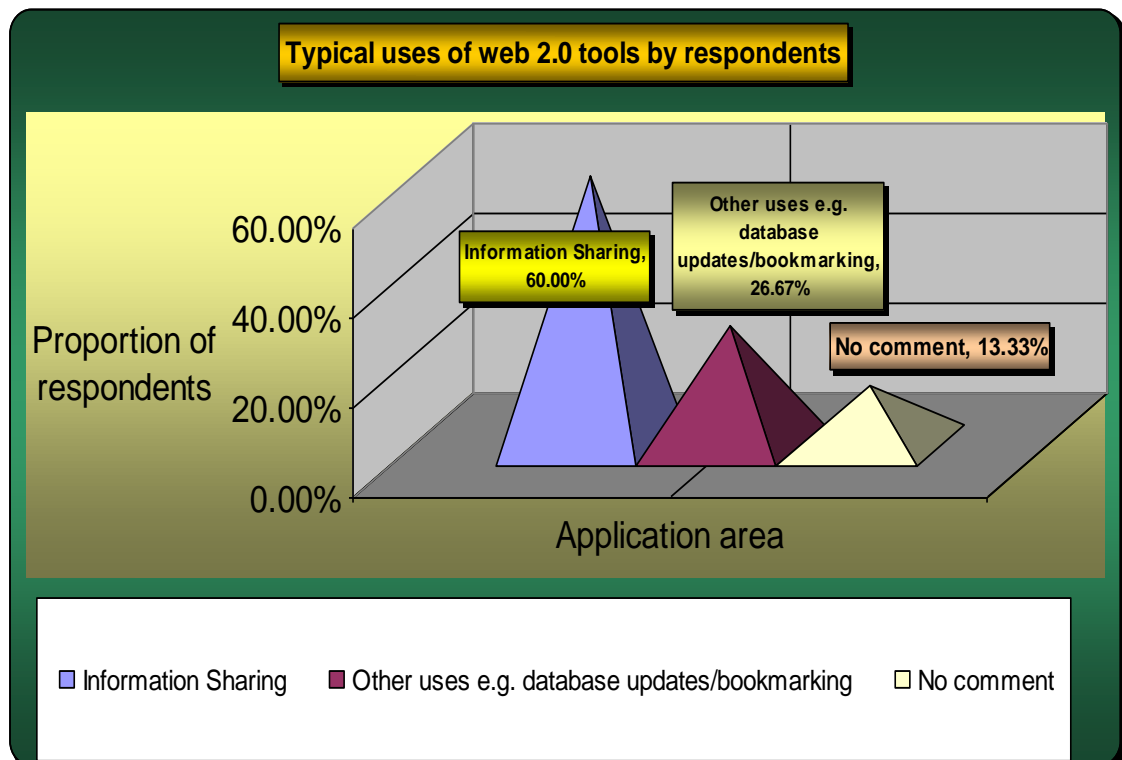
**Table 4.0 Ranking of the ICT Tools Based on Usage**

<b>User Category</b>	<b>Score</b>
<b>Websites / intranet</b>	14.06%
<b>E-mail</b>	14.06%
<b>Telephone</b>	14.06%
<b>Blogs</b>	12.50%
<b>Social media (Facebook, Youtube etc.)</b>	10.94%
<b>Collaborative tools (Wiki spaces etc.)</b>	7.81%
<b>E-Newsletters</b>	7.81%
<b>Teleconference</b>	7.81%
<b>Others</b>	7.81%
<b>Social bookmarking</b>	3.13%
<b>RSS</b>	0.00%
<b>Mashup services</b>	0.00%

In terms of popularity, the website, intranet, e-mail and telephone are the most commonly used ICT tools for information dissemination, according to the interview results. However, as established in section 2.2.2.4, non-web applications like e-mail, instant-messaging clients, and the telephone fall outside the Web 2.0 hierarchy. In considering the actual Web 2.0 tools, the number of respondents using the existing Web 2.0 tools (blogs and social media such as Facebook accounted for 11 to 13%

which is quite low given that most of the users were not scientists as seen in section 4.1.3. Important Web 2.0 tools such as RSS feeds and mashup applications were not among the Web 2.0 tools being used by the scientists. One of the researchers remarked: *“Most of us have no idea what RSS feeds or mashups are all about, but now that you have explained I am sure all of us will find them useful.”* While the use of RSS feeds would be a useful way of alerting research on the latest developments in their research areas these remarks show that if well introduced to the researchers they could make a significant impact to their research by keeping up to date with the most current developments.

#### 4.1.3b Applications of Web 2.0 Tools by Respondents



*Figure 13: Typical Uses of Web 2.0 Tools by Respondents*

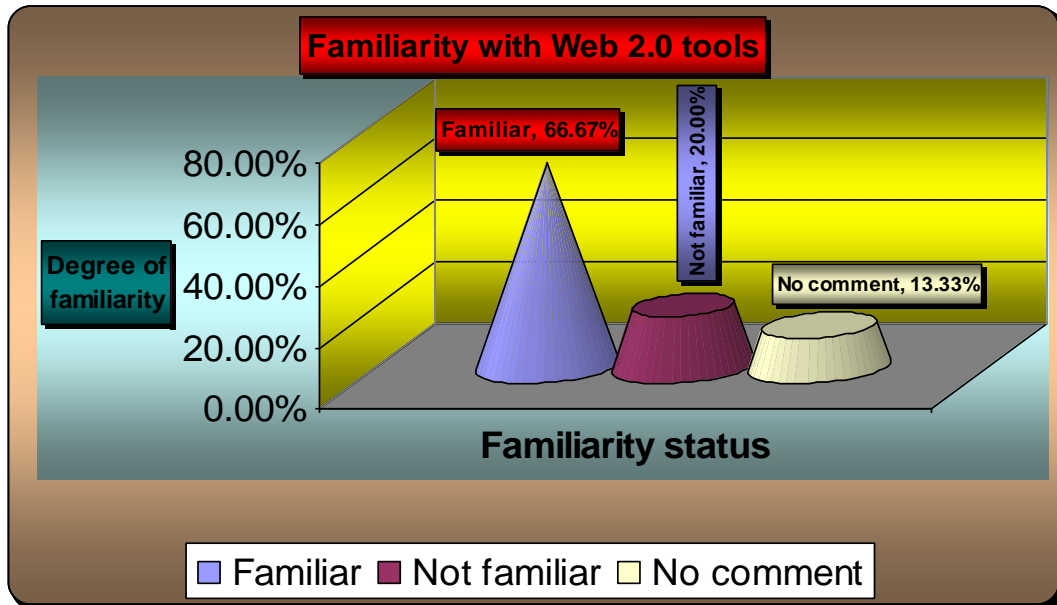


The interview results showed that respondents who use Web 2.0 tools use them tools for information sharing, and updating their project databases with new information. It was noted that the interviewed researchers did not want to comment on this aspect showing their lack of knowledge on the applications of Web 2.0 tools. However, it was noted that majority of the non-scientific users find Web 2.0 tools to be useful for information sharing as one of them commented: *“I have found Web 2.0 tools to be a quick means of reaching out to millions of people almost instantaneously, it may be necessary to have the database of research outputs linked to these tools to enable rapid sharing of Agroforestry research including online submissions of publications by scientists to avoid missing out on reporting institutional outputs to the various consumers of the World Agroforestry Centre”*. Linking the database of research outputs to Web 2.0 tools would indeed be the most convenient way of accelerating World Agroforestry Centre’s research to the outside world because every search results from the database would be shareable through any of the relevant Web 2.0 tools, hence targeting a global audience.

#### **4.1.4 Challenges in Application and use of Web 2.0 Tools**

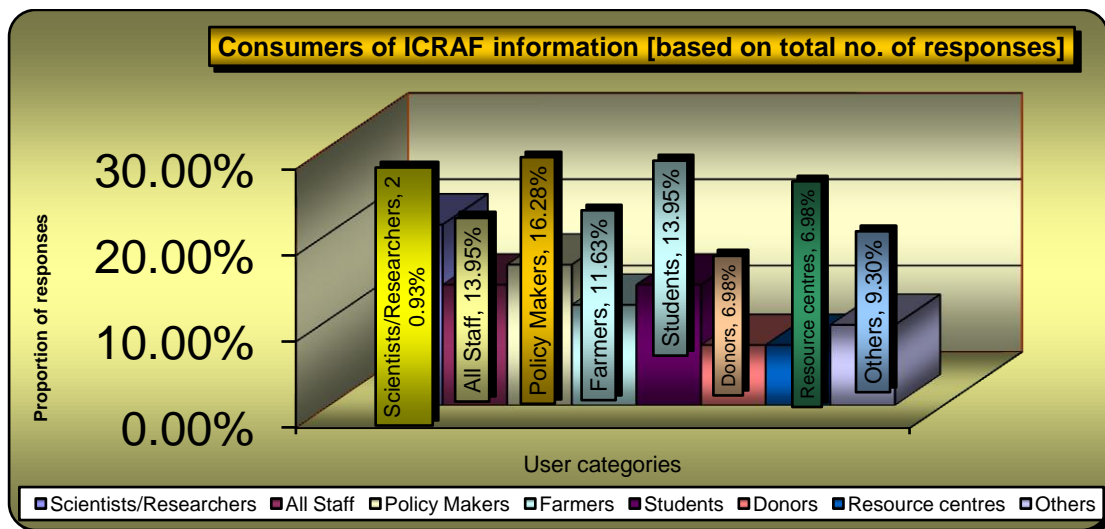
Most Information and Communication Specialists interviewed displayed some familiarity with the concept of Web 2.0 while most scientists said they had no idea of the concept of Web 2.0. It was noted that even those who expressed some familiarity with Web 2.0 needed further explanation on what it really entails. One interviewee remarked: *“Even as you plan to introduce some of these new technologies, some simple demonstrations on how to make the most out of them is necessary.”* It is apparent from these remarks that a detailed explanation of Web 2.0 tools and their

relevant features for research is necessary to solicit a high level of appreciation from the research community at the World Agroforestry Centre.



*Figure 8: Familiarity with Web 2.0 Tools*

#### 4.1.5 Consumers of World Agroforestry Centre's Research



*Figure 9: Consumers of ICRAF Information (Based on Total Number of Respondents)*

From the interview schedule and from local (participant observation) knowledge about the World Agroforestry Centre, the main consumers of the World Agroforestry Centre's scientific knowledge can be categorized as shown in Table 4.0. One interviewee commented that *"We need a way of categorizing information online according to the specific users of the World Agroforestry Centre's research. This way, it will be easy for specific targeted consumers, to access information relevant to them and share it with the right audience."* This observation is indeed in agreement with the prevailing scenario because there is need to avail targeted information products and services to the World Agroforestry Centre researchers.

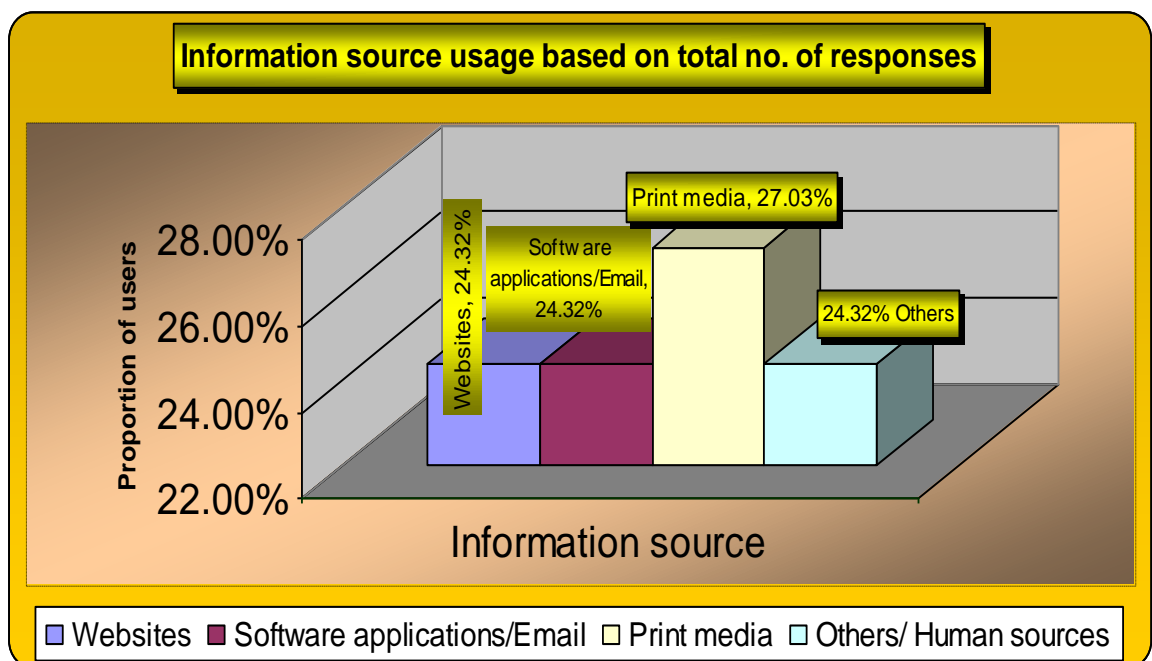
**Table 4.1 Main Users of World Agroforestry Centre's Knowledge**

<i>User Category</i>	<i>Score</i>
<i>Scientists &amp; Researchers</i>	20.93%
<i>Policy makers</i>	16.28%
<i>Students</i>	13.95%
<i>All Staff</i>	13.95%
<i>Farmers</i>	11.63%
<i>Donors, Board of Trustees</i>	6.98%
<i>Resource centres</i>	6.98%
<i>General Public</i>	9.30%
<b><i>TOTAL</i></b>	<b>100.00%</b>

This observation implied the need for a user-centred interface as well as to determine the most appropriate Web 2.0 tools for integration into the World Agroforestry Centre website.

#### 4.1.6 Tools used for Knowledge Sharing

The interview schedule revealed that majority of the respondents find ICTs to be a more effective means of overcoming geographical barriers compared to other conventional means such as face-to-face interactions, and print media even though some of the respondents use a combination of the two means. The two popular mediums employed were Websites and communication media such as e-mail applications. One of the respondents noted that *“We could take advantage of the Internet as a means of introducing Web 2.0 tools through the institutional website.”* This remark amounts to requesting for a Web Portal integrating the relevant Web 2.0 tools for use by World Agroforestry Centre scientists.

