



Technical Assistance Consultant's Report

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Philippines: Enhancing Community Resource Mapping Through GIS (Cofinanced by the Republic of Korea e-Asia and Knowledge Partnership Fund)

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ABBREVIATIONS

3g/4g	–	Third or Fourth Generation mobile technology
ALS	–	Alternative Learning System
ACT	–	Area Coordinating Teams
AO	–	Assessor's Office
BLGU	–	Barangay Local Government Units
BOT	–	Build Operate and Transfer
BPQ	–	Barangay Profile Questionnaires
CBMS	–	Community-Based Monitoring System
CDD	–	Community-Driven Development
CEAC	–	Community Empowerment Activity Cycle
CLC	–	Community learning center
CLUP	–	Comprehensive Land Use Plan
CMTS	–	Cellular Mobile Telephone System
CPE	–	Customer Premises Equipment
CPP	–	Connectivity Pilot Project
CRM	–	Community Resource Mapping
CSU	–	Caraga State University
CV	–	Community Volunteer
DepEd	–	Department of Education
DICP	–	DepEd Internet Connectivity Project
DILG	–	Department of Interior and Local Government
DMC	–	Developing Member Countries
DOH	–	Department of Health
DOST	–	Department of Science and Technology
DOST-ICTO	–	Department of Science and Technology- Information and Communications Technology Office
DSWD	–	Department of Social Welfare and Development
ECRM	–	Enhanced Community Resource Mapping
ESRI	–	Environmental Systems Research Institute
FGD	–	Focused Group Discussion
FOSS	–	Free and Open Source Software
FWIAPP	–	Free WIFI Internet Access in Public Places
GTZet	–	German Technical Cooperation
GIS	–	Geographic Information Systems
GPS	–	Global Positioning Systems
HLURB	–	Housing and Land Use Regulatory Board
ICT	–	Information Communications Technology

ICTO	–	Information and Communications Technology Office
IP	–	Indigenous Peoples
ICT	–	Information and Communications Technology
IMS	–	Internet Map Server
ISP	–	Internet Service Provider
KBPS	–	kilobits per second
KC	–	KALAHI-CIDSS
KII	–	Key Informant Interview
LAN	–	Local Area Network
LIS	–	Learner Information System
LRN	–	Learner Reference Number
LTE	–	Long Term Evolution
MAO	–	Municipal Agricultural Office
MDRRMO	–	Municipal Disaster Risk Reduction and Management Office
MENRO	–	Municipal Environmental Resources Office
MIMAROPA	–	Mindoro, Marinduque, Romblon, Panay (a.k.a Region 4-B)
MLGU	–	Municipal Local Government Unit
MPDO	–	Municipal Planning and Development Office
NAPC	–	National Anti-Poverty Commission
NEP	–	National Expenditure Program
NGA	–	next generation access
NHTS	–	National Household Targeting System for Poverty Reduction
NOAH	–	National Operational Assessment of Hazards
NPMO	–	National Program Management Office
OS	–	Operating System
P3DM	–	Participatory Three-Dimensional Modeling
PC	–	Personal Computer
PGIS	–	Participatory geographic information system
PIMO	–	Provincial Information Management Office
PLA	–	Participatory Learning and Action
PLUDP	–	Participatory Land Use Development Project
PPMO	–	Provincial Program Management Office
PO	–	Planning Office
PSA	–	Participatory Situation Analysis
QGIS	–	Quantum GIS
RPMO	–	Regional Program Management Office
SK	–	Sangguniang Kabataan (Youth Council)

SWOT	–	Strengths, Weaknesses, Opportunities, and Threats
TA	–	Technical Assistance
TVWS	–	TV White Space
WIFI	–	Wireless Fidelity
WMN	–	Wireless Mesh Network

GLOSSARY

barangay	–	smallest administrative division in the Philippines; a village, district, or ward
poblacion	–	the central, downtown, or central business district area of a Philippine municipality; may take up a single barangay or multiple barangays
sitio	–	also known as zone; subdivision of a barangay

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I. INTRODUCTION

A. Rationale

1. The Technical Assistance (TA) for Supporting the Operationalization of Community-Driven Development in Developing Member Countries (DMC) will support knowledge generation for and capacity building in the DMCs on community-driven development (CDD) approaches. CDD gives control over planning decisions and investment resources to community groups and local governments. A 2009 study showed that CDD:

- i. results in more cost-effective delivery of international development partners' funding for a broad range of infrastructure and other community projects;
- ii. is more responsive to local community infrastructure demands, generating increased benefits;
- iii. instills a sense of ownership that translates to better operation and maintenance, and increased sustainability;
- iv. provides a fund disbursement mechanism that promotes transparency and limits leakages; and
- v. results in projects with higher rates of return than other ADB-financed projects.

2. In response to growing DMC demand for CDD knowledge solutions, the TA through a scoping study:

- i. produced analytical work on CDD approaches to support the agenda of inclusive growth;
- ii. conducted cross-country learning exchanges on CDD approaches to contribute to building the capacity of selected DMCs; and
- iii. identified ICT initiatives to improve basic service delivery at the local level. This assignment explored ICT initiatives that will complement the CDD program in the Philippines.

3. Three years ago, the Kapit-Bisig Laban sa Kahirapan-Comprehensive and Integrated Delivery of Social Services-National Community-Driven Development Program (KC-NCDDP) was introduced to Geographic Information System (GIS) and geo-tagging to address two things: i) monitoring of the physical progress of community projects, and ii) identification of project sites that fall within hazard zones.

B. Background

1. Existing Applications of GIS

4. To assure and strengthen accountability and transparency of KC-NCDDP community projects, the development and build-up of the Geographic Information System (GIS) of KC-NCDDP was initiated around fiscal year 2012. Among the methods that were rolled out by the KC-NCDDP involved the use of "geotagging". Geotagging is a particular technique used to capture photos, audios and videos on field and pinpoint the location of the user. Because the technique requires a device with camera and built in GPS (Global Positioning System) receiver, KC-NCDDP uses smart phones and tablet in conducting geo-tagging activities. In geo-tagging, the surveyor must stand in unobstructed view of the sky and let the smart phones communicate

and receive radio signals from the satellite. Geotagging is most commonly used for photographs and can help people get a lot of specific information about where the picture was taken or the exact location of a friend who logged on to a service.

5. In KC-NCDDP, geo-tagging is used to generate spatial database of community projects that is currently used by program implementers in the National and Regional project management offices to oversee status of monitoring activities, proposed, on-going and completed community projects on GIS maps.

6. Prior to the implementation of geo-tagging and GIS mapping, the Program is experiencing the following challenges in terms of spatial information collection, handling, sharing and analysis:

- i. absence of visual tracking of the progress of thousands of community projects, for quality, timeliness, cost effectiveness and functionality;
- ii. The lack of location information of accelerated and scaled up community projects;
- iii. no clear method for analyzing and verifying gaps between critical facilities and services and locations of vulnerable populations in a spatial context;
- iv. hazard risk analysis is done manually using pens and paper-based maps;
- v. no matching of thousands of community projects funded and the priorities generated during community planning and prioritization (participatory situation analysis (PSA), participatory mapping and post review using GIS); and
- vi. curbs on delivery of “accessible” spatial information to communities and local governments such as:
 - data on other national agencies, local governments and civil society programs and projects;
 - areas declared as safe and hazard zones;
 - convergence initiatives of programs in their areas; and
 - community-defined boundaries of their areas.

7. The two major applications of geo-tagging and GIS mapping in KC-NCDDP are in i) project implementation and ii) Local planning and development.

8. At present, geo-tagging is mainly used to improve operational monitoring of projects and activities in KC-NCDDP. But the most important gain from geo-tagging technique is that it allows the program to represent community projects, critical facilities and influence areas on a GIS map, conveying the actual conditions and additional needs of poor communities for better and more intelligent decision-making. Other benefits from geotagging and GIS mapping are as follows:

- i. identify vulnerable and at-risk population and facilities within the community;
- ii. able to share geo-tagged data sets through a web-based mapping application which would lead to better situation analysis at the field level; and
- iii. combine all data sets from other poverty reduction programs of the Department of Social Welfare and Development (DSWD) and national government agencies (NGAs) to allow more comprehensive development analysis.

9. With the exploitation of GIS technologies and geotagging technologies, KC-NCDDP now boasts of a web-based KC-NCDDP Geotagging portal (<http://geotagging.dswd.gov.ph>). The web

service is hosted in GIS servers in the DSWD central office in Manila. In the web portal is a geotagging web application that serves as a user-friendly dashboard for the public to view KC-NCDDP-related projects.

2. Current approaches in conducting PSA

10. A basic truth about development is that local people know more about local conditions that are relevant to development planning than do people at higher levels. As a poverty reduction program adopting community-driven development as the primary project strategy, development solutions to address local poverty issues under the KC-NCDDP proceed from community demand, and are not pre-identified by external experts.

11. By allowing local determination of development solutions, the need for a process of careful analysis of local conditions by local communities takes on a prime importance. In the context of KC-NCDDP, this process proceeds through PSA. The PSA is a research approach where the community members work together to assess and analyze the situation themselves, based on their own observations, experiences and perspectives. The SA objectives aim to:

- i. Facilitate community members and CVs' deeper understanding of the community's condition, including contributors to poverty and vulnerabilities in the barangay;
- ii. Facilitate community members and CVs' identification of problems and needs in their community and prioritize on what needs to be immediately addressed; and
- iii. Facilitate community members and CVs' identification of possible solutions to address priority problems and needs in their community, including the corresponding resources needed.

12. Because of its participatory character, the PSA is an effective and efficient form of collective data gathering and analysis that engages community people in simple, visual, fun, and semi-structured processes of sharing, gathering and analyzing information in order to ascertain the general and particular needs of the community for the creation of concrete, responsive and relevant strategies for community development.

13. The first stage of the PSA process, is where PSA volunteers share information about local conditions through the use of visual tools. The over-all goal of this stage is to produce a coherent profile of the barangay.

14. Because of the participatory nature of the PSA process where the people themselves undertake information gathering, the PSA makes use of various tools - visual, creative and participatory - in gathering and presenting information.

15. Currently, there are more than a hundred documented PSA tools, and the number is increasing rapidly due to the nature of PSA as inspiring and encouraging creativity and innovations among communities. Following are some of the most important and commonly used tools during PSA:

- i. Resource Maps
- ii. Social Maps
- iii. Transect Maps
- iv. Seasonality Diagrams
- v. Pair-Wise Ranking
- vi. Matrix Ranking

- vii. Venn Diagram
- viii. Work Division Matrix
- ix. Historical Transect
- x. Pie Chart
- xi. Service Map
- xii. Flow Chart
- xiii. Organizational Rating Matrix
- xiv. Vision Map

16. A map is defined as a representation, usually on a flat surface, of a whole or part of an area. The job of a map is to describe spatial relationships of specific features that the map aims to represent. There are many different types of maps that attempt to represent specific things. Maps can display political boundaries, population, physical features, natural resources, roads, climates, elevation (topography), and economic activities. There are two basic qualities of a map. These are Map Scale and Geographic Coordinate System.

17. Map scale refers to the relationship (or ratio) between distance on a map and the corresponding distance on the ground, while geographic coordinate system is a reference system that uses latitude and longitude to define the locations of points on the surface of the earth.

18. Of particular importance in our current discussion is the Community Resource Map (CRM), which is said to be the "top view" of the community. The map is the two-dimensional representation of a community's physical (man-made) and natural resources. It portrays the resources of a community, e.g., forest cover, rivers, springs, irrigated land, crops, residential areas, public infrastructures (roads, bridges, buildings), watersheds, grazing land, etc.

19. The chore of resource mapping is done by community volunteers themselves and often facilitated by highly-trained Area Coordinating Teams (ACTs) of KC-NCDDP. By tradition, community resource mapping is done by these community volunteers using the "paper-and-pen" method, where they are asked to draw a community resource map, information contained therein are usually drawn and mapped from the volunteers' memory. For consistency, we shall refer to the paper-and-pen method as the traditional community resource mapping method.

3. Participatory GIS

20. Participatory GIS (PGIS) is an emergent practice in its own right; developing out of participatory approaches to planning and spatial information and communication management. The practice is the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with Geographic Information Technologies (GIT).

21. PGIS combines a range of geo-spatial information management tools and methods such as sketch maps, Participatory 3D Models (P3DM), aerial photographs, satellite imagery, Global Positioning Systems (GPS) and GIS to represent the communities' spatial knowledge in the forms of virtual or physical, two- or three-dimensional maps used as interactive vehicles for spatial learning, discussion, information exchange, analysis, decision making and advocacy. Participatory GIS implies making GIT available to disadvantaged groups in society in order to enhance their capacity in generating, managing, analyzing and communicating spatial information.

22. PGIS practice is geared towards community empowerment through measured, demand-driven, user-friendly and integrated applications of geo-spatial technologies. GIS-based maps and spatial analysis become major conduits in the process. The practice integrates several tools and methods whilst often relying on the combination of 'expert' skills with socially differentiated local knowledge. It promotes interactive participation of stakeholders in generating and managing spatial information and it uses information about specific landscapes to facilitate broadly-based decision making processes that support effective communication and community advocacy.

4. The Need to Integrate GIS and PSA

a. Limitations of GIS

23. While KC-NCDDP had been initial gains in exploiting the use and application of GIS and geotagging have proven to be indispensable tools that aid in social development, let alone, such technologies still have limitations. As of current, GIS cannot represent the actual condition of municipalities and barangays because of the lack of accurate spatial information, such as but not limited to, political boundaries, natural resources, physical features, existing facilities, etc.

24. Despite the fact that there exists an overabundance of national geographic data and maps produced by and among national government agencies, such data cannot be easily overlaid with each other, more so on local community data. Hence, the analysis that can be gotten from current GIS databases and maps are incomplete and could be said to be unable to provide enough useful information about the real situations among local communities in the Philippines.

b. Limitations of the Current Paper-and-Pen Community Resource Mapping

25. While the paper-and-pen resource mapping is a highly valid approach, the (paper) material itself has some limitations. These limitations include durability, that is, paper maps are often destroyed by floods or typhoons that ravage the communities nationwide, and could not survive long enough for repetitive use in successive community planning and PSA sessions.

26. Furthermore, these community resource paper maps also lack the basic qualities of map scale and geographic coordinates. All community resource paper maps are usually drawn from memory and on free-flowing, free-style method, without due regard to how objects in the real world are represented on the drawn map itself. Likewise, coordinate information is never made reference to during the whole process of paper-and-pen community resource mapping process.

27. Because of these two basic limitations of paper-based community resource maps, the information contained therein need to be converted through a process of Georeferencing. To georeference means to associate something with locations in physical space. The term is commonly used in the geographic information systems (GIS) field to describe the process of associating a physical map or raster image of a map with spatial locations. Georeferencing may be applied to any kind of object or structure that can be related to a geographical location, such as points of interest, roads, places, bridges, or buildings. More detailed description of the process of georeferencing can be found in Appendix 3.

c. Convergence of GIS, PSA and ICT

28. Recognizing the limitations of GIS and that of the current community resource mapping technique, and in order to expand the use of these tools, the KC-NCDDP intended to integrate the data gathered from the present paper-and-pen community resource mapping being conducted in the context of the PSA, into a standardized geodatabase, by developing digital versions of the resource maps drawn by the community volunteers during their PSA activity.