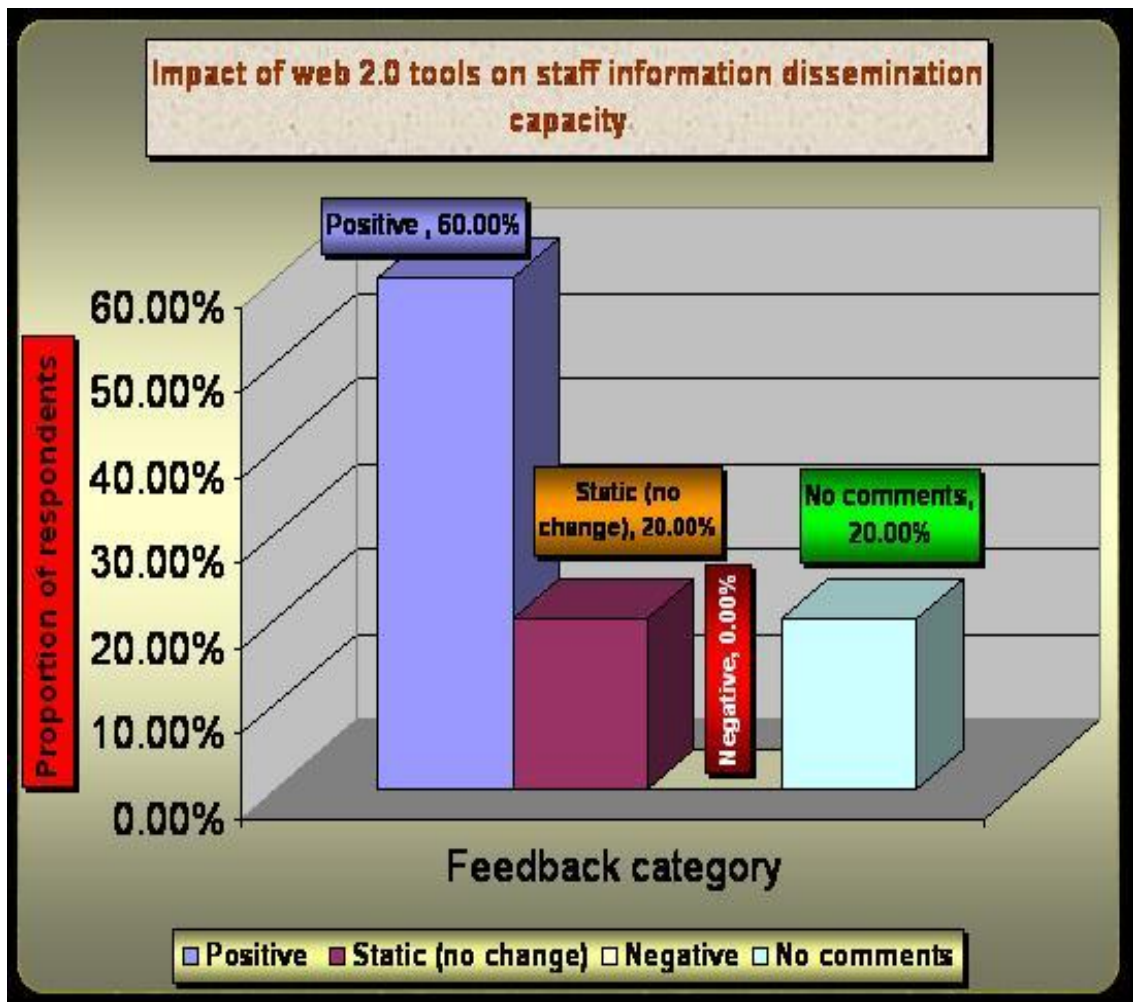


*Figure 10: Information Usage Based on the Number of Respondents*

#### 4.1.7 Impact of Web 2.0 Tools

60% of the interviewees agreed on the potential of Web 2.0 tools to improve their knowledge sharing capacity. Although none of the users gave negative feedback, most

scientists did not comment and a few others said that they did not notice any change in their work as a result of using Web 2.0 tools. One researcher noted that *“One can only appreciate the good in anything if and only if one has had some prior experience with it; in this case I cannot comment anything as a scientist.”* Although this feedback indicates some reservations on the potential of Web 2.0 tools to positively contribute to researchers, it also shows that the researchers are willing to embrace these new technologies given the proper training.



*Figure 11: Impact of Web 2.0 Tools*

#### 4.1.8 Recommendations on Use of Web 2.0 Tools

Majority of the interviewees supported the use of Web 2.0 tools to enhance knowledge sharing at the World Agroforestry Centre, whereas the minority was non-committal, apparently because until the time of undertaking this study the concept of Web 2.0 was rather hazy to them. Again, most of those who did not comment were scientists - emphasizing the fact expressed by one of them that “*Web 2.0 tools targeted at scientists have to be elaborated to them in a way that will captivate their interest.*” This feedback demonstrates a positive interest in Web 2.0 tools by scientists which means Web 2.0 tools can find ready acceptance within the scientific community.

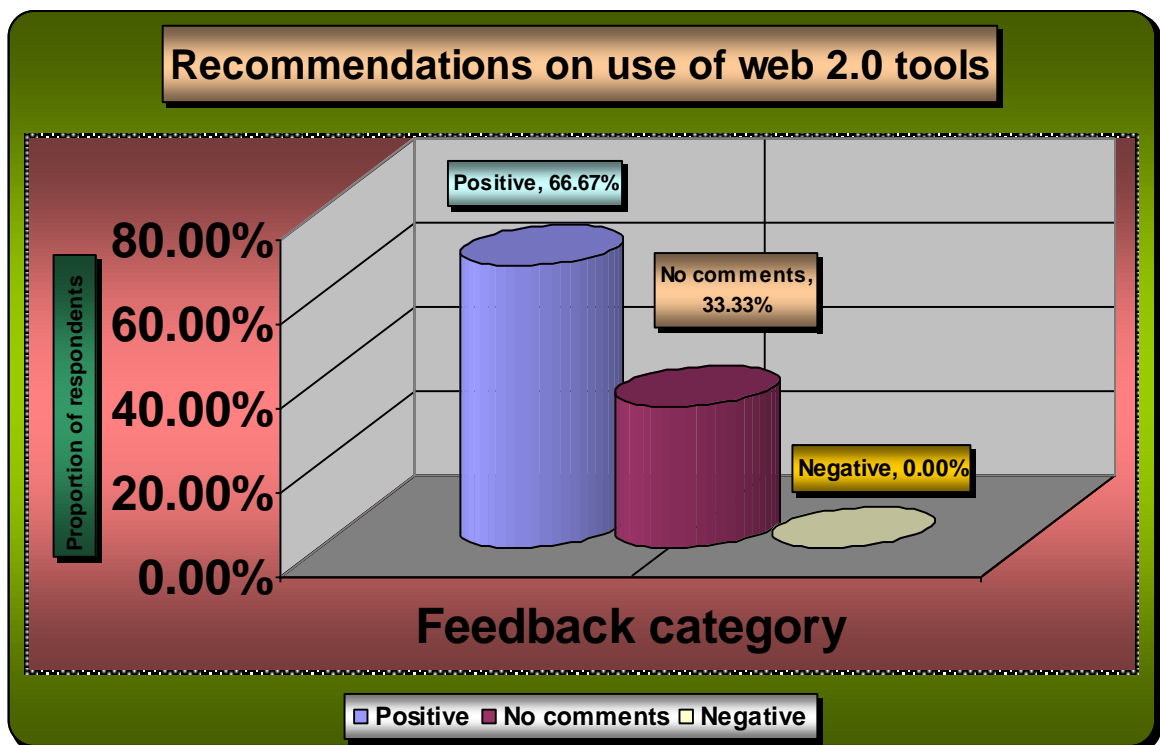


Figure 12: Recommendations on use of Web 2.0 Tools

## **4.2 CHAPTER SUMMARY**

This chapter analyzed the data collected for the study while addressing the study objectives. An evaluation of the features of selected Web 2.0 tools was done to arrive at most relevant ones for use by the World Agroforestry Centre to achieve the strategic objectives of accelerating the impact of the Centre's research and strengthening partnerships with interested stake holders. Selected comments from individual respondents have been used to qualify the analysis from the interviewees. Ultimately the feedback obtained was used to make recommendations on the adoption of relevant Web 2.0 tools for the World Agroforestry Centre.

## CHAPTER FIVE

### ANALYSIS, DESIGN AND DEVELOPMENT OF RESEARCH 2.0 PORTAL PROTOTYPE

#### 5.0 INTRODUCTION

Due to the immense network effect of Web 2.0 tools, many organizations are finding them useful for adoption as appropriate channels for enhancing global communication. This can easily be supported by evidence from the Google timeline on Web 2.0 in section 2.3.1, which depicts that the concept of Web 2.0 has grown rapidly with a lot of research interest from the year 2004 to date (Timetoast, 2010). A number of Web 2.0 portals such as Scienceblogs (section 1.1.1) and OpenWetWare (section 1.1.2) dedicated to scientific research have also been established, giving prominence to the relevance of Web 2.0 technologies in scientific research (O'Reilly, 2005).

The results of our study show that most of the Web 2.0 tools are likely to be useful in accelerating the propagation of scientific research. The top ten Web 2.0 tools (*ResearchGate, CiteULike, Reddit, Diigo, Connotea, LiveJournal, StumbleUpon, Mendeley, Bit.ly, and Google+*) have been selected for integration into *Research 2.0 Portal* (including the already existing ones - Facebook, Twitter, Flickr, Slideshare and Youtube), taking into consideration the *Relevance* and *User Interface Design* dimensions, mentioned in section 4.1.2.



The ultimate goal of this study was to prototype a Web Portal known as *Research 2.0 Portal*, integrating Web 2.0 tools relevant to the research objectives of the World Agroforestry Centre.

Drupal Content Management System built on Microsoft ASP.NET 2.0 was used to develop *Research 2.0 Portal*.

## **5.1 RESEARCH 2.0 PORTAL PROTOTYPING**

(Smith, 1991) states that the original purpose of a prototype is to allow users of the software to evaluate developers' proposals for the design of the eventual product by actually trying them out, rather than having to interpret and evaluate the design based on descriptions. Prototyping can also be used by end users to describe and prove requirements that developers have not considered, and that can be a key factor in the commercial relationship between developers and their clients. Interaction design in particular makes heavy use of prototyping with that goal.

### **5.1.1 Requirements Analysis**

From the data interpreted in chapter 4, it emerged that a system with the following attributes is required:-

- One which will facilitate accelerating the impact of the World Agroforestry Centre's scientific research as mentioned in the aim of the study on section 1.5. Using the knowledge derived from theoretical framework on the strength of numerous ties, Web 2.0 tools come into play as the most appropriate modern approach to meet this requirement due to their immense network effect.

- One which will provide a *central online location* where users can share knowledge with like-minded or interested individuals on relevant research areas as indicated by section 4.1.2a. This translates into the need for a Web Portal dedicated to Agroforestry research.
- One which will be more widely used by scientists because it addresses their needs or due to its relevance as shown by the results in section 4.1.2.
- One that integrates RSS feeds on various Agroforestry themes as shown by the results in section 4.1.3a
- One which contains and links research outputs to the selected Web 2.0 tools to enable rapid sharing of Agroforestry research as revealed in section 4.1.3b.
- One which facilitates remote submissions of publications by scientists in the regional offices to avoid missing out on reporting institutional outputs to the various consumers of the World Agroforestry Centre's scientific research as reported in section 4.1.3b. This will contribute to strengthening science quality since scientists will ensure what they submit is of the highest standards.
- One with an appealing design outlining the usefulness of Agroforestry Web 2.0 tools and how researchers can make the most out of them according to sections 4.1.4, 4.1.7 and 4.1.8.”
- One which, according to the results in section 4.1.5, will categorize The World Agroforestry Centre's scientific outputs online according to the targeted consumers of its research. This will make it easy for them to access relevant information and share it with the right audience. This will contribute to achieving three of the four institutional strategic objectives listed in section 1.2.3.3, namely *enhancing operational efficiency*, and *strengthening*

*institutional partnerships* by categorizing information for specific user groups, *accelerating impact of scientific research* by using the integrated Web 2.0 tools.”

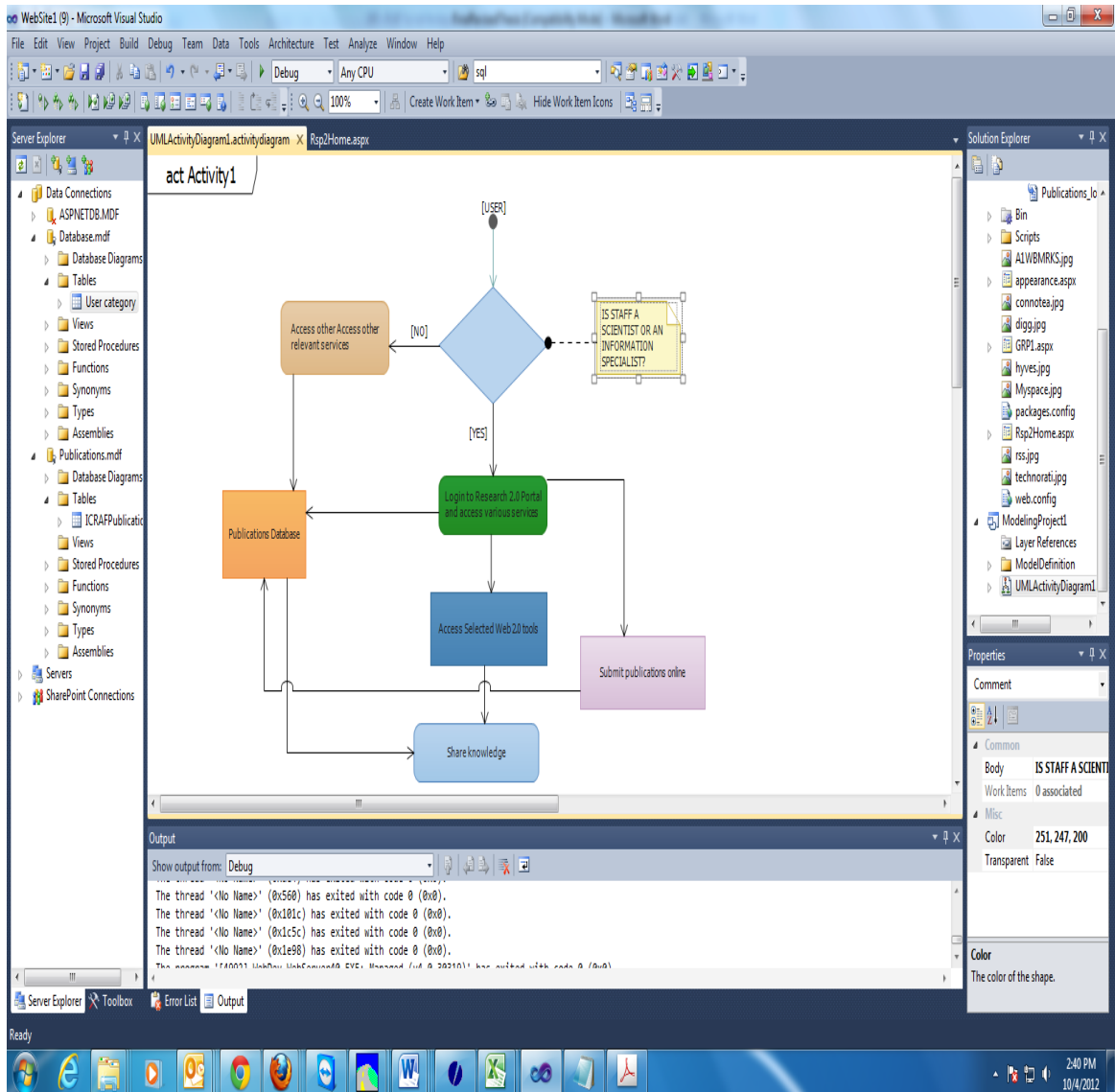
## **5.2 SYSTEM MODELING**

This section is a detailed abstraction of the proposed prototype (*Research 2.0 Portal*). It outlines the system modeling process and the tools used to design and develop the prototype and the database structure of the database that will be employed by the system.