29. The combination of participatory, community resource mapping with GIS can help the communities to accurately evaluate their local condition, as well as, come up with more sustainable decisions in resource planning and management. More importantly, the participatory GIS (PGIS) mapping is expected to result in easier information exchange across all local government units through GIS; effective response on their local development needs; and, a stronger community resiliency to disaster.

30. Participatory GIS (PGIS) is an emergent practice in its own right; developing out of participatory approaches to planning and spatial information and communication management. The practice is the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with Geographic Information Technologies (GIT).

31. PGIS combines a range of geo-spatial information management tools and methods such as sketch maps, Participatory 3D Models (P3DM), aerial photographs, satellite imagery, Global Positioning Systems (GPS) and GIS to represent the communities' spatial knowledge in the forms of virtual or physical, two- or three-dimensional maps used as interactive vehicles for spatial learning, discussion, information exchange, analysis, decision making and advocacy. Participatory GIS implies making GIT available to disadvantaged groups in society in order to enhance their capacity in generating, managing, analyzing and communicating spatial information.

32. PGIS practice is geared towards community empowerment through measured, demand-driven, user-friendly and integrated applications of geo-spatial technologies. GIS-based maps and spatial analysis become major conduits in the process. The practice integrates several tools and methods whilst often relying on the combination of 'expert' skills with socially differentiated local knowledge. It promotes interactive participation of stakeholders in generating and managing spatial information and it uses information about specific landscapes to facilitate broadly-based decision making processes that support effective communication and community advocacy.

33. Apart from managing program implementation, KC-NCDDP's geotagging and GIS mapping are planned to be incorporated into participatory practices in the community level. Hence, all communities covered by the Program will be capacitated to geotag and map their critical facilities, values, local practices and condition, risks and other development solutions.

34. The proposed method shall capitalize on the inherent and indigenous knowledge of communities about their resources and the latter's geographic distribution in space, whilst capturing, enhancing and standardizing the process through the introduction and use of information communications technology (ICT)-enabled mapping and GIS techniques during one

of the phases of the Community Empowerment and Activity Cycle (CEAC). The spatial information built is expected to facilitate better community and localized decision-making.

35. The role of ICT, particularly internet connectivity cannot be overemphasized. In order for the vision of KC-NCDDP of capitalizing on geotagging and GIS to better managed a robust and sustainable internet and digital communications infrastructure must be carefully designed, executed and institutionalized in order support national, regional and even local initiatives. The use of internet and the convergence of different technology-based solutions in order to capture and digitize community resource knowledge, and use these to support national initiatives in the direction of harmonizing geotagging and GIS activities at the different levels of government, is indispensable since it provides the vital link in the conveyance of information from one level of the society to the next.

C. Objectives of the Study

36. The overall objective of this TA is to develop a standardized community resource mapping process in support to KC-NCDDP's geotagging and buildup of a harmonized geographic information system of projects under its purview.

37. The specific objectives include:

- i. To scope the current community resource mapping techniques locally, regionally and globally;
- ii. To determine the levels of readiness of different LGUs and communities to adopt a PGIS technique (manpower, trainings, GIS information available, hardware, software, LGU initiatives);
- iii. To determine the ICT support infrastructure and mechanisms-internet connectivity, government initiatives and private initiatives, if any;
- iv. To harmonize community-based approaches with national level initiatives; and
- v. To provide a systematic technology-based PGIS protocol that can be adopted by communities.

38. In support of objective v and one of the major outputs of this TA, is the production of a standardized PGIS procedure that would guide and aid local governments and the KC-NCDDP ACT in the conduct of an enhanced community resource map.

39. To attain the objectives, the report is divided into the following sections:

- i. Methodology
- ii. Results and Discussions
- iii. Recommendation for KC-NCDDP's enhanced community resource mapping
- iv. Conclusion
- v. Appendixes

II. METHODOLOGY

40. In order to provide comprehensive picture of the PGIS landscapes in the Philippines, in the regional, as well as in the global perspectives, a detailed scoping (desk review and survey)

was made to evaluate different participatory GIS mapping efforts in Asia, the Pacific and elsewhere around the globe.

A. Literature Review of GIS, PGIS and ICT

41. Review of on-line literature was undertaken among key government agencies and non-government organizations (NGOs) that are in one way or the other, using Geographic Information Systems or Technologies (GIS/GIT) in the delivery of their mandated service or the further development of such in research and development undertakings. The scanning exercise also tried to capture relevant information and communication technology-based (ICT) initiatives, such as but not limited to the provision of computer and related accessories, broadband, mobile and next generation access (NGA) technologies to the internet, among others. The list of government agencies scanned can be found in Appendix 2.

42. Likewise, a quick literature scan was made on the use and application of PGIS in the Philippines, as well as, within the Asia-Pacific region and elsewhere around the world. The objective of this exercise is to determine the lessons learned from these various local, regional and international initiatives, in the conduct of PGIS and be able to adopt, modify or enhance and apply (if any), such PGIS methods on the local/Philippine context. (see Appendixes 1 and 2).

B. Focused Group Discussions and Key Informant Interviews

43. Informants of the Focused group discussions (FGDs) and key informant interviews (KIIs) were representatives and staff from the following entities:

- i. KC-NCDDP Regional Program Management Office (RPMO)
- ii. provincial local government units (PLGUs)
- iii. ACTs
- iv. municipal local government units (MLGUs)
- v. barangay local government units
- vi. community volunteers (CVs)
- vii. public schools
- viii. internet café owners
- ix. Department of Science and Technology-Information and Communications Technology Office (DOST-ICTO)

44. FGDs and KIIs were conducted in two 3rd class KC-NCDDP municipalities in order to determine real-world situations on the ground, the readiness of such communities to adopt technology-driven solutions, in preparation for the eventual deployment by KC-NCDDP of the proposed PGIS contained in this technical study.

45. The 3rd class KC-NCDDP municipalities are Santa Josefa in Agusan del Sur in Region XIII, and Gloria of Oriental Mindoro in Region IV-B. The choice for these two municipalities stems from the fact that both Santa Josefa and Gloria have long experiences in the conduct of PSAs, have regular staff, and have very good understanding of PSA process.

46. The primary objective of the FGDs and KIIs was to establish/determine baseline information on the readiness of communities to create a platform of spatial information which leads to greater transparency among BLGUs and the MLGUs, and allow these communities to retrieve, update and use the information as basis for local decision-making. Among the key variables the FGDs and KIIs sought to measure were the following:

- i. Hardware
- ii. Software
- iii. Information
- iv. Human resource
- v. Skills/Trainings
- vi. Connectivity
- vii. Others (electricity, facilities within the municipality, non-government entities such as private entities that can act partners or possibly support the initiative)

47. Additionally, the survey aimed to assess the readiness and receptiveness of these KC-NCDDP communities to the introduction of new materials and tools for resource mapping; the communities' tools for spatial data collection, visualization, analysis, and sharing; as well as the introduction of standardized means of conducting resource mapping in the context of the KC-NCDDP PSA process.

48. The FGDs and KIIs were guided by a set of prepared questions that centered on the following themes as regards mapping or activities related to mapping:

- i. Support to Planning and the CEAC Project Cycle
- ii. Social Preparations and Capacity Building
- iii. Project Identification and Conceptualization
- iv. Project Selection and Prioritization
- v. Project Implementation, Monitoring and Evaluation
- vi. Support to Project Coordination and Communications

49. The FGDs and KIIs among community volunteers were capped with mini-workshops whereby volunteers were introduced to the printed Google Earth-derived base maps of their respective municipalities. During these mini-workshop sessions, the volunteers were allowed to trace out on a clear plastic transparencies (overlaid on the tarp print outs), the features of their respective communities' resources, much as what they would do during the "traditional" paper-and-pen community resource mapping sessions.

C. Processing of FGD Results

50. Processing and analysis of the results of the field survey made use of a common technique dubbed the SWOT analysis. A SWOT analysis (alternatively called the SWOT matrix) is a structured planning method used to evaluate the strengths, weaknesses, opportunities and threats involved in a project or in a business venture. A SWOT analysis can be carried out for a product, place, industry or person. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective.

- i. Strengths: characteristics of the business or project that give it an advantage over others.
- ii. Weaknesses: characteristics that place the business or project at a disadvantage relative to others.
- iii. Opportunities: elements that the project could exploit to its advantage.
- iv. Threats: elements in the environment that could cause trouble for the business or project.

D. Protocol Development

51. As earlier indicated, one of the major outputs of this TA is a standardized process which is an enhancement of the community resource mapping activity conducted during the CEAC.

52. Dubbed as the Enhanced Community Resource Mapping (ECRM) method, the technique incorporates Google Earth Pro as the main source of free, satellite-derived map data, with a minor adaptation to/modification of the usual community resource mapping of any CEAC.

53. The ECRM has four (4) major phases, namely:
- i. Preparation of base resource maps (ECRM 1)
 - ii. Actual Community Resource Mapping (ECRM 2)
 - iii. Converting Resource Maps to Digital Form (ECRM 3)
 - iv. Digital Manipulation and Map Attribute Extraction (ECRM 4)

54. The detailed ECRM procedure is described in Appendix 3.

E. Limitations

55. One major limitations of the TA was that the FGDs and KIIs were conducted in just two (2) municipalities, consisting in total of just six (6) barangays. Hence, one of the future directions of the study will be the conduct of online (internet-based) surveys targeting most if not all the 846 municipalities under KC-NCDDP.

56. Furthermore, the conduct of this FGDs and KIIs in the municipalities of Santa Josefa and Gloria used recall and no actual PSA was observed. The scoping results particularly those which have been derived from FGDs and KIIs would have been nearer to real-world situations, had the FGDs and KIIs been conducted in the context of a real PSA.

III. RESULTS AND DISCUSSIONS

A. Community Resource Mapping Techniques Locally, Regionally and Globally

1. Global Distribution of PGIS

57. Based on literature review and documented information, to date there are around 126 Participatory Geographic Information Systems (PGIS) projects worldwide. Majority of these

PGIS projects used participatory three-dimensional modeling (P3DM) as a means of portraying geographic information and local knowledge of different communities.

58. The P3DM is a community-based mapping method which integrates local spatial knowledge with data on elevation of the land and depth of the sea to produce stand-alone, scaled and geo-referenced relief models. Essentially based on local spatial knowledge, land use and cover, and other features are depicted by informants on the 3-dimensional model by the use of cardboard or papermache, quick-dry plaster, pushpins (points), yarns (lines) and paints (polygons). On completion, a scaled and geo-referenced grid is applied to facilitate data extraction or importation. Data depicted on the model are extracted, digitized and plotted. On completion of the exercise the model remains with the community
59. In the Philippines, a total of 33 PGIS projects have been implemented since the early 1990s. These 33 PGIS projects (all of which are P3DMs) nationwide, account for around 25% of the PGIS activities globally, making the Philippines the trailblazer in the use of PGIS among its neighboring countries and within the region. The continent of Africa, as a whole, trails after the Philippines, at 17% of PGIS initiatives worldwide.

2. PGIS Applications

60. In terms of the applications of PGIS, these can be categorized in to three (3) major applications, which are: Hazard Management (or Disaster Mitigation), Resource Management (such as but not limited to forestry, agricultural, and fishery applications), and settling of Ancestral Claims (and disputes) and Indigenous Peoples (IPs).
61. In the Philippines, the major applications of PGIS on hazard management projects account for the 40% (13 projects), followed by PGIS applications on settling disputes related to ancestral domains (33%, 11 projects) and indigenous peoples. Lastly, PGIS applications on resource management account for about 27% (9 projects). It is note worthy that all 33 PGIS initiatives made use of P3DM.

3. PGIS Distribution

62. In terms of distribution, of the 33 PGIS projects implemented in the Philippines, majority of the projects were in Luzon (52%, 17 projects), followed by PGIS projects conducted in the Visayas (36%, 12 projects), and lastly, in Mindanao (12%, 4 projects).

4. Community-Focused GIS and ICT Projects

63. From the literature review of Philippine-based projects (both government and non-government led) that have GIS and ICT components, it was found out that there are eight (8) community-focused projects, where community participation is a vital component in their implementation, and in order for them to achieve the over-all success of the project's implementation. Of these, four projects have at their cores GIS/GIT or derivatives of GIS/GIT in the collection of data from the community (or participating entities, otherwise known as crowd-sourced data) and, likewise, in the delivery and dissemination of processed information among their stakeholders and users. The other four community-focused projects are basically ICT-led

initiatives, with GIS/GIT not necessarily an essential component of their systems. A more detailed discussion about these projects can be found in Appendix 2.

B. Major Findings from Field Visits

64. A number of problems and issues have been encountered during the conduct of the FGDs and KIs. Though there are problems that are unique for one municipality or barangay that was sampled, the issues hereby presented are found to be common if not “most likely universal” in 3rd and 4th class municipalities in the Philippines. The specific issues and attributes of the field visited communities were mapped out in a SWOT analysis matrix, which can be found in Appendix 4. These issues can be summarized into the following:

- i. Availability of computer hardware and GIS software in BLGUs
- ii. Availability of GIS-trained staff in BLGUs
- iii. Retention of technical personnel in ICT and GIS
- iv. Quality and reliability of internet connectivity
- v. Availability and stability of electricity
- vi. Availability of other spatial information

65. These problems and issues, unless addressed directly by KC-NCDDP, have long-term implications on the sustainability and long-term implementation of PGIS.

1. Availability of Computer Hardware and GIS Software in BLGUs

66. It is noteworthy that GIS and ICT-enabled services or a combination of these technologies are already being used and applied at different levels of local government, particularly at the MLGUs up to the provincial levels of local government in the two municipalities which were surveyed by this study. State-of-the-art GIS and software packages, be they proprietary (i.e. ArcGIS) or free and open source software (FOSS) such as QGIS, are being used at the municipal and provincial government offices visited.

67. Common applications and use of maps and GIS data at the provincial and municipal levels of government are in tax mapping –related activities of the planning and assessor’s office.

68. The role of developing and maintaining maps and related geographic data often are the responsibilities of the provincial and municipal planning department and/or the engineering department of these offices.

69. However, the situations are totally different at the barangay local governments. While the purchase of GIS and ICT are integral components of the budget at the provincial and municipal LGUs, no budget is allocated by the BLGUs for the purchase of related ICT equipment.

70. Also, not all barangays would have their own computer hardware (i.e. computer processor, monitor and printer). In all instances during the survey, the more creative barangays which have their own computer setup, were able to purchase such using their *Sangguniang Kabataan* (SK) funds and not from the BLGUs’ normally allocated fiscal funds. These computers are used for the routine business matters of the barangay office. At the community level paper-and-pen resource mapping is the prevailing method in PSA.

2. Availability of GIS-trained staff in BLGUs

71. From the field surveys conducted, it could be surmised that at the provincial and municipal LGUs, there exist manpower who are highly-trainable in GIS. In all cases, these staff has basic knowledge on the use and application of GIS. GIS knowledge could have been acquired through formal training and/or self-taught, or have been acquired through the performance of the staffs' inherent roles and responsibilities relevant to the position. A classic example is that of the municipal engineer's office or department, which is traditionally the main entity involved in GIS-related development and applications in the context of the municipality's inherent services. Likewise, the municipal planning and development office or department would often have trained manpower knowledgeable in GIS.

72. In very special instance, such as that which exists at the Provincial government of Agusan del Sur, the Provincial Information Management Office (PIMO) also performs GIS-related functions, with its in-house development of a CBMS, apart from its inherent function in ICT-related activities of the provincial government office.