The Unified Modeling Language (UML), a standardized general-purpose software engineering modeling language (Booch, Jacobson, & Rumbaugh, 2000) was used to elaborate the logical design of the Research 2.0 Prototype.

UML includes a set of graphic notation techniques to create visual models of software systems. This notation is used to specify, visualize, modify, construct and document the system under development and offers a standard way to visualize a system's architectural blueprints (Mishra, 1997).

In developing this prototype, a UML activity diagram was used to describe the step-by-step workflows of the components of Research 2.0 Portal. The UML activity diagram shows the overall flow of control.



**Figure 13: UML Activity Diagram on Visual Studio.Net 2010 Integrated Development Environment**

The UML activity diagram demonstrates the workflow and the interaction between the user and the various system components.

The initial node is the **USER** who is either a **Researcher**, a **Farmer**, an **Information Specialist** or **Other** type of support staff such as HR, and Administrative staff as listed in section 1.2.3.2 (Support funtions). Depending on the User Category, one is able to log into the portal and access the online publications system allowing them to

submit their publications to the World Agroforestry Centre Publications database as well as access publications for sharing using any of the top ten Web 2.0 tools relevant to Agroforestry research. Other users such as **Administrative personnel** and **Donors** will be able to access the publications database and generate reports based on individual scientists' records and the six Agroforestry research themes.

### 5.2.1 Database Design

Drupal's online Extensions Directory was used to download the Drupal Webforms module which was used to design the table schema for data capture.

#### 5.2.1a Publications Submission Database

The Publications Submission Form holds the **Publications Table** whose schema is designed to collect data on all the scientific outputs (publications) by the World Agroforestry Centre researchers.

**Table 5.1 - Research Publications Table Schema**

Column Name	Data Type	Allow Nulls
<b>ID</b>	Int	NO
<b>Title</b>	Text	NO
<b>Author</b>	Text	YES
<b>Corporate_author</b>	Text	YES
<b>Place</b>	Text	YES
<b>Publisher</b>	Text	YES
<b>Research_area</b>	Text	NO
<b>Target_audience</b>	Text	NO
<b>Publication_category</b>	Text	NO
<b>Publication_date</b>	Date	NO

### 5.2.1b Free Resources Database

Among the consumers of World Agroforestry Centre’s research are Information Resource Centres that regularly need information updates pertaining to Agroforestry. A database of free resources is required to capture details of materials for distribution. This database will have the same schema like the **Publications table** of the Publications Submission database.

**Table 5.2 - GIFTS Table Schema**

Column Name	Data Type	Allow Nulls
<b>ID</b>	Int	NO
<b>Title</b>	Text	NO
<b>Author</b>	Text	YES
<b>Corporate_author</b>	Text	YES
<b>Place</b>	Text	YES
<b>Publisher</b>	Text	YES
<b>Research_area</b>	Text	NO
<b>Target_audience</b>	Text	NO
<b>Publication_category</b>	Text	NO
<b>Publication_date</b>	Date	NO

### 5.2.2 Physical Design

The physical design of Research 2.0 Portal prototype refers to the user interface design and the database schema for the scientific knowledge represented by the research outputs which are institutional publications and the system’s user categories as listed in section 4.1.5 on Consumers of World Agroforestry Centre’s information.

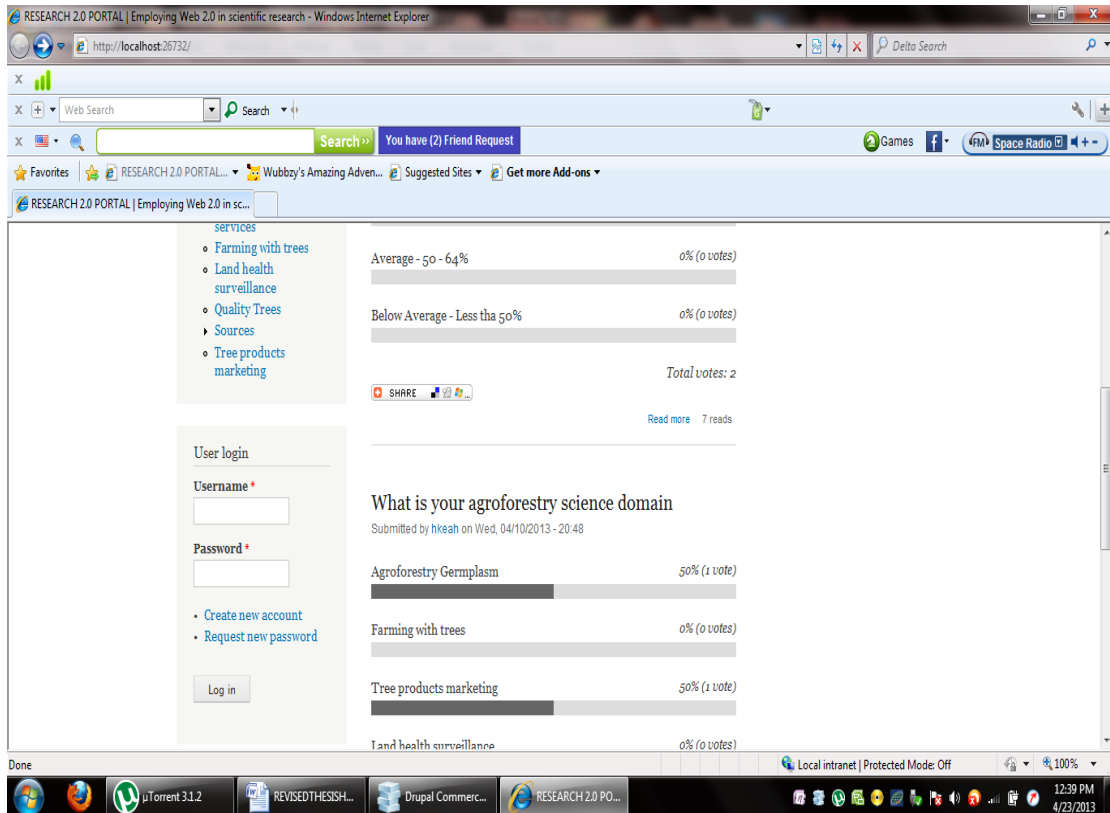
### **5.2.2a User Interface Design**

Drupal Content Management System built on Microsoft ASP.NET and running on Windows is the development tool employed in developing the user interface of Research 2.0 Portal prototype.

Drupal is a suitable development tool since it is built on the Web 2.0 philosophy making it easy to build Web 2.0 features such as blogs, RSS feeds, opinion polls, as well as extend a Website's functionality by integrating Web 2.0 plugins known as Extensions which are designed to perform various tasks such as creation of web forms, integration of knowledge sharing tools and online advertisements. The main features of the physical system user interface are as follows:-

### **5.2.2b System Security**

Users will access the services offered by Research 2.0 Portal based on their authentication status. Users will initially be required to register and upon revisiting the portal will be required to authenticate themselves by username and password.



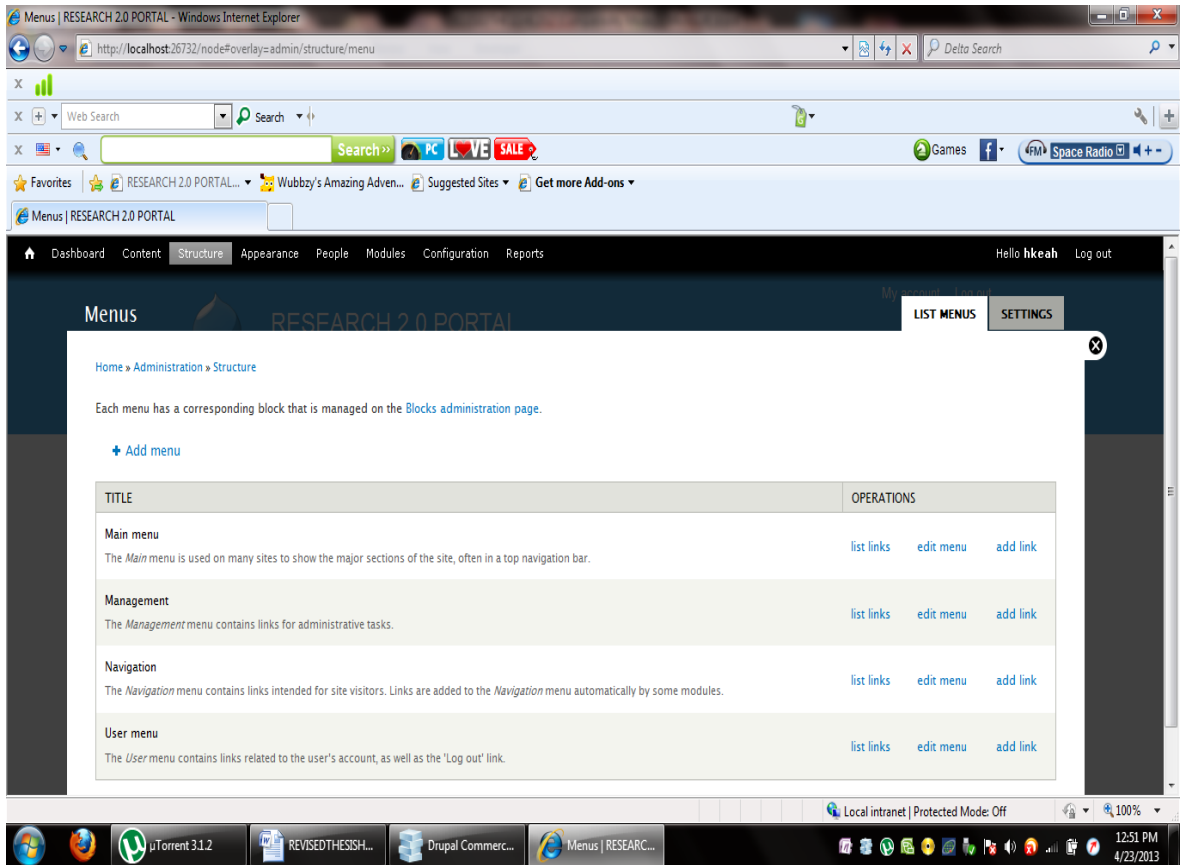
**Figure 20: Authentication Controls**

### 5.2.2c Menu Control

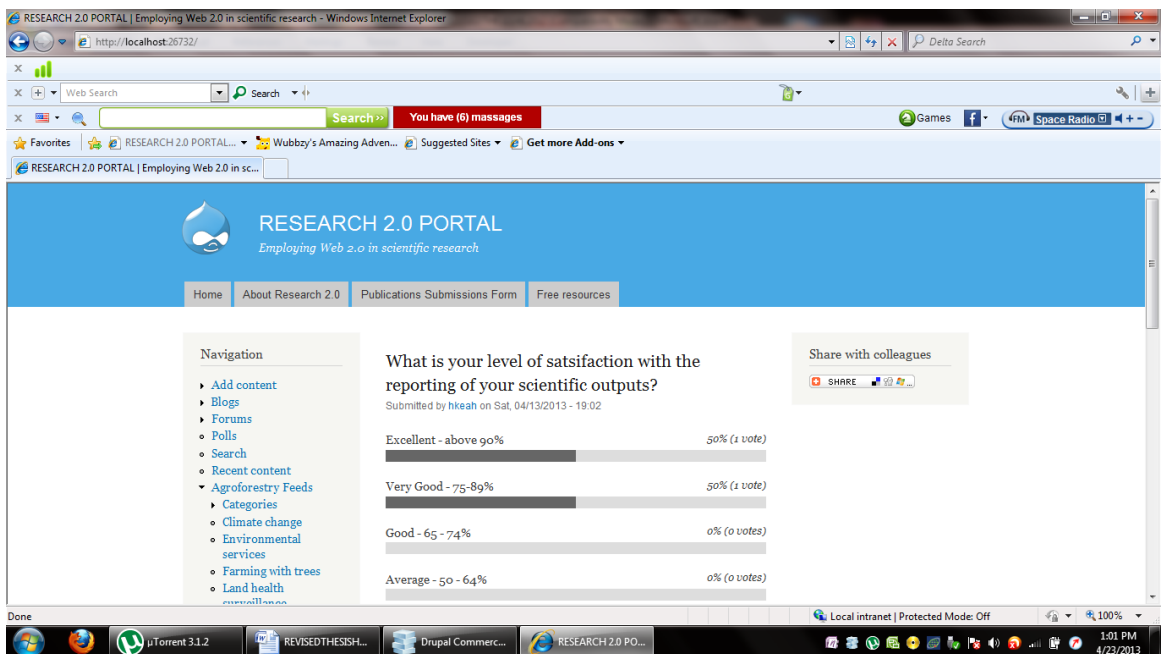
The Menu control was used to create the Main menu comprising of the following elements:-

Home (which links back to the main website), About Research 2.0, Research areas, Research 2.0 tools, Regions, Databases, Free resources, Languages and Online Publications Submission.





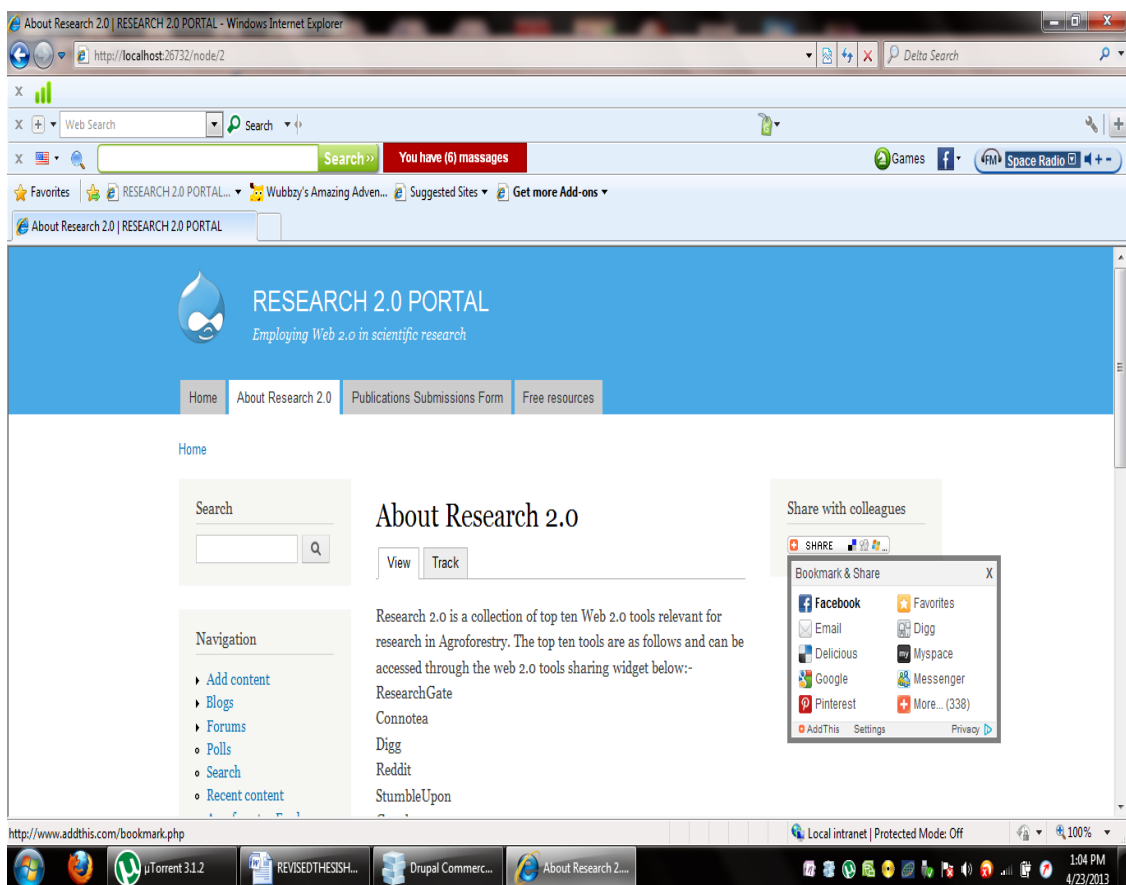
**Figure 21: Menu Controls**



**Figure 22: Menu Items Added to Main Page**

### 5.2.2d About Research 2.0 Portal

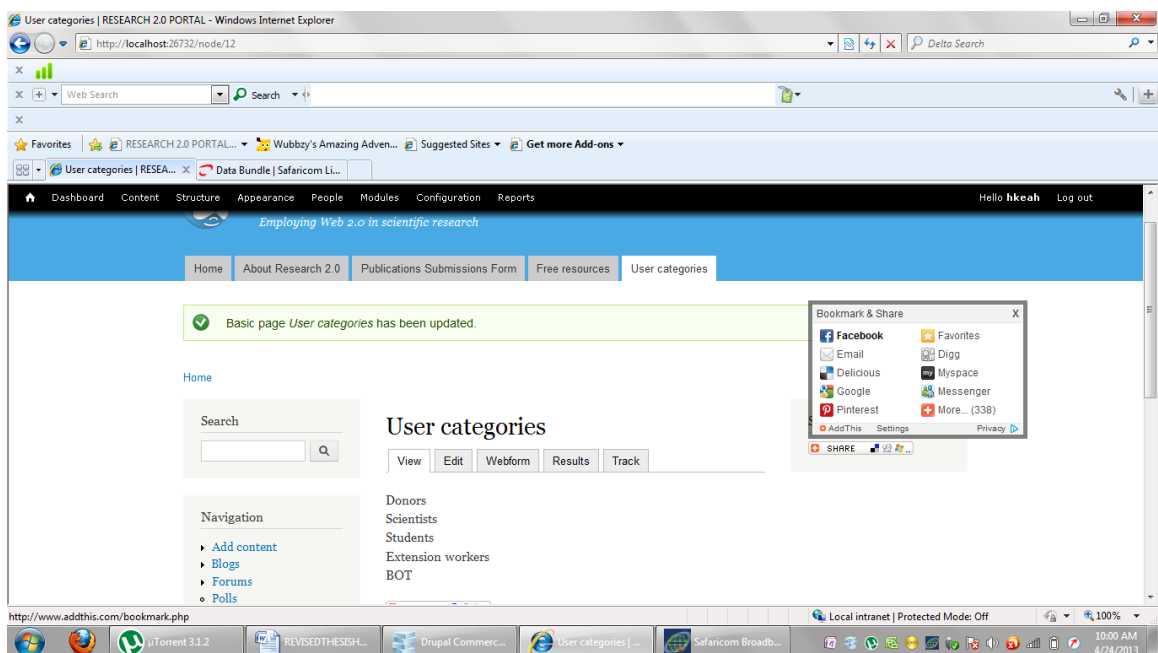
This section outlines the scope of Research 2.0 Portal to the users and lists the top ten Web 2.0 tools relevant to Agroforestry and displays the knowledge sharing widget alongside the list. Typing the required Web 2.0 tool's name makes it pop out and the user can create an account and proceed with instructions on how to make use of the tool.



**Figure 23: About Research 2.0 Portal**

### 5.2.2 e Discussion Forums

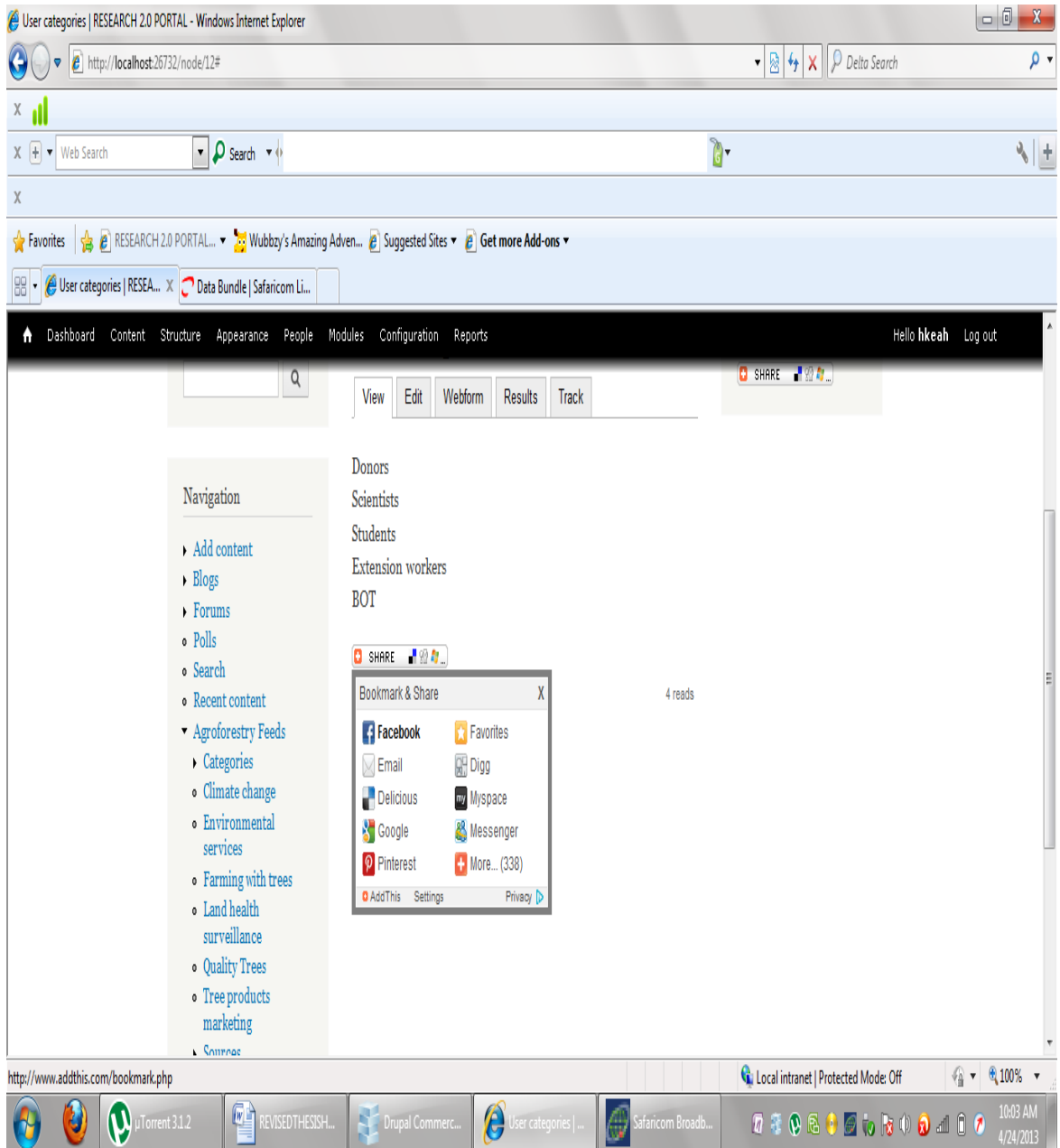
Nine Forum groups were created on the Drupal Configuration Manager based on the list of nine user categories on Table 4.0 of section 4.1.5 – *Consumers of the World Agroforestry Centre’s Research*. A user belonging to a given category will be able to view all the research relating to his or her area of interest and these can be shared using any of the relevant Web 2.0 tools.



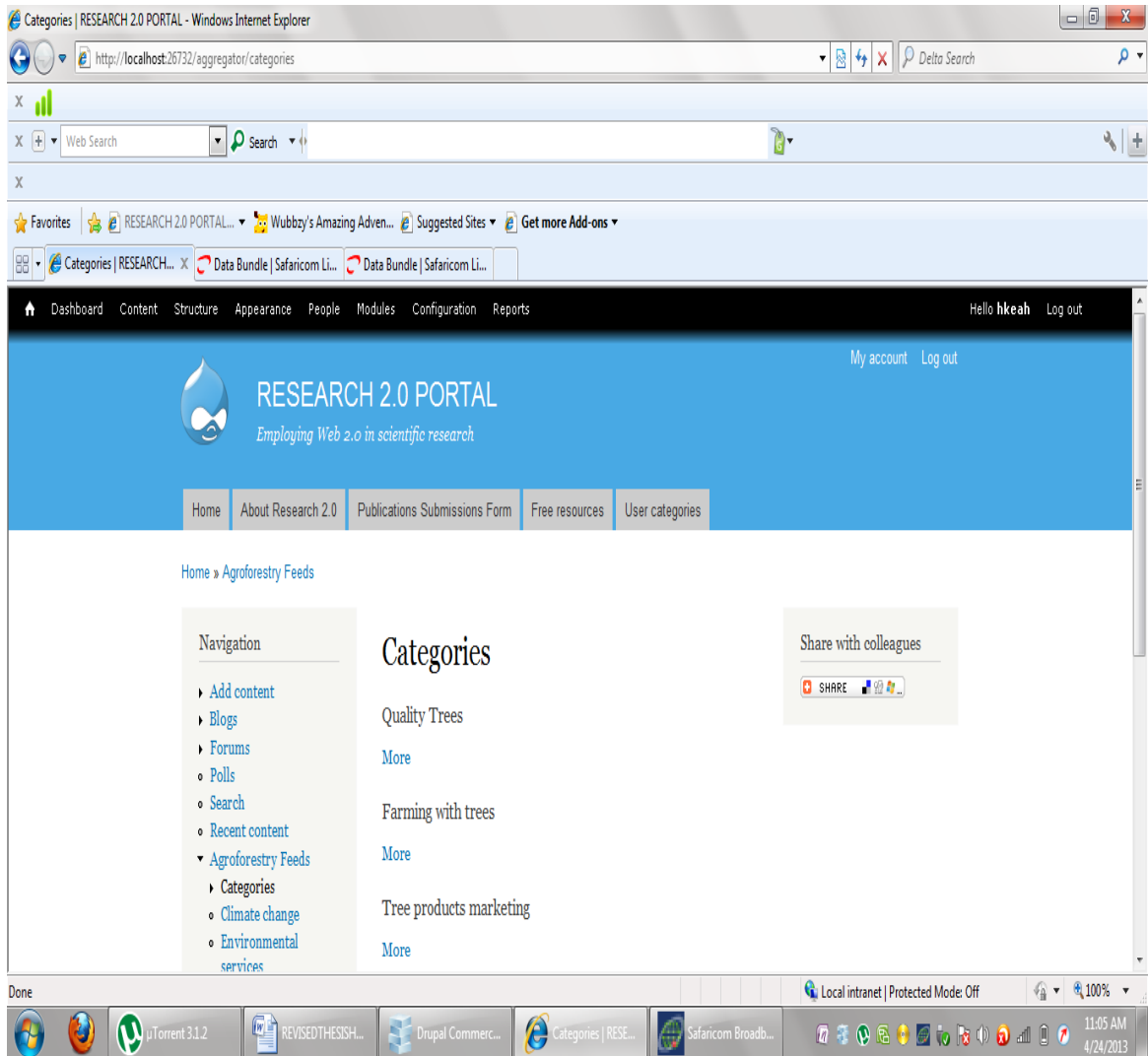
*Figure 24: Discussion Forums Menu*

### 5.2.2 f Research Areas

This refers to the six Agroforestry research themes at the World Agroforestry Centre (ICRAF). Selecting any of the six areas, will be present the user with all the related information in Research 2.0 Portal and that can be shared with colleagues through any of the top ten Web 2.0 tools available on the Web 2.0 sharing widget on the page.