73. However, based on the field surveys among all 6 barangays sampled, nobody in the BLGU have had trainings or have basic knowledge on GIS.

3. Retention of Technical Personnel in ICT and GIS

74. An age-old problem in most government offices plagues the local governments as well. This is the issue of technical personnel retention particularly those personnel who are highly-specialized in GIS/ICT. It had been noted during the interviews that there is a high turn-over rate of relatively young personnel, most of whom have IT backgrounds and are adept at using and manipulating GIS software. In most cases, these personnel have left government service in search of better paying jobs in the private sector or abroad, once they have gained substantial training and expertise in GIS. The more basic reason for their departure from service stems from the fact that in all of those cases, these personnel are holding temporary contractual or job-ordered positions, which do not provide considerable security of tenure. Since this issue is administrative in nature, the solution to this issue is beyond the scope of this current technical study.

4. Quality and Reliability of Internet Connectivity

75. While there is presence of wireless broadband internet in all the barangays visited during the study, however, the issue of signal strength, quality and reliability remain salient issues that need to be addressed in order for the grand design of the PGIS to be effective and sustainable.

76. Internet connectivity is necessary in two vital components of the proposed PGIS. Primarily is its role during the map data capture process, when map data is actually sourced from satellite images of Google Earth. Secondly, is during the conveyance of processed map information which are products of the ECRM process (described in later parts of the text), to the different levels of government, coming from the BLGU, MLGU, up to the concerned national government.

77. Although in both the provincial governments of Agusan del Sur and Oriental Mindoro, internet connectivity is not an issue, that is to say, both offices are connected to the internet, at the municipal and barangay local governments, however, connectivity becomes a prime concern that need to be dealt with when designing the PGIS.

5. Availability and Stability of Electricity

78. The all-important role of electricity to power computers and to run the necessary GIS software, need not be over-emphasized. A case in point and based on the field visits made in the province of Agusan del Sur in Mindanao, it was noted that the locality suffers from frequent power outages, averaging at around 4 hours a day. It is said that the whole of Mindanao suffers from these power outages due to electric power deficiencies, the causes of which are beyond the scope of this study.

79. Hence, if GIS systems are to be rolled out in KC-NCDDP beneficiary communities, it should be taken into account as to which possible power sources would be made available to run the computer-based GIS systems or technology-based solutions would be most appropriate to provide target communities.

6. Availability of Other Spatial Information

80. With the field visits made in two 3rd class municipalities, and having visited 6 representative barangays, it could concluded that computer-based GIS is relatively non-existent at the barangay LGUs in both provinces. There exists what are called spot maps being used by barangays and even sitios, these spot maps are sparse and cannot be expected to exist in neighboring sitios of the same barangay. These spot maps, often hand-drawn or sometimes elegantly printed on tarpaulin material (but without known map scale and coordinates) portray the geographic location of people with a specific attribute, for example cases of an infectious disease. Because of their usability in health-related service, these spot maps are often derived from health surveys conducted by community health workers.

81. Also, while it can be noted that at the MLGU there exists municipal maps that clearly define the different barangays under their jurisdictions, barangay maps that should have been derived from these municipal are non-existent. There is therefore a “disconnect” between municipal geographic data and that of the development and production of barangay maps.

IV. PROPOSED SOLUTIONS

A. Availability of computer hardware and GIS software in BLGUs

82. The levels of readiness of KC-NCDDP-serviced communities to adopt GIS or technology-driven mapping, in terms of available IT equipment or computer differ. As noted in the field visits, for some creative barangays, they have been able to source or acquire computers by tapping into or using what is called as SK funds. Some barangays, which the study was not able to capture may not even have a computer or have acquired one, for some reason or another.

1. Strategy

83. The existence of at least one computer in the barangay is essential for KC-NCDDP to be able to support and enhance its current (paper-and-pen) community resource mapping process, which is conducted during a PSA. In order to address this particular issue, it is necessary that in subsequent fiscal budgeting process for BLGUs incorporate substantial budget for the purchase and maintenance of at least one computer setup package (CPU, monitor, and printer).

84. Similarly, if the KC-NCDDP's ultimate goal is to capacitate its stakeholders at the barangay level, it may want to endeavor to provide computer hardware on a phased and need basis, considering that KC-NCDDP has around 846 stakeholder municipalities. That is to say, only those barangays which do not have computers must be prioritized to be provided with computers from those barangays with existing and working computers.

85. In terms of GIS software, the way forward would be the introduction of and trainings on FOSS GIS, such as but not limited to QGIS, SagaGIS, DivaGIS, to name a few. There are many free and available GIS software, and are easily downloadable via the internet.

B. Availability of GIS-trained staff in BLGUs

86. From the interviews gathered, the most computer literate members of the BLGU are those of the barangay secretaries and treasurers. In all accounts, the latter personnel are the only ones who have basic knowledge on the use and operation of a computer, but do not have basic knowledge on GIS principles nor experience in the use of GIS software.

1. Strategy

87. If KC-NCDDP will push through with the capacitation of its stakeholders at the barangay level, the barangay secretary and/or treasurer are the more feasible and more practical persons to train in GIS principles, on the assumption that since these persons have basic knowledge on the use and operation of computers, they would most likely have a less steep learning curve on the principles and use of GIS.

88. Additionally and in order to capacitate the local barangay office on related GIS processes, the following processes must be undertaken:

- i. Training on the proper photography of traced plastic transparency from the resource mapping process (this is one of the stages in the data capture process which is part of the ECRM described in greater detail in later parts of the text); and
- ii. Training of the barangay secretary(ies) and/or treasurer(s) in the basic use and manipulation of QGIS, particularly in georeferencing of the digital traced plastic transparency from the resource mapping process. It has been noted that it is the barangay secretary and/or treasurer are the two personalities who are most computer-literate among other barangay officials.

C. Retention of Technical Personnel in ICT and GIS

89. This is a purely administrative/human resource and management issue. This TA will not attempt to propose solutions to this issue since this is beyond the scope of the current study.

The TA is putting the issue into the fore so that the KC-NCDDP is sensitized to and aware of the issue, prior to the eventual roll-out of the proposed PGIS.

D. Quality and Reliability of Internet Connectivity

90. Internet connectivity is necessary in two vital components of the proposed PGIS of KC-NCDDP. Primarily is its role during the map data capture process, when map data is actually sourced from satellite images of Google Earth. Secondly, internet connectivity is necessary during the conveyance of processed map information, which are products of the ECRM process, to the different levels of government, coming from the BLGU, MLGU, up to the concerned national government.

1. Strategies

91. There are four possible enabling technologies/strategies as regards internet connectivity, which the KC-NCDDP may consider. Two of these technologies (i.e. TV White Space and Free WIFI Internet Access in Public Places) as of this writing are ongoing, while the other two (i.e. Wireless Mesh Networks and Tapping into Public Schools Internet Connection) are still conceptual.

a. TV White Space Technologies

92. The TV White Space (TVWS) Connectivity Pilot Project (CPP) is part of the Department of Science and Technology-Information and Communications Technology Office's (DOST-ICTO) initiative called "TVWS Technologies Study Program" to further expand internet broadband connectivity coverage in the country. This initiative is a program to pave the way for the adoption of TV White Space Technologies in the country. TVWS technologies are postulated as a means to bridge the business-case gap encountered with traditional technologies by using the inherent characteristics of the frequencies allocated for TV services. TV White spaces which actually vacant frequencies between assigned broadcast TV channels in the VHF/UHF range, allow signals and travel long distances even over water and could penetrate obstacles and walls.