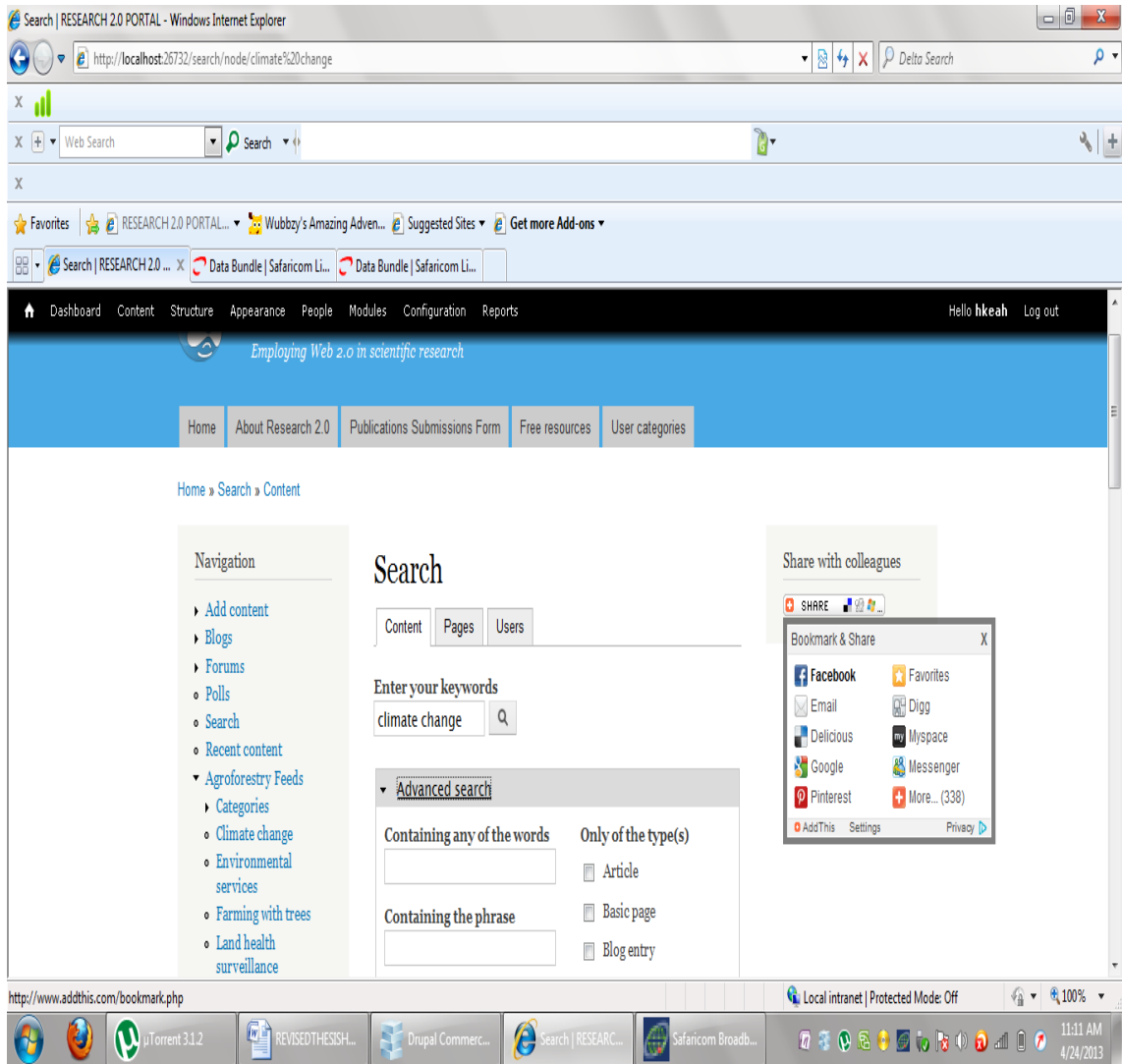
**Figure 25: Research Areas Menu**



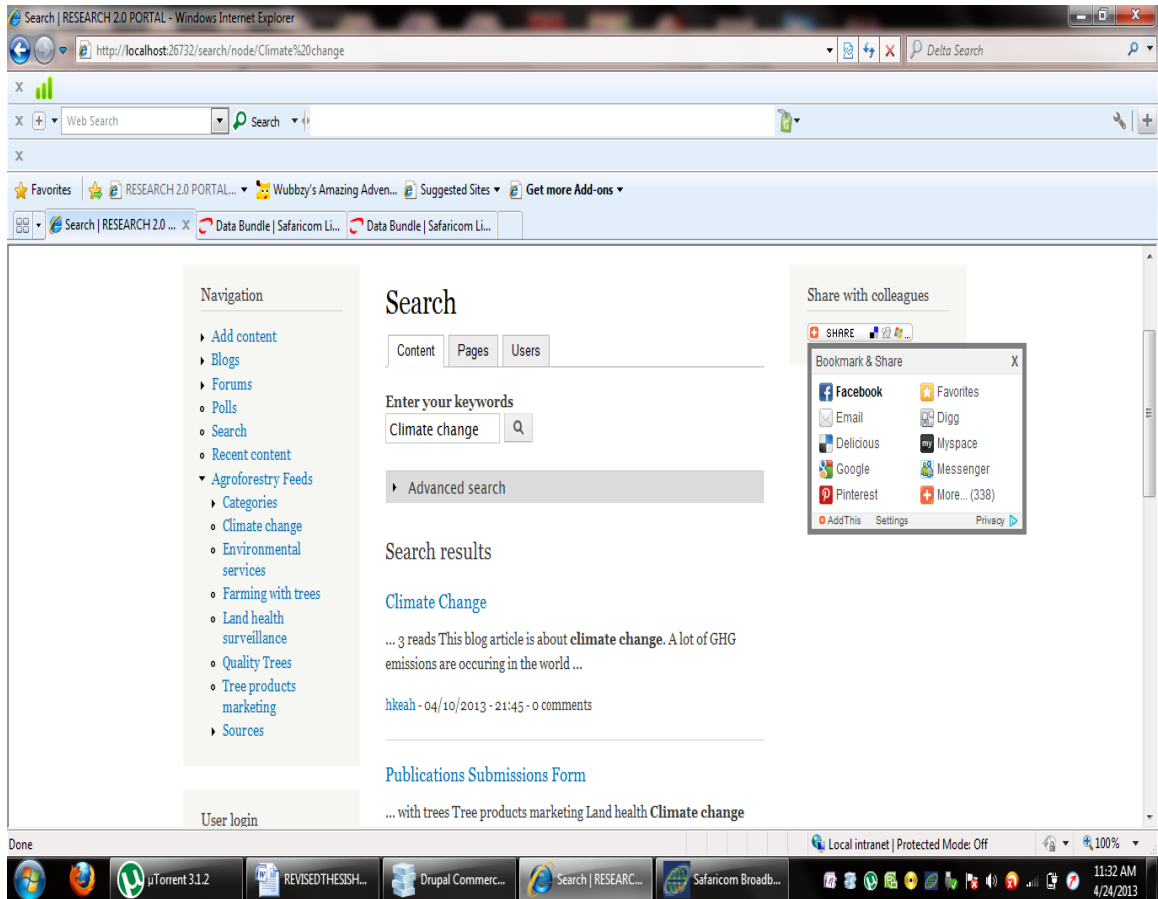
**Figure 26: Results of Selected Research Areas (Categories)**

### 5.2.2g Search Interface

The Configuration manager was used to build the search interface which includes an Advanced Search. The Search results can then be shared using the relevant Web 2.0 tools available on the Web 2.0 sharing widget to the right of page .



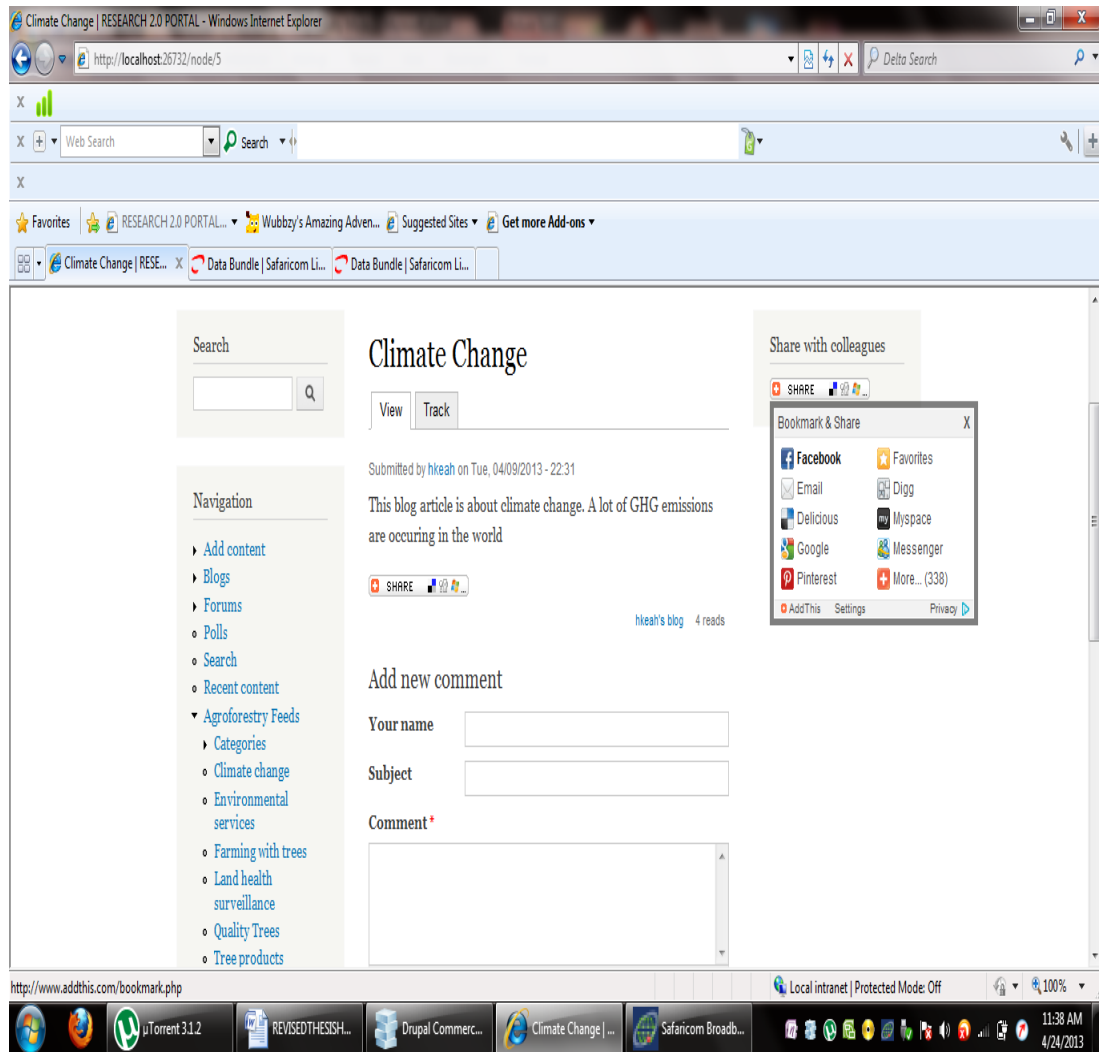
**Figure 27: Publications Search Interface**



**Figure 28: Search Interface Showing Results for "Climate Change"**

### 5.2.2 h Blog and Comments Area

The Configuration Manager was used to create a Blogging section with a multiline textbox for users of the portal to post their comments on a particular research topic e.g. Climate change.

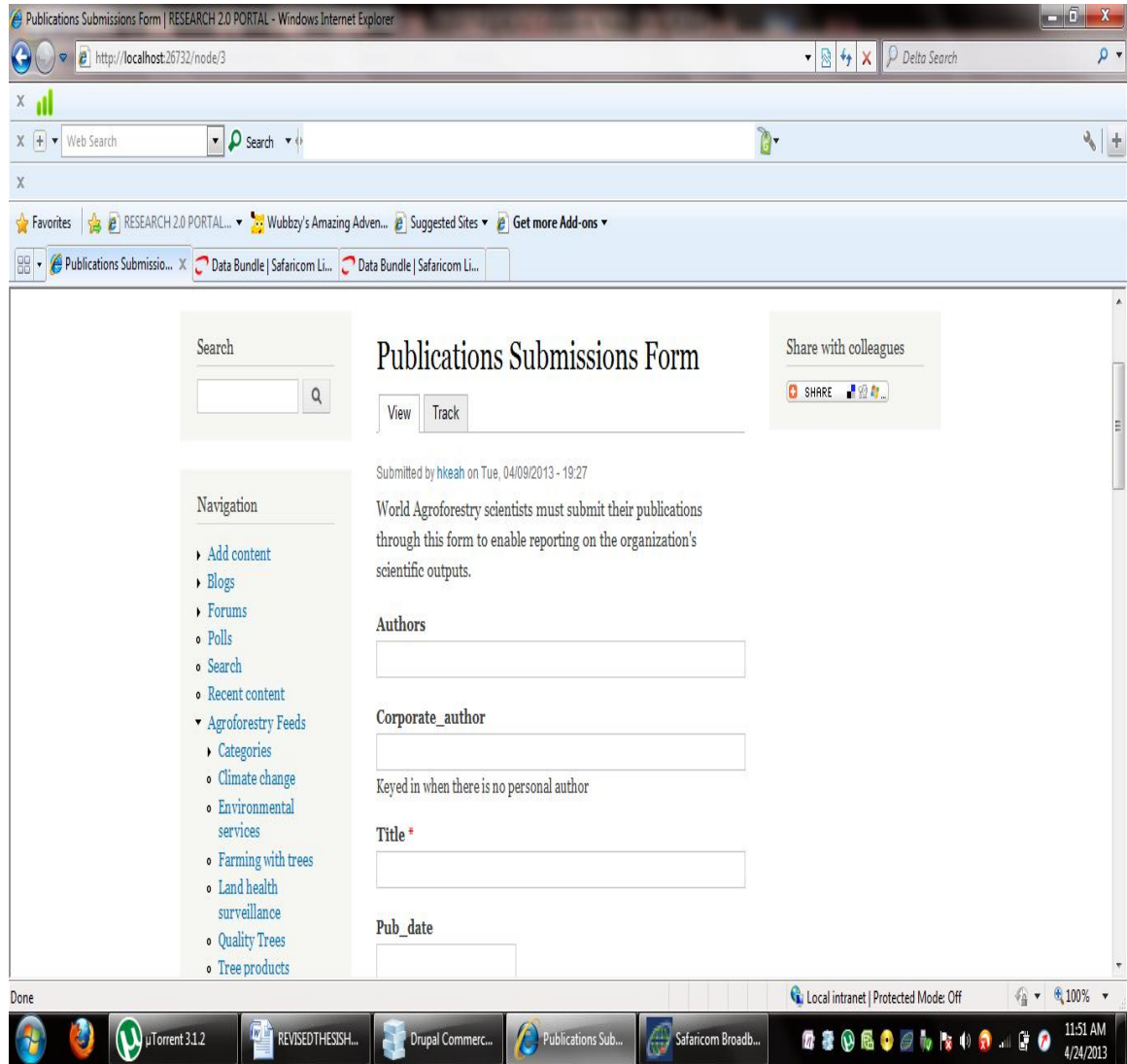


**Figure 29: Blog & Comments Area**

### 5.2.2 i Publications Submission Form

Finally, the Drupal Webform Extension from the online Drupal Extensions Directory was used to design a Webform through which scientists can submit their scientific outputs.





**Figure 30: Publications Submission Form**

### 5.3 RELEVANT WEB 2.0 TOOLS

This section consists of the top ten Web 2.0 tools according to the ranking obtained through the Web 2.0 tools evaluation matrix described in section 3.7.2 (Appendix III). Researchers can use of any of these tools to share Agroforestry research information. The following are the top ten Web 2.0 tools recommended for integration into Research 2.0 Portal and their features depicting their relevance to Agroforestry research:-



### 5.3.1 Research Gate Scientific Network

ResearchGate is a Web 2.0 site with a membership of over 2.1 million users spread across divergent disciplines. It strives to facilitate scientific collaboration on a global scale. ResearchGate membership cuts across a range of disciplines and the following statistics show the breakdown in terms of membership and scientific outputs (publications) of disciplines related to the science of Agroforestry:-

**Table 5.3: Research gate Network Content by Scientific Discipline**

<b>DISCIPLINE</b>	<b>MEMBERSHIP</b>	<b>PUBLICATIONS</b>
<b>Physics</b>	<b>58,485</b>	<b>2,437,284</b>
<b>Mathematics</b>	<b>40,171</b>	<b>872,150</b>
<b>Geoscience</b>	<b>43,831</b>	<b>798,052</b>
<b>Chemistry</b>	<b>157,620</b>	<b>3,894,792</b>
<b>Biology</b>	<b>356,083</b>	<b>9,183,359</b>
<b>Agricultural Science</b>	<b>120,412</b>	<b>1,807,519</b>
<b>Space Science</b>	<b>17,894</b>	<b>329,920</b>
<b>Economics</b>	<b>81,533</b>	<b>1,043,764</b>

### **5.3.1.1 Features**

#### ***ResearchGate Live Feed***

This feature allows one to share notes, publications, links, images and files in real time with the Public, ResearchGate users, one's followers and contacts on ResearchGate.

#### ***ResearchGate Topics***

ResearchGate has a range of topics related to Agroforestry which users can select and pose questions to the Public, ResearchGate users, one's followers and contacts on ResearchGate. One can also choose topics to follow and the ResearchGate suggests additional topics to follow.

#### ***ResearchGate Projects***

ResearchGate allows one to create projects and define their activities as well as add members who will collaborate by contributing their ideas on the projects through ResearchGate.


#### ***ResearchGate Institution***

ResearchGate allows its users to create their institutional profiles including departmental information. It also automatically reports the total count of publications by a particular institution as well as the institution's total membership.