93. While almost of the municipalities in the country has Cellular Mobile Telephone System (CMTS), around 47% of cities and municipalities have broadband access (fixed or wireless) which is more often than not limited to the immediate vicinity of the center. Majority of its barangays and schools particularly those in the remote areas and nearby islands are still not yet connected to the internet due to lack of last mile infrastructure. DOST-ICTO is planning to leverage ultra-low cost broadband technologies and innovative business models to ensure that even marginalized populations have access to information and services (via broadband). And as such, Broadband Wireless Access deployment thru TVWS technology is foreseen suitable solving last mile connectivity gaps in these areas.

94. Among the salient findings during the field surveys done in Santa Josefa, Agusan del Sur and that of Gloria in Oriental Mindoro, are low to poor wireless broadband internet services in those areas. The hesitation for private telecommunications companies, the likes of Globe and Smart to improve or upgrade the communications infrastructure in those places may be

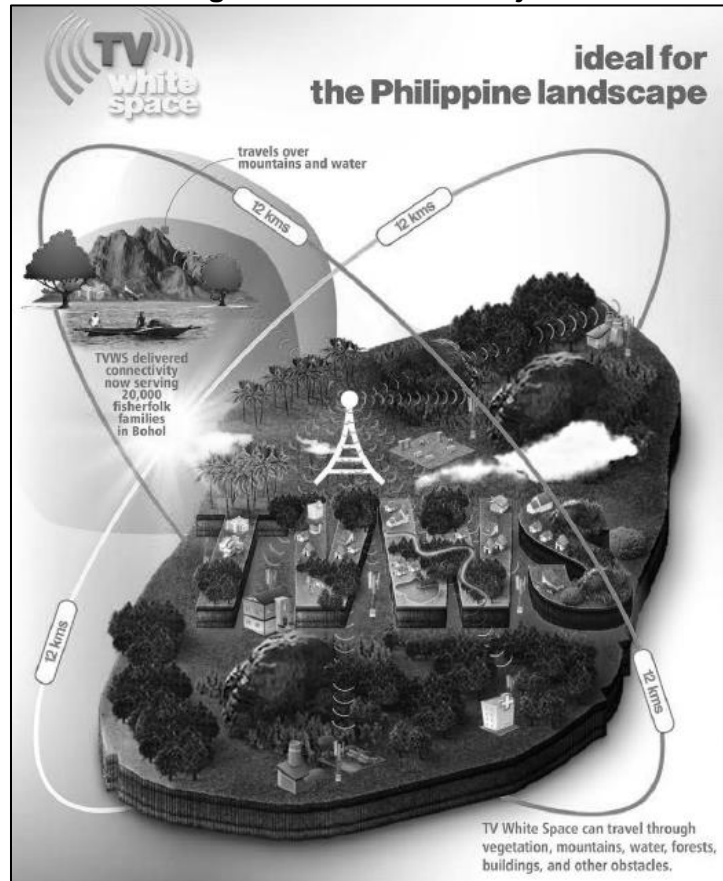
due in part to the small client base of internet users in those areas, and as such a slow rate of return in these companies' capital investments.

95. Cognizant of this very basic issue of lack of internet connectivity, several possible interventions can be considered by KC in order to digitally connect the different tiers of local government (from barangay, municipal, provincial, regional to national levels) and community stakeholders, which are the vital sources of resource data, for immediate and seamless transfer of GIS data.

96. The project had established three (3) TVWS Base Stations at the existing ICTO-TELOF telecommunications facilities in the municipalities of Talibon, Ubay and Tubigon in Bohol, Central Visayas,. The base station is designed to set up a white space communication link between the base and client (CPE) radio units that operates in two operation modes supported by the system: "two-way streaming mode" for radio link testing (requires no internet connection) and "access point mode" for normal operation (requires Internet connection). The project targets internet/broadband connectivity of DOST-ICTO's "test license" in the island of Bohol serving at least 100 sites in area coverage of approximately 900 square kilometers.

97. A quick scan of the KC-NCDDP initiated projects in these cited municipalities indicated that there are at least 45 KC-NCDDP projects of various modalities in Talibon, 119 KC-NCDDP projects in Ubay, and 95 KC projects in Tubigon. These KC-NCDDP-initiated projects based in these 3 municipalities can therefore be harmonized with the TVWS initiatives as they are within the effective range of radio signals of the TVWS system now in place in the island of Bohol. Harmonization of these projects may take the form of applying internet connectivity to better manage, monitor and sustain existing or established KC-NCDDP projects through enhanced communication among community stakeholders and the different tiers of the local government. Likewise, harmonization in this sense would be for its foremost application of internet to support the geotagging and GIS database buildup of the communities in the purview of these three municipalities of Talibon, Ubay and Tubigon.

Figure 1: The TVWS Project



b. Free WIFI Internet Access in Public Places (FWIAPP)

98. The DOST, through its Information and Communications Technology Office (ICT Office), has already embarked to provide internet connectivity in public places across the Philippines. This Project aims to accelerate the government's efforts in enhancing Internet accessibility for Filipinos to accelerate economic, social and educational opportunities and in reducing the growing Digital Divide under the overarching e-Filipino Program of the DOST-ICT Office. This project is directly in line with the "Internet For All" thrust identified in the Philippine Digital Strategy 2011-2016.

99. The budget for this project as authorized in the 2015 General Appropriations Act (GAA) is P 1.408 billion, instead of the originally proposed P 339 million in the National Expenditure Program (NEP).

100. With the increase in the budget, the scope of the project has been expanded. In addition to the original 748 plazas of Class 4, 5 and 6 municipalities, the public spaces in public school, libraries, government hospitals and rural health units, and possibly others, in all municipalities Class 3 and lower shall now also be covered. Sites in Metro Manila, Cebu and Davao, as well as other cities that will serve as distribution points or Points of Presence shall also be included.

101. Once fully deployed, the Project will serve 105,000 concurrent users with internet speeds of 256 kilobits per second (kbps) each, which is the lowest prevailing speed requirement for “broadband” service. A data volume based Fair Usage Policy shall also be implemented to promote an equitable distribution of the public service.

102. The concept of managed services shall be leveraged all throughout the project, not only ensure rapid rollout, a responsive service, allow economies, and other aggregation derived benefits, but also to create commercial opportunities for private sector participants that would redound to greater economic benefit through expanded services for all.

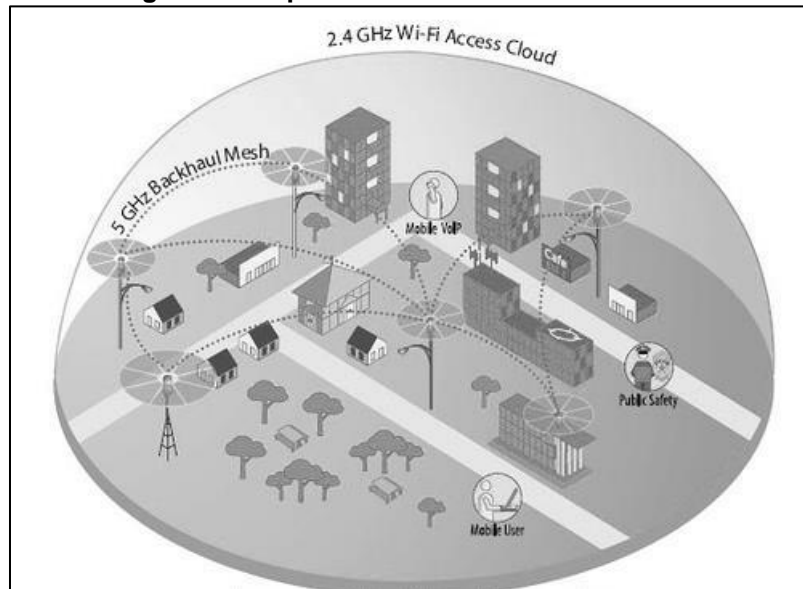
103. Since the FWIAPP Project had already been launched, it might be useful for KC-NCDDP to coordinate with the proponents of the FWIAPP to enable the former to ride-on the main backbone connection of the Project. This is similar to the harmonization approach described earlier in the TV White Spaces, where KC-NCDDP projects that are within the domain or purview of FWIAPP be allowed to use and access the internet, to support the geotagging and GIS database buildup of the KC-NCDDP communities within the domain and purview of FWIAPP.

c. Wireless Mesh Network using Internet Cafés embedded in KC-NCDDP communities

104. A **Wireless Mesh Network (WMN)** is a communications network made up of radio (WIFI) nodes (in this case capitalizing on the existing internet cafés embedded in KC-NCDDP communities) organized in a **mesh topology**. It is also a form of wireless ad hoc network. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward network traffic to and from the gateways which may, but need not, connect to the Internet.