#### ***ResearchGate Publications***

The publications section of ResearchGate allows one to upload publications for sharing. It also displays images of researchers connected with research relevant to the uploaded publications.

**ResearchGate Jobs** Finally, ResearchGate has a Research jobs page listing employment opportunities categorized by discipline. On this page one can also post a job or subscribe to RSS feeds and monthly e-mail alerts for new employment opportunities.

**5.3.2 Citeulike**  CiteULike is a free service for managing and discovering scholarly references with over 6.5 million online references.

#### 5.3.2.1 Features

**CiteULike Profile** The Profile page of CiteULike is used to capture personal details of the users which will be necessary to categorize the users according to some criteria. This section allows users to add favorite references for future reading. The added items are listed and various database functions can be performed on the list such as sorting, exporting in the following encoding formats:-

<b><u>RIS</u></b>	Export as RIS which can be imported into most citation managers
<b><u>BibTeX</u></b>	Export as BibTeX which can be imported into most citation/bibliography managers
<b><u>PDF</u></b>	Export formatted citations as PDF
<b><u>RTF</u></b>	Export formatted citations as RTF which can be imported into most word processors
<b><u>Formatted Text</u></b>	Export formatted citations as plain text

The CiteULike Library is also searchable and provides access to recent additions to its publications database through RSS feeds.

### ***CiteULike Authors***

*CiteULike Authors* is a list of all the authors whose names are recorded in the *CiteULike database*. This feature also shows the number of times that a given author has been cited.

### ***CiteULike Tags***

*CiteULike Tags* lists all articles in the *CiteULike* library defined by a particular tag. A superscript numeral indicates the frequency of the particular tag in the library and clicking on it will return all articles defined by that tag including other people who have accessed the article.

### ***CiteULike URL Posts***

This page allows one to post the URL address of an article using the http:// protocol, the digital object identifier (DOI) or its ISBN. One can post from a vast number of online journals and if the chosen journal is not supported, a request can be made to *CiteULike* for it to be included.

### ***CiteULike Manual Posts***

If the *CiteULike URL Post* does not work, it can be done manually by supplying all the publication details provided in the manual posts template. CiteULike Blog.

This section allows one to create a blog where people other users can comment and one can specify the level of privacy preferred. On this page one can also populate the

blog with a set of tagged articles and select a citation display format out of the sixteen citation formats provided by CiteULike.

***CiteULike Groups*** On CiteULike, if one is not a member of any group, one is free to create a new group and one will be responsible to manage its membership and content.

### ***CiteULike Recommendations***

*CiteULike* implements several algorithms for recommendations, such as the **User-Based Collaborative Filter (UBCF)** – where the system finds other libraries that are most similar to a user’s library and selects articles from those other libraries to recommend them to the user.

### ***CiteULike Neighbours***

These are *CiteULike* users who have bookmarked the same items as a particular user. This can be useful for researchers to determine who else they could possibly strike some collaboration with on certain projects.

### **5.3.3 Reddit**

Reddit is a type of multilingual online community where users vote on content so that the most important stories are featured on top of the list and the less important ones sink to the bottom. There are about 2 million registered users (redditors) accessing a variety of information on Reddit. The science section on the Reddit Science page contains various articles and the number of users who are online. One can also opt to submit peer reviewed publications online through Reddit.

### 5.3.3.1 Features

#### *Reddit Peer Reviewed Publications Submission*

This section allows researchers to submit peer reviewed publications on Reddit.

#### *Reddit comments*

- This section allows redditors to submit comments on posts or about reddit. One such comment says, "*reddit is quickly challenging Twitter's turf as a place for real-time updates and citizen journalism.*"

### 5.3.4 Diigo

Diigo is a cloud-based modern information management Web 2.0 tool. It is a collaborative research tool on the one hand, and a knowledge-sharing community and social content site on the other.

#### 5.3.4.1 Features

##### *Diigo Research*

Diigo allows one to highlight text and attach sticky notes to specific parts of web pages. Diigo highlights and sticky notes are persistent in the sense that whenever one returns to the original web page, one will see their highlights and sticky notes superimposed on the original page regardless of where they access the page from.

##### *Diigo Blog*

One can keep things private or public, or shared with a group, publish findings to their blog by using "Send to Blog" feature, by setting up automatic daily posting, one can also easily post to other sites like twitter, facebook, and Delicious.

##### *Diigo groups*

Diigo Groups provides a platform for collaborative research and is a learning tool that allows any group of people to pool their findings through group bookmarks, highlights, and sticky notes.

### 5.3.5 Connotea



Connotea is a free online Web 2.0 reference management tool for all researchers, clinicians and scientists. It allows researchers to save and organize links to references, easily share references with colleagues, and to access the saved references from any computer.

#### 5.3.5.1 Features

##### **Finding references on Connotea**

To add a reference to Connotea, one can save the references to Connotea as one comes across them. One can add any page on the web to their Connotea library. If one adds an academic article, Connotea will automatically import all the bibliographic details of that article.

##### ***Connotea Bookmarks***

On this section researchers can create bookmarks by typing the URL of a given site, its title, some keywords as well as provide some descriptive information about the site. This section also allows the researcher to set access restrictions depending on whether the researcher wants to make his content public or not.



### ***Connotea Groups***

This section allows researchers to create user groups based on their interests, by specifying the Group name and user names of the group members as well as a description of what the group is all about.



### **5.3.6 Live Journal LIVEJOURNAL**

LiveJournal is a social network owned by SUP Media where Internet users can keep a blog, journal or diary of their activities.

#### **5.3.6.1 Features**

##### ***LiveJournal Communities***

This feature allows researchers to join particular groups with similar research interests and share knowledge on various subjects.

##### ***LiveJournal Security***

Unlike in most social sites, LiveJournal provides security eliminating scrutiny of individuals by unwanted observers.

##### ***LiveJournal Tags***

This feature allows users of this tool to mark their contributions with specific keywords which researchers can use to identify content relevant to their research needs.

##### ***LiveJournal Archive***

This feature keeps a record of past events hence it is useful for ensuring that relevant shared information does not get lost.



### 5.3.7 Stumble Upon

Stumble upon is a Web 2.0 tool for discovering or *stumbling upon* interesting information that may be useful for one's research. It has a membership of 25 million *Stumblers*. By selecting the *Follow* link on the Home Page, one is directed to a page with a range of broad subjects e.g. Science, Environment, and Technology to select from. One can also perform a search using some keywords on this page. Once a subject is chosen for *following* Stumble Upon will also display a list of other users who are interested in that area.

#### 5.3.7.1 Features

##### *Stumble Upon Page Creation*

This section allows one to create new pages by submitting their website URLs and selecting areas of interest from a drop down list to categorize the websites. It allows addition of tags and comments regarding the websites being added to the site.

##### *Stumble DNA*

One's *Stumble DNA* is a representation of their *Likes*. It is also a quick way to see what they and other Stumblers have in common. Every page a Stumbler likes belongs to an Interest. All of the Interests on StumbleUpon map to one of fourteen larger categories that are represented by a unique color. The number of Likes a Stumbler has per category determines the amount of a category's color in the Stumbler's DNA. As you like more content, your DNA will change to reflect what you like.

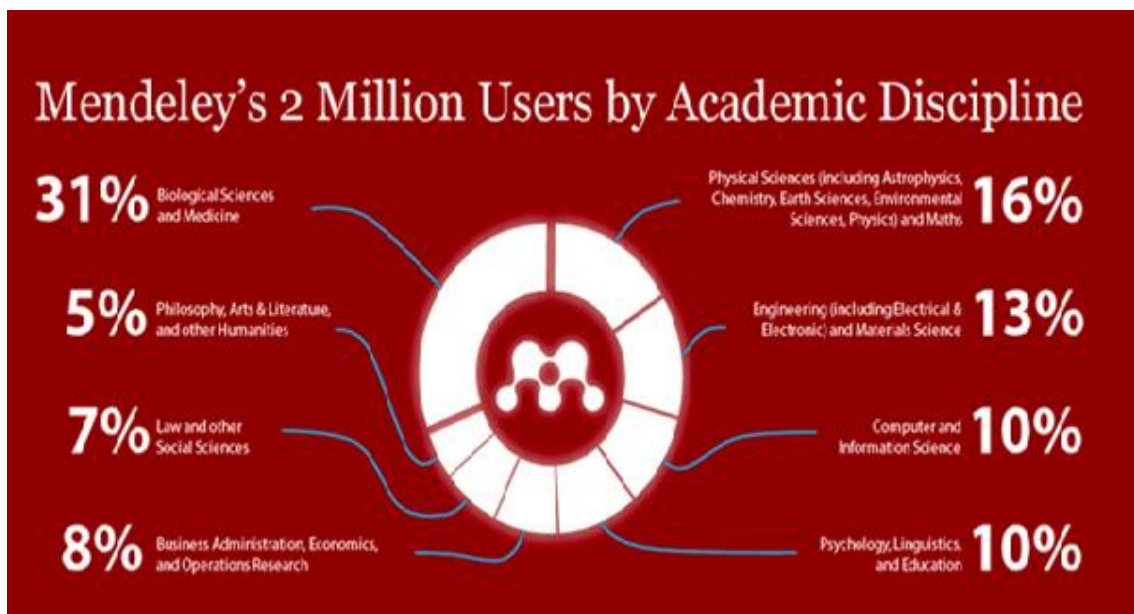
### *Stumble Share*

Stumble Share allows researchers to share its content through e-mail addresses of targeted recipients accompanied with messages from the sender. It also links to other popular social media sites, namely Facebook, twitter and LinkedIn.

### 5.3.8 Mendeley



Mendeley is a Web 2.0 application with a membership of more than 2 million users and is designed to manage research information by organizing, sharing and assisting discovery.



***Figure 31: Demographics of Mendeley Users by Academic Disciplines***

### **5.3.8.1 Features**

#### **Mendeley Dashboard**

The Mendeley Dashboard allows researchers to build their network of contacts on Mendeley and keep up to date with their research updates and profile changes.

#### **Mendeley Library**

Allows researchers to create folders and groups, add to and delete documents from folders, import documents from forty eight different sites including major scientific publishers such as Science Direct, ISI Web of Science, JSTOR, SpringerLink, SAGE, and Spires.

#### **Mendeley Resource Centre**

This is Mendeley's learning facility and allows researchers to find lots of information to guide them through the main components that make up Mendeley which includes how to organize, manage, read and write, collaborate, discover and participate in improving Mendeley.

#### **Mendeley Papers**

*Mendeley papers* feature allows one to search Mendeley's crowd-sourced catalogue with millions of online papers.

#### **Mendeley Groups**

The *Mendeley Groups* feature is a growing component consisting of sixty thousand public groups and allows researchers to search groups in their areas of interest, share papers and start collaborating either publicly or privately.

## Mendeley People

*Mendeley People* feature allows researchers to search contacts by name, research interests, location or keywords. It also allows researchers to invite colleagues to join and form an interest group.

### 5.3.9 Bit.ly

#### 5.3.9.1 Features

##### *Bit.ly Bitmarks*

Bit.ly provides the *Bitmarks* feature to facilitate knowledge sharing. *Bitmarks* are better bookmarks. Bit.ly allows researchers to organize their bookmarks in a user friendly manner.

##### *Bit.ly Bundles*

The *Bit.ly Bundles* feature allows researchers to save, search, and organize all their links from around the web, group them into bundles (categories) and share them with friends through e-mail and Facebook.

*Bit.ly Stats*

The *Bit.ly Stats* page gives a summary of the total number of clicks on a particular topic of interest created by the researcher e.g. Agroforestry, Climate change, Biodiversity etc over a given duration e.g. the last 7 days. Through this, a researcher can easily be able to figure out research trends on given research domains.

### 5.3.10 Google+ (Plus)



Google+ is a Web 2.0 tool with a variety of features useful for extensive information dissemination, including Google maps. A user must create an account to start using *Google+*.

#### 5.3.10.1 Features

##### *Google+ Search*

Google+ Search is built on Ajax technology and has an autosuggest functionality that assists the user select the desired item from a drop-down list of suggested options. For instance typing “*Agrof*” lists all the words starting with these five letters and it is up to the user to select the desired results.

##### *Google+ Circles*

Once logged in, a user can create various categories of people in his or her network, for instance the targeted users of ICRAF’s research e.g. Researchers, Farmers, Donors, Academicians, and BOT.

##### *Google+ Chat*

Google+ Chat is an instant messaging tool that one can use to communicate with members of his or her various *circles* as defined above.

##### *Google+ Calendar and Events*

This feature allows one to create events, for instance conference announcements and invite members of one’s circles – both through Google+ and through e-mail. The created events are also displayed on the Google+ Calendar.

### ***Google+ Share***

Through *Google+ Share* researchers are able to add any new information in terms of text, links and images – both photos and videos, and share them with their *circles* instantly.

## **5.4 PROTOTYPE REVIEW**

After the initial development of the prototype based on user requirements, the prototype was presented randomly to selected members of the nine (9) categories of consumers of the World Agroforestry Centre's research listed in table 4.0 of section 4.1.5 for testing and evaluation in order to provide feedback on possible additions or changes. Some of the users requested for changes on the user interface design in terms of displaying the selected Web 2.0 tools to ensure visibility by the users. They also requested some descriptive information on the User categories and Research areas menus.

### **5.4.1 Prototype Revision and Enhancement**

As noted in section 3.14.4, using feedback from the system users, both the specifications and the prototype can be improved according to the requirements. According to the users' comments mentioned in the review section (5.2.8), it was necessary to enhance the system with the suggestions provided.

For instance, the clients' request for some change on the user interface design in terms of displaying the selected Web 2.0 tools led to the prominent display of their icons to ensure visibility on all the pages of the Research 2.0 Portal.

## **5.5 CHAPTER SUMMARY**

This chapter dwelt on the methodology and tools used to model the Web 2.0 Portal which may be called Research 2.0 Portal because not only does it feature the relevant Web 2.0 tools for Agroforestry Research, but is itself designed with some Web 2.0 features such as Online discussion forums, Blogs, and content syndication with RSS feeds. The chapter also elaborated on the functionalities of the top ten Web 2.0 tools in relation to scientific research and the images of these tools can be viewed in Appendix 1 (Agroforestry 2.0 Tools). In conclusion, as was noted on section 1.9.2 (Study limitations), “Every ten years or so a new technology arrives that changes the way we think about application development” (Liberty, 2005). This observation indicates the highly dynamic nature of technology, meaning the recommended Web 2.0 tools may be rendered obsolete by more superior tools with time. Hence, there has to be constant monitoring of the Web 2.0 landscape to see if any obsolete tools can be dropped and new ones adopted. Hence, Research 2.0 Portal will have to undergo constant monitoring and evaluation by a Web 2.0 Specialist who will make recommendations on upgrades, or future system modifications in terms of integrating new Web 2.0 tools.



## **CHAPTER SIX**

### **SUMMARY OF MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS**

#### **6.0 INTRODUCTION**

This chapter outlines the major findings, concludes on the objectives and research questions and gives recommendations based on the research findings. The conclusions are also tied to the literature review in form of brief discussions.

#### **6.1 MAJOR FINDINGS**

The major findings were used to make recommendations on the implementation of Web 2.0 tools at the World Agroforestry Centre (ICRAF). The level of adoption of Web 2.0 tools for sharing research information at the World Agroforestry Centre (ICRAF) is very low because they are held in low regard as essential to scientific research. The study has revealed some relevant Web 2.0 tools that can attract the interest of scientists by virtue of their content and the audience they target.

Given the World Agroforestry Centre's operations across six regional offices globally there is need to address the Francophone audience through its West and Central African Office, the Hispanic audience through its Latin American office, the Indonesian audience through its Southeast Asia office, and the Chinese audience through its South Asia node. Users in these regional offices would be more comfortable accessing information in their native languages through a multilingual portal.

A look at the World Agroforestry Centre' Social Network Analysis map on section 2.1.4 reveals that it is a tight network without the loose connections characterized by the Web 2.0 paradigm. This strengthened the need to introduce Web 2.0 tools for scientific research due to their strong network effects.

## 6.2 CONCLUSION & RECOMMENDATIONS

It can be seen from the findings that the subject of Web 2.0 presents an important opportunity for intellectual study by Information and Communication Specialists because of its immense capacity for knowledge sharing.

The field of Agroforestry being one of the disciplines that heavily relies on scientific research can be classified as one of the disciplines that stands to benefit from the use of Web 2.0 tools.

The first research objective which was *to examine the features of existing Web 2.0 tools* was fulfilled by accessing and evaluating a total of 120 Web 2.0 tools aggregated on the **AddThis** Social bookmarking toolbar on the Internet. The results obtained from their evaluation can be extrapolated to the population of 226 Web 2.0 tools on the **AddThis** Social bookmarking toolbar.

Given the variety of content and audience of Web 2.0 tools, the second research objective focused on *the relevance of Web 2.0 tools*. However, this study has established in section 4.1.2 that at least eighty five (85) of the Web 2.0 tools investigated are relevant to Agroforestry research, hence it can be concluded that

there is great potential in using Web 2.0 tools to propagate scientific research at the World Agroforestry Centre.

The third objective of this study focused on studying *the extent of use of Web 2.0 tools for sharing research knowledge at the World Agroforestry Centre*. As noted in section 4.13 majority of the users of Web 2.0 tools at the World Agroforestry Centre were non-scientific staff. This observation agrees with the second study assumption in section 1.7 which supposes that Information and Communication Specialists may be the right professionals to engage scientists on the application of new ICT tools in a research organization. It can also be emphasized that Information professionals may be the right personnel to sensitize others on the role of Web 2.0 tools because they are likely to explore more on the capabilities of Web 2.0 tools since their work is about raising the standards of information sharing.

A look at consumers of the World Agroforestry Centre's information (4.1.5) can also be useful in determining the extent of use of Web 2.0 tools bearing in mind that majority of the users are non-scientific staff as noted in section 4.1.3. This means use of Web 2.0 tools within the organization needs to be extended to cover users who are engaged in the core business of the organization, namely the World Agroforestry Centre scientists.

The fourth study objective was *to establish the challenges experienced by research scientists in the application and use of Web 2.0 tools*. Most scientists pointed out that familiarity with modern ICT trends poses the most serious challenge. Even the Information and Communication Specialists who were more prolific users than

scientists agreed that there is need to sensitize users more on the applications of Web 2.0 to specific situations such as scientific research. This is further corroborated by the results in sections 4.1.7 and 4.1.8 on the impacts of Web 2.0 and recommendations from users concerning the use of Web 2.0 tools.

The final objective of prototyping a web-based knowledge sharing portal integrating relevant Web 2.0 tools was achieved through the design and development of *Research 2.0 Portal* Prototype. The goal of the portal can be summed up as consisting of capturing information from researchers and information specialists into related databases, querying the Portal and sharing the results and any other related Agroforestry research information through the relevant integrated Web 2.0 tools.

### **6.3 RECOMMENDATIONS**

A couple of recommendations are proposed in order to improve knowledge sharing with Web 2.0 tools at the World Agroforestry Centre and consequently contribute towards achieving the Centre's institutional strategy.

#### **6.3.1 Integration of Relevant Web 2.0 Tools on the Prototype Portal**

As established in section 2.1.2 on the theory of Social Network Analysis, "*more open networks, with many weak ties and social connections, are more likely to introduce new ideas and opportunities to their members than closed networks with many redundant ties*" (Passmore, 2004). The World Agroforestry SNA map shows that it is tightly connected and therefore needs to be extended by adding more open networks or weak ties.

The integration of relevant Web 2.0 tools in effect translates to increasing the number of loose connections on ICRAF's social network map by extending the network to more users targeted by the recommended tools. This recommendation addresses the issue of viability of Web 2.0 tools for research (section 4.1.2) and that of loosening ICRAF's tight social network map (section 2.1.4).

The following top ten Web 2.0 tools (which could be referred to as *Agroforestry 2.0 tools or Research 2.0 tools*) are recommended for integration into the Research 2.0 Prototype Portal:-

*ResearchGate, CiteULike, Reddit, Diigo, Connotea, LiveJournal, StumbleUpon, Mendeley, Bit.ly, and Google+*

### **6.3.2 Research Outputs Submission**

In order to avoid the problem of research outputs failing to reach the targeted audience in good time due to the absence of online submission of research outputs by scientists, it is recommended that researchers submit their own research outputs through the Submissions Form instead of waiting for e-mail reminders from Information Specialists.

### **6.3.3 Web 2.0 Sensitization**

It is highly recommended that regular workshops to sensitize researchers and other users of Web 2.0 at the World Agroforestry Centre be conducted to boost the extent of

use of Web 2.0 tools at the World Agroforestry Centre. Such trainings could be tapped from relevant organizations such as the CGIAR ICT/KM Program or the Technical Centre for Agriculture (CTA) Web 2.0 Training initiatives that have been rolled out in various countries including one in which the author of this study participated in Rome, Italy (2009) and some of which have been held at the Moi University School of Information Science.

#### **6.3.4 Web 2.0 Content Localization**

To address the problem of web culture sensitivity it is recommended that the same content be rendered in French for the Francophone audience through its West and Central African Office, Spanish for its Hispanic audience through its Latin American office, Indonesian or Bahasa language through its Southeast Asia office, and Chinese through its South Asia node to make users in these regional offices more comfortable accessing information in their native languages.

#### **6.3.5 Sharing Free Resources through Web 2.0**

As seen in sections 1.3.1 and 1.3.2 Agroforestry information is currently facilitated by e-mail notifications to a targeted audience whereas such information could easily be shared through Web 2.0 tools to target as many clients as possible. It is recommended that a **Free Resources** database be introduced to capture details of materials for distribution. This is likely to positively contribute to meeting the organization's strategic objective of strengthening partnerships with organizations and individuals that are interested in Agroforestry research.

### **6.3.6 Web 2.0 Specialist**

As noted in section 1.9.2 “*Every ten years or so a new technology arrives that changes the way we think about application development*” (Liberty, 2005). This means Web 2.0 tools are undergoing constant modification. It is highly recommended to have in place a Web 2.0 Specialist to monitor and evaluate the relevance of Web 2.0 tools as they evolve. This will ensure that the best tools are being employed to facilitate optimal results in communicating the organization’s research and related activities.

### **6.3.7 Social Media Policy**

In the midst of rapidly proliferating social media tools, it is important to institute regulations on the proper use of Web 2.0 tools. Such guidelines could be modeled on the plan adopted by the International Fund for Agricultural Development (IFAD) Social media guidelines which are accessible on Slideshare (Samii, 2011). The policy will prevent abuse of the tools available for use by the organization’s staff.

### **6.3.8 RSS Feeds on Website and Intranet**

It is suggested that RSS feeds specific to the organization’s Global Research Priorities (GRPs) be implemented. Such feeds will alert the researchers whenever there is an update on the content of *Research 2.0 Portal*.

## **6.4 SUGGESTIONS FOR FURTHER RESEARCH**

This study focused on the integration of relevant Web 2.0 tools on a multilingual portal to aid scientific research at the World Agroforestry Centre (ICRAF). In the

course of developing the multilingual interface for Research 2.0 Portal, it was discovered that within the wider CGIAR context (to which the World Agroforestry Centre belongs) there is a growing interest in making research data open access and shareable through Web services. Hence the Semantic Web (Web of Data) as an agent for research support using linked open data is suggested as an area for further research.



## BIBLIOGRAPHY

- American Psychological Association (APA). "Technophobia." October 2010. December 2011 <http://dictionary.reference.com/browse/technophobia> .
- Aubrey, A. "Happiness: it really is contagious." *British Medical Journal*. doi: <http://doi.dx.org/10.1136/bmj.a2338> (2008).
- BBC News. *Facebook friends mapped by Wolfram Alpha app*, 24 September 2012.
- Bell, R.J. *Social Networks - what are they?* 21st October 2007.
- Bellinaso, M. *ASP.NET 2.0 Website Programming: Problem-Design-Solution*. Indianapolis: Wiley Publishing Inc., 2006.
- Best, D. "Web 2.0: next big thing or next big Internet bubble?" *Lecture on Web Information Systems*. Technische Universiteit Eindhoven, 2006.
- Booch, G., I. Jacobson and J. Rumbaugh (2000). *OMG Unified Modeling Language Specification*.
- Borgatti, S.P. *NetDraw Network Visualization*. Harvard, MA: Analytic Technologies, 2002.
- Chiq. 2010. December 2011 <http://www.chiq.com/> .
- Committee of Inquiry into the Changing Learner Experience. *Higher education in a Web 2.0 world: report of an independent committee of Inquiry into the impact on higher education of students' widespread use of Web 2.0 technologies*. London, U.K.: Committee of Inquiry into the Changing Learner Experience, 2009.
- Decrem, B. "Introducing flock beta 1. Flock official blog." 13th January 2007. December 2011.
- DiNucci, D. "Fragmented future." *Print* 53 (4) (1999): 32.
- Eggers, W.D. *Government 2.0: using technology to improve education, cut red tape, reduce gridlock, and enhance democracy*. Lanham MD, U.S.A: Rowman & Littlefield Publishers, Inc., 2005.
- Flyvbjerg, B. "Case study." *The sage handbook of qualitative research*, Ed. K. Norman, et al. 4th. Thousand Oaks, CA: Sage, 2011. 301-316.
- . "Five misunderstandings about case study research." 2006: 219-245.
- Freeman, L. *The development of Social Network Analysis*. Vancouver: Empirical Press, 2006.
- Garrett, J.J. Ajax: a new approach to Web applications. "AdaptivePath.com." 2005. *AdaptivePath.com*, June 2011 <http://AdaptivePath.com> .
- Graham, P. "Web 2.0." November 2005. November 2011.

- Granovetter, M. *The strength of weak ties* 78 (1973): p. 1360-1380.
- Greenmeier, L. and Gaudin, S. "Amid the rush to Web 2.0, some words of warning – Web 2.0 – InformationWeek." 4th April 2008. <http://www.informationweek.com>.
- Grimm, T. *The human condition: a justification for rapid prototyping*. Vols. Time Compression Technologies, vol. 3 no. 3. Accelerated Technologies, Inc., 1998.
- Hogan, B, Carrasco, J.A. and Wellman, B. "Visualizing personal networks: working with participant-aided sociograms." *Field Methods* 19 (2) (2007): p. 116-144.
- Holzner, S. *Ajax: your visual blueprint for creating rich Internet applications*. Hoboken: Wiley Publishing Inc., 2006.
- ICT-KM Program of the CGIAR. 2004. CGIAR. December 2011 <http://ictkm.cgiar.org/>.
- Israel Ministry of Foreign Affairs. *Israel video blog aims to show the world 'the beautiful face of real Israel'*. 24 February 2008. Ynet.com. 15th January 2009.
- Kleinfield, J.S. "Could it be a big world after all? The "six degrees of separation" myth." *Society* (2002).
- Krebs, V. "Social Network Analysis: a brief introduction." 2006. <http://www.orgnet.com/sna.html>
- LFC Multimedia. 2010. LFC Multimedia. December 2011 <http://www.classicalplace.com/?u=http%3A%2F%2Fwww.addthis.com%2F%2F3.UHkrk7tejId.classicalplace&t=AddThis+-+Share+Button%2C+Social+Bookmark%2C+Sharing+Plugins+and+Analytics&c=>.
- Liberty, J. *Programming C#*. Beijing, China: O'Reilly Media Inc., 2005.
- Likert, R. "A technique for the measurement of attitudes." *Archives of Psychology* 1932: 1-55.
- Mack, G. "Total Information Awareness Program (TIA)." 2002.
- McAfee, A. "Enterprise 2.0: the dawn of emergent collaboration." *MIT Sloan Management Review* 47.3 (2006): 21-28.
- Mishra, S. "Visual Modeling & Unified Modeling Language (UML) : introduction to UML". 1997. Rational Software Corporation. December 2011 [http://www2.informatik.hu-berlin.de/~hs/Lehre/2004-WS\\_SWQS/20050107\\_Ex\\_UML.ppt](http://www2.informatik.hu-berlin.de/~hs/Lehre/2004-WS_SWQS/20050107_Ex_UML.ppt).
- Nadel, S.F. *The theory of social structure*. London: Cohen and West, 1957.
- OpenWetWare. 3rd March 2009. July 2012 [http://openwetware.org/wiki/Main\\_Page](http://openwetware.org/wiki/Main_Page)

- O'Reilly, T. "What is Web 2.0?." 2005. *O'Reilly Network*. October 2010. <http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html> .
- Paireepairit, I. "Technology behind Web 2.0." 4th July 2007.
- PC World. "Protoyping definition"." 2011. *PC World Magazine*. 2011 [http://www.pcmag.com/encyclopedia\\_term/0,1233,t=prototyping&i=49886,00.asp](http://www.pcmag.com/encyclopedia_term/0,1233,t=prototyping&i=49886,00.asp) .
- Podolny, J.M. & Baron, J.N. "Resources and relationships: social networks and mobility in the workplace." *American Sociological Review* 62.5 (1997): p. 673-693.
- Pritchard, J. "Web 2.0." 17th March 2008. *Wikimedia Foundation Inc*. November 2011. [http://en.wikipedia.org/wiki/User:JohnPritchard/Web\\_2.0](http://en.wikipedia.org/wiki/User:JohnPritchard/Web_2.0) .
- Quantcast. 14 March 2010. 10 April 2010 <http://www.quantcast.com/> .
- ScienceBlogs LLC. January 2006. 1st September 2012 <http://scienceblogs.com/about/> .
- Scott, J. *Social Network Analysis*. London: Sage, 1991.
- Timetoast. *Timetoast website*. 2010. December 2011 <http://www.timetoast.com/timelines/101741> .
- Valdis Krebs. "Social Network Analysis." 2010. *Orgnet.com*. <http://www.orgnet.com/sna.html>
- Walther, S. *ASP.NET 2.0 unleashed*. Indiana: Sams Publishing, 2006.
- Watts, D.J. *Six Degrees: the science of a connected age*. W.W. Norton & Company, 2003.
- Wellman, B., Chen,W. and Weizhe, D. "Networking Guanxi." Thomas Gold, Douglas Guthrie and David Wank (eds.). *Social Connections in China: Institutions, Culture and the Changing Nature of Guanxi*, . Cambridge University Press, 2002. 221–41.
- Wikimedia Foundation Inc. *Social Network Analysis*. 26th September 2012.
- World Agroforestry Centre (ICRAF). *Transforming lives and landscapes: strategy 2008-2015*. Nairobi, Kenya: World Agroforestry Centre (ICRAF), 2008.
- Ynet. "Israel video blog aims to show the world 'the beautiful face of real Israel'." 24 February 2008. *Ynet*. 15 January 2009.