105. It had been observed that in the 3rd class KC-NCDDP municipalities of Santa Jose and Gloria, there are thriving businesses of small-scale internet cafes, with computers numbering from 5 to 10 workstations. With the assumption that these internet cafés have subscribed to a relatively stable internet access, these cafés can be commissioned to act as “local hubs” for internet access in the communities where they are located. Take the case of Santa Josefa in barangay Poblacion where 6 internet cafés are operating. If these 6 internet cafés can be enhanced to be WMNs having an effective range of 100-meter radius of WIFI connectivity, the estimated effective area that can be covered by 1 WMN is around 31,415.93 square meters or equivalent to 3 hectares. If all 6 internet cafés are converted to WMNs, then the total area covered by WIFI connectivity by these 6 WMNs is around an effective area of 18 hectares.

106. This configuration can be achieved by these internet cafés’ establishing WIFI hotspot or a group of hotspots, forming a WMNs that are designed to extend the range of a particular point of access by cascading the signal. A detailed description of a WMN can be found in earlier text of this study.

Figure 2: Simple WMN with 2.4 GHz WIFI cloud

Source: Skypilot Network

d. Tap into public school ICT infrastructure and internet connection and educational systems for build-up, long-term sustainability and maintenance of the GIS database

107. The existence of ready, turn-key ICT equipment (such as but not limited to computer desktops/ laptops, printers and projectors) in most public schools and internet connectivity can be tapped into by KC-NCDDP by partnering with these schools.

108. The building infrastructure as well as the innate security offered by public schools can be leveraged by KC-NCDDP, for the latter to provide the following:

- i. GIS server back-up - for community-developed, community-generated resource maps, as well as related GIS data and software;
- ii. Venue for community-focused GIS training/ seminars. Public schools have the appropriate set of ICT equipment to conduct GIS capacitation among community stakeholders; and
- iii. Assured Internet Connectivity - as it is now imperative that all public schools be connected to the internet, it may be assumed that in the near future, public schools and their connections to the internet can be tapped into by KC-NCDDP for efficient communications within KC-NCDDP, as well as for conveyance of GIS-related information and applications.

E. Availability and Stability of Electricity

109. While this has been identified as one of the major issues in the implementation of a PGIS, solutions to address such may be varied to include renewable alternatives such as solar, mini-hydro, biogas, etc., depending on the location as well as the resources present in a

particular community. Furthermore, the topic of concern is beyond the scope and terms of the present study.

F. Availability of Other Spatial Information

110. With the development of the ECRM, one of the essential components is the capacitation through training of stakeholders on GIS principles and processes. It is hoped that existing spot maps of barangays and sitios can be digitized, integrated and harmonized in a single, centralized geodatabase.

Table 1: Synthesis of Findings (secondary data collection, field activities)

No.	Components	NPMO	RPMO/ SRPMO	ACT	PLGU	MLGU	BLGU/ Community	Local Schools	Internet Shops
1	Hardware	Existence of centralized, web-based GSI	Existence of Computers used in the provision and delivery of the office's services	Existence of Computers used in the provision and delivery of the office's services	Existence of Computers used in the provision and delivery of the office's services	Existence of Computers used in the provision and delivery of the office's services	No budget for procurement of basic computer and peripherals Budget often sourced from SK funds	Existence of computer and peripherals mainly used for teaching and learning	Existence of computer and peripherals mainly used for internet access and gaming
2	Software	Use of web-GIS systems; Use of both FOSS and proprietary GIS software	GIS software available	No GIS software	GIS software available; mostly acquired from foreign grant FOSS such as QGIS seldom used Existence and use of CBMS	GIS software available; mostly acquired from foreign grant FOSS such as QGIS seldom used	No GIS software	No GIS software	No GIS software
3	Information	Consolidated GIS and map data in central databases	Map and GIS data is available	No map nor GIS data	Map and GIS data is available but often not harmonized nor consolidated	Map and GIS data is available but often not harmonized nor consolidated	No map nor GIS data	No map nor GIS data	No map nor GIS data
4	Human resource	Existence of trained personnel but often hired on temporary or job order basis	Existence of trained personnel but often hired on temporary or job order basis	No trained personnel in GIS	Existence of trained personnel but often hired on temporary or job order basis	Existence of trained personnel but often hired on temporary or job order basis	No trained personnel in GIS BLGU secretary and treasurer as possible staff to be trained in GIS	No trained personnel in GIS	No trained personnel in GIS
5	Skills / Trainings	Ample formal GIS training	Ample formal GIS training	No GIS training	Ample formal GIS training	Non-formal GIS training	No GIS training	No GIS training	No GIS training
6	Connectivity	Connected to internet through wired or wireless modes Internet quality good	Connected to internet through wired or wireless modes Internet quality good	Seldom connected Most commonly connected via wireless broadband Poor signal quality in 2 municipalities visited	Connected to internet through wired or wireless modes Internet quality good	Seldom connected Most commonly connected via wireless broadband Poor signal quality in 2 municipalities visited	Seldom connected Most commonly connected via wireless broadband Poor signal quality in 2 municipalities visited	Seldom connected Most commonly connected via wireless broadband Poor signal quality in 2 municipalities visited	Seldom connected Most commonly connected via wireless broadband Poor signal quality in 2 municipalities visited

FOSS- Free and Open Source Software, QGIS-Quantum GIS, CBMS-Community-Based Monitoring System

V. THE ECRM AS PGIS TECHNIQUE FOR KC-NCDDP'S ENHANCED COMMUNITY RESOURCE MAPPING

111. Despite the initial gains made by the national program management of the KC-NCDDP with the implementation of its geotagging and GIS initiatives at the national, regional and provincial levels, there is still the need to harmonize its community-driven development programs with active community stakeholder participation more so with the implementation of the PGIS. The whole essence of KC-NCDDP's PGIS initiative is to capitalize on the inherent indigenous community knowledge of their resources, empowering KC-NCDDP community stakeholders in new GIS and mapping technologies, while at the same time harmonizing and standardizing the procedure in order to exploit the rich community geographic information as useful and valuable inputs into the geographic databases being built up at the national levels.