## APPENDIX I: INTERVIEW SCHEDULE

### PART 1: BIODATA

Scientist / Researcher: \_\_\_\_\_

Non-Scientist Staff: \_\_\_\_\_

Department/Unit: \_\_\_\_\_

Job Title: \_\_\_\_\_

### PART 2: SUBJECT MATTER

Q1a. What is your primary source of information?

- 3 Websites
- 2 Software applications
- 1 Print media
- 0 Others (Human sources)

Q1b. Who are the consumers of your information?

- 7 Scientists / Researchers
- 6 Farmers
- 5 Donors
- 4 Policy Makers
- 3 Resource Centres
- 2 All Staff
- 1 Students
- 0 Others (General Public)

Q2a. Addressing geographical barriers:

How do you effectively work in geographically distributed environments?

- 1 Through ICT
- 0 Face to face interaction

Q2b. Which of the following ICT tools do you use most frequently (use the following rating):      2 = Always

- 1 = Sometimes
- 0 = Never

<b>ICT TOOLS</b>	<b>FREQUENCY</b>
<b>SOCIAL MEDIA TOOLS (WEB 2.0 TOOLS)</b>	
<ul style="list-style-type: none"> <li>• Social networking tools</li> <li>• Blogs</li> <li>• Collaborative tools (Wikis)</li> </ul>	
<b>DISCOVERY METHODS (WEB 2.0 METHODS)</b>	
<ul style="list-style-type: none"> <li>• Mashups</li> <li>• Social Bookmarking tools</li> <li>• RSS Feeds</li> </ul>	
<b>OTHERS</b>	
<ul style="list-style-type: none"> <li>• E-mail</li> <li>• Newsletters</li> <li>• Telephone</li> <li>• Teleconference</li> <li>• E-Newsletters Websites / Intranet</li> </ul>	

Q3. What are the main challenges facing you in ensuring efficient and quality dissemination of knowledge?

- 1 ICT- Based
- 0 Non-ICT Based

Q4. Do you know something about the applications of Web 2.0 technologies?

- 1 YES
- 0 NO

Q5. Does your department or unit make use of Web 2.0 technologies to propagate its research agenda?

- 2 Internally
  - YES
  - NO
- 1 Externally
  - YES
  - NO
- 0 Never

- Q6. How does your department / unit use Web 2.0 technologies to disseminate knowledge?
- 2 Information Sharing
  - 1 Information Updates
  - 0 No comment
- Q7. Have your knowledge sharing needs or skills (with regard to realizing the organizational mission), improved as a result of using these tools compared to when you were not using them?
- 3 YES
  - 2 No Comment
  - 1 NO
  - 0 Negative
- Q8. If you have any recommendations on how Web 2.0 can be used to improve the World Agroforestry Centre's (ICRAF) capacity to serve its stakeholders, briefly outline them below:
- 2 YES
  - 1 NONE
  - 0 Negative

## APPENDIX II: PARTICIPANT OBSERVATION SCHEDULE

During the process of conducting this study, the following observation schedule was used to capture data related to the study objectives in order to supplement the interview schedule:-

SUBJECT UNDER OBSERVATION	DEFINITION	OBSERVATIONS
Main consumers of World Agroforestry Centre's information	Researchers, Donors, BOT, Students, Farmers, Community Based Organizations, HR	
Main sources of information	Internet, Intranet	
Attitude of researchers towards information service provision	It can be improved upon significantly	
ICT Tools employed by consumers of World Agroforestry Centre	Website, Intranet, Blog, E-mail	
Knowledge of Web 2.0 Tools	Limited, more training is required in this area	
Use of Web 2.0 Tools	Limited due to limited knowledge of the tools	











131	Linkuj.cz	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Polish?
137	memori.ru	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Russian
139	Meinverzeichniss	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Not very user friendly in terms of login / German - English
143	Moemesto	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Russian
149	Nujjj.nl	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	German; identifies intranet;rich user interface
165	Prati.ba	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Turkish/Polish?
170	Scoop.at (beta)	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	German; rich user interface;good user interface
172	Sekoman	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Turkish/Polish? 947 k members



218	WebNews	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	German
220	Wykop.pl	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Polish
228	Yorumcurum.com	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Turkish?
230	Zalkadok.net	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	foreign language tool	Russian; has cloud tags
7	Delicious	1	1	1	1	1	1	1	1	7
10	BIT.LY	1	1	1	1	1	1	1	1	7 Links to Twitter and Delicious [highly relevant to agroforestry scientific research although not being heavily used]

28	Reddit	1	1	1	1	1	1	1	7	Has Amazon recommendations; allows adverts; detects intranet and is relevant; very relevant to Agroforestry
35	Facebook	1	1	1	1	1	1	1	7	
36	Y!Bookmark	1	1	1	1	1	1	1	7	
43	YouTube	1	1	1	1	1	1	1	7	Rich user interface
46	StumbleUpon	1	1	1	1	1	1	1	7	Has over 25 Million registered users; highly relevant to agroforestry research and is interdisciplinary
51	Yammer	1	1	1	1	1	1	1	7	Rich user interface; relevant to Forestry research as the CGIAR network is there
52	WordPress	1	1	1	1	1	1	1	7	Can be used for sharing blogs by submitting their urls

68	Connotea	1	1	1	1	1	1	1	7	Very Good for research; has blog; step by step instructions on set up
87	Faves.com	1	1	1	1	1	1	1	7	links to facebook; rich user interface;has info on forestry / environment
88	Status.net	1	1	1	1	1	1	1	7	StatusNet is the open source microblogging platform that helps you share and connect in real-time within your own domain.With StatusNet you can encourage collaboration, build and engage your community, and be in command of your brand.
92	Fwisp.com	1	1	1	1	1	1	1	7	Environment, business, science technology; links to twitter facebook, rss;videos;rich user interface;tag clouds
113	Hotklix	1	1	1	1	1	1	1	7	very rich user interface relevant to forestry;links to rss can submit stories through links/urls
114	Hyves	1	1	1	1	1	1	1	7	very rich user interface;relevant



121	Jamespot	1	1	1	1	1	1	1	7	Social bookmarking site; rich user interface available in 12 languages; covers a wide range of fields - relevant
125	Kaboodle	1	1	1	1	1	1	1	7	rich user interface; various subjects, relevant to forestry; business links to Amazon;collects data through 1 question survey (age)
126	Kirsty	1	1	1	1	1	1	1	7	diverse arears; rich user interface relevant to forestry;rss links;share links
134	LiveJournal	1	1	1	1	1	1	1	7	Rich user interface; has good text editor with html option; highly relevant for Agroforestry; one can personalise settings
138	Meneame.net	1	1	1	1	1	1	1	7	Spansih; very rich user interface;relevant to forests suitable for integration
142	Mixx	1	1	1	1	1	1	1	7	Very rich in forestry content; rich user interface; can customize / personalize UI settings;links to twitter has polls;rss feeds

144	Multiply	1	1	1	1	1	1	1	7	Rich user interface; rss relevant to forestry; links to University of Liverpool site ad
146	NetLog	1	1	1	1	1	1	1	7	Rich User interface relevant to forestry;Links to Gmail;Hotmail; MySpace; Yahoo!mail!; Windowslive ID
147	MySpace	1	1	1	1	1	1	1	7	Rich user interface; relevant to forestry; has localization feature to Latin; multimedia;relevant to forestry; multimedia; links to sharing; search engine powered by google
148	NetVibes	1	1	1	1	1	1	1	7	Very mature technology; rich user interface; links to facebook; MySpace; gmail; integrated Googlemaps;relevant to Agroforestry;detects intranet
150	Oknotizie	1	1	1	1	1	1	1	7	Italian; rich interface and relevant to forests
151	Netvouz	1	1	1	1	1	1	1	7	Rich user interface with blog; has a social bookmarking service

152	NewsTrust	1	1	1	1	1	1	1	7	Rich user interface; relevant to forestry; detects intranet;links to facebook
153	Oneview	1	1	1	1	1	1	1	7	Available in three languages- English, German, Italian and rich user interface;links to facebook;very relevant to forestry and has cloud tags
154	Osmosus (beta)	1	1	1	1	1	1	1	7	Rich user interface; relevant to forestry and environment;climate change;carbon trade
166	Propeller	1	1	1	1	1	1	1	7	Excellent search engine;instant logon and links to other web 2.0 tools (Aol); rich user interface;highly relevant to Agroforestry
175	Newsvine.com	1	1	1	1	1	1	1	7	Very rich user interface relevant to forestry;links to popular social networking sites – twitter;facebook;has rss feeds
176	SheToldMe.com	1	1	1	1	1	1	1	7	Very rich user interface linking to other social networking sites e.g. Chitika.com a full-service on-;relevant to forestry;strict on registration;line advertising network serving over 2 billion

										monthly impressions across more than 80,000 websites;French version available and has rss + mail features
179	Simpy.com	1	1	1	1	1	1	1	7	Rich user interface; logon problem relevant to forestry; rss link;social bookmarking site
180	SodaHead.com	1	1	1	1	1	1	1	7	Rich user interface;relevant to forestry;can create polls, blogs etc.
186	Spruzer	1	1	1	1	1	1	1	7	Links to twitter, facebook and sharing ; relevant to forestry & environment;rich user interface
190	Strands	1	1	1	1	1	1	1	7	Very appealing user interface; mainly dedicated to sports can be relevant as has stuff on climate change;English French and Spanish
193	Stumpedia	1	1	1	1	1	1	1	7	Rich user interface relevant to forestry with real time feeds from twitter;links to facebook

196	Symbaloo beta	1	1	1	1	1	1	1	7	Very rich user interface powered by google search engine and links to sites like cnn; Flickr;craigslist; Gmail;wall street journal;has rss feeds;relevant to forestry has web mixes;presents info in tile form
197	Stylehive	1	1	1	1	1	1	1	7	Rich user interface and relevant to forestry research; lifestyle
201	Tagza	1	1	1	1	1	1	1	7	Rich user interface and relevant to forestry powered by Google search engine and has rss feeds; a social bookmarking site
205	The Web Blend	1	1	1	1	1	1	1	7	Very rich user interface;rss feeds relevant to environment and climate change;links to twitter; other areas e.g. typography etc..
206	Tweetmeme	1	1	1	1	1	1	1	7	Good user interface relevant to forestry with hottest links on twitter
209	Tulingq	1	1	1	1	1	1	1	7	Spanish; good user interface relevant to forestry;links to rss, technorati, netvibes,newsgator, and My Yahoo

210	Viadeo	1	1	1	1	1	1	1	7	Links to rss, CNN, has a calendar of localized events; relevant to forestry; very rich user interface
212	Technorati	1	1	1	1	1	1	1	7	Rich user interface and search engine relevant for forestry; links to twitter
217	Wirefan	1	1	1	1	1	1	1	7	Social bookmarking site; rich user interface relevant to forestry and links to rss, xml, Yahoo; Google
224	Yoolink	1	1	1	1	1	1	1	7	Very rich user interface links to facebook, twitter, delicious, has rss; highly relevant;has cloud tags
232	Shelfari	1	1	1	1	1	1	1	7	global community of book lovers and encourages them to share their literary inclinations; rich user interface; relevant to forestry;links to Google and Amazon.com; started 2006 acquired by Amazon.com in 2008; uses recommendation algorithms

233	ResearchGate	1	1	1	1	1	1	1	7	Highly relevant to Agroforestry research; mainly dedicated to scientific research
234	Mendeley	1	1	1	1	1	1	1	7	Highly relevant to diverse disciplines including agroforestry research; links to a variety of publishers databases and integrates with them for data transfer
235	Google+	1	1	1	1	1	1	1	7	Highly relevant to scientific research including agroforestry research; has ability to mashup information from various sources, hence can easily do this for the six agroforestry themes at ICRAF
236	CiteULike	1	1	1	1	1	1	1	7	A free service for managing and discovering scholarly reference with over 6.5 million online references; highly relevant to agroforestry research
23	Diigo	1	1	1	1	1	1	1	7	Links to facebook, yahoo, google; has autosuggest as you type for communities interested in subject matter e.g. forests; highly relevant to forestry and environmental issues

1	A1Webmarks	1	1	1	1	1	1	0.8	6.8	Dynamic linking to Amazon.com as items are added through recommendation algorithms [WorldAgLibrary;pwd=mynew2010PWD] - authoring not strong
8	Digg	1	1	1	1	1	0.8	1	6.8	Has javascript for Digg widgets; rich user interface – relevant for forestry
49	Wirefan Social Bookmarking	1	1	1	1	1	1	0.8	6.8	Links to RSS with XML
57	Yardbarker	1	1	1	1	1	0.8	1	6.8	Rich user interface; relevant to forestry; predominatly sports (BB), links to twitter; facebook; youtube and rss
58	Yoolink	1	1	1	1	1	0.8	1	6.8	Rich user interface; multimedia – links to twitter, facebook
123	Jumptags	1	1	1	1	1	0.8	1	6.8	very rich user interface divers fields relevant to forestry has rss feeds;diverse fileds including the arts music



129	Laaikit	1	1	1	1	1	0.8	1	6.8	Good user interface; can be good for forestry in SciTech category
130	linkaGoGo	1	1	1	1	1	0.8	1	6.8	Rich user interface;bookmarking service;has cloud tags variety of content areas;highly business & tech related
140	MindBodyGreen	1	1	1	1	1	0.8	1	6.8	dedicated to health issues and environment; good user interface
161	Twitter	1	1	1	1	1	1	0.8	6.8	One of the most popular social media tools; has rss feeds:microblogging tool
183	Sportpost	1	1	1	1	1	0.8	1	6.8	Rich user interface links to facebook and twitter, has rss; clouddtags; relevant to environment and therefore forestry;predominantly sports
214	Visitez mon site.com	1	1	1	1	1	0.8	1	6.8	Very rich user interface, French, relevant to forestry; but more of lifestyle

215	Who is.domaintools.c om	1	1	1	1	1	0.8	1	6.8	Very rich user interface relevant to forestry though business oriented
226	Worio (beta)	1	1	1	1	1	0.8	1	6.8	High level rich user interface with recommendations highlighted on the search; links to delicious, Google and blogger
24	.NET Shoutout	1	1	1	1	1	0.7	1	6.7	Mainly technology based – links to twitter, facebook
42	WorldCat	1	1	1	1	1	1	0.7	6.7	Rss
73	Extraplay	1	1	1	1	1	0.6	1	6.6	<b>Limited content; mainly to personal lifestyles – essentially a translation tool – Translate text, webpages and documents – 52 languages available;links to twitter, facebook, Google; good user interface</b>

82	Friendfeed (ff)	1	1	0.8	1	1	1	0.8	6.6	Good user interface; suitable for Agroforestry; links to CNN breaking news and friends (privacy), but not well developed authoring; facebook, twitter; gmail;Yahoo!;Hotmail
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