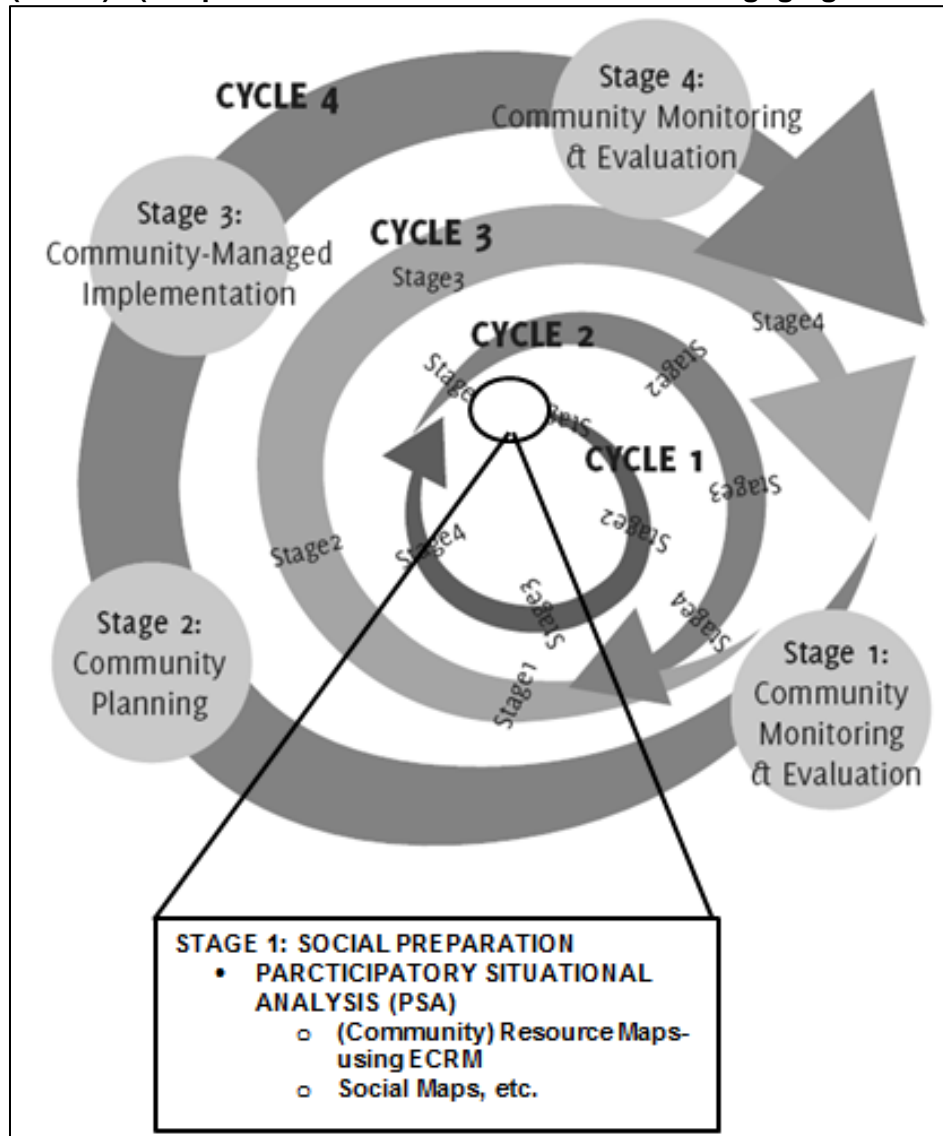
112. In order to capture and standardize the inherent community knowledge and transform the former into usable GIS information, the Enhanced Community Resource Mapping (ECRM) method was developed under this TA. The ECRM is not much of a deviation from the classical "paper-and-pen" CRM approach used during the PSA processes of the KC-NCDDP, but rather an "enhancement", as the term explicitly conveys.

113. The ECRM attempts to capture inherent and indigenous community knowledge, without drastically changing the participatory nature and flow of traditional PSA process employed by KC-NCDDP. Hence, the ECRM can be considered as one of the many approaches or techniques of PGIS.

A. The ECRM in the context of CEAC

114. The implementation of the ECRM will have to happen during Stage 1 (a.k.a. Social Preparation Stage) of the PSA of the Community Empowerment Activity Cycle 1 (CEAC). Simply put, ECRM is part of Stage 1 Cycle 1 of CEAC. During this time around twenty-five (25) days are allocated to cover at least four (4) barangays, and for these barangays to come up with their own situational analyses. It is also during Stage 1 of CEAC that communities are expected to come with their own social and resource maps.

Figure 3: The ECRM and how it fits in the overall Community Empowerment Activity Cycle (CEAC). (Adapted from CEAC 101: Your Guide in Engaging Communities)



ECRM = Enhanced Community Resource Mapping

B. Basic Requirements of the ECRM

115. In order for the ECRM to be implemented effectively and efficiently, there are basic and essential requirements that must be present or put in place (through training or capacitation and equipment build-up and acquisition). These basic components include the following:

- i. Hardware
- ii. Software
- iii. Internet Connectivity
- iv. Map Information
- v. Human Resource Trainings
- vi. Tarpaulin Printing

1. Hardware

116. For this TA, it will be assumed that at least at the barangay level, a computer is already existing which should have the basic minimum specifications or better. Below is the set of minimum hardware requirements to run a basic GIS system:

Table 2: Minimum Hardware Specifications

CPU Speed	2.2 GHz minimum ; Hyper-threading (HHT) or Multi-core recommended
Processor	Intel Pentium 4, Intel Core Duo, or Xeon Processors; SSE2 minimum
Memory/RAM	2 GB minimum
Display properties	24-bit color depth
Screen resolution	1024 x 768 recommended minimum at normal size (96 dpi)
Swap space	Determined by the operating system; 500 MB minimum.
Disk space	Minimum of 50 GB HDD or SDD In addition, up to 50 MB of disk space may be needed in the Windows System directory (typically, C:\Windows\System32). You can view the disk space requirement for each of the 10.1 components in the Setup program.
Video/Graphics adaptor	64 MB RAM minimum, 256 MB RAM or higher recommended. NVIDIA, ATI, and Intel chipsets supported. 24-bit capable graphics accelerator
Networking Hardware	Simple TCP/IP, Network Card
Operating System (OS)	Windows 8 or newer OS

2. Software

117. There are basically two essential softwares used in ECRM, one software is for map data capture, and the other one is for GIS manipulation/

118. For map data capture, Google Earth or Google Earth Pro is used, while for GIS applications, QGIS is the software of choice. More information about QGIS and how to use it can be found in Appendix 3 of this report.

3. Internet Connectivity

119. Internet connection is an essential component during the preparatory stages of the ECRM (i.e. ECRM 1) when map data of a community is actually derived and captured using Google Earth (or Pro). These satellite data are actually acquired and downloaded to a local computer through one's (online) connection to the internet.

120. However, it should be noted that there may be other options in order to achieve map data capture (in ECRM 1) such as offline data caching of Google Earth Pro satellite image, which described in greater detail in Appendix 3.

4. Map Information

121. Any source of map or geographic information about the community would be very useful. These information may be in digital or printed forms, such as spot maps, previous community resource maps, topographic maps, etc.

5. Human Resource Training

122. Trained human resource is essential in any GIS initiative or undertaking. Among the major preparations that have to be undertaken to fully and effectively implement the ECRM/PGIS are the following:

- i. trainings on basic mapping and GIS (details and specific mechanisms of which are beyond the scope of this current TA);
- ii. training on QGIS (details and specific mechanisms of which are beyond the scope of this current TA); and
- iii. training on georeferencing (details can be found in ECRM 1 and ECRM 3 of this text).

6. Tarpaulin Printing

123. Other essential components in order for PGIS to be implemented at the different levels of government which are the BLGU, MLGU and PLGU are outlined in Table 3.

Table 3: Essential Components and Tasking to run the PGIS/ECRM at the barangay level, the municipal level, and provincial level

	Stage 1 of CEAC Cycle			Post-ECRM Processing
	ECRM 1	ECRM 2 & ECRM 3	ECRM 4	
	Municipal Level	Barangay Level	Municipal Level	PMO to RPMO to NPMO
Computer Hardware	Please see Table 2	Please see Table 2	Please see Table 2	Please see Table 2
Computer Software	<ul style="list-style-type: none"> • QGIS • Google Earth Pro 	<ul style="list-style-type: none"> • QGIS 	<ul style="list-style-type: none"> • QGIS • Google Earth Pro 	<ul style="list-style-type: none"> • QGIS • Google Earth Pro
Internet Connectivity	<p>ONLINE: 256 kilobits per second (kbps) using fixed landline or wireless broadband (paid/subscribed under regular office's budget or piggybacked with current or future DOST initiatives)</p> <p>OR</p> <p>OFFLINE: for Google Earth Caching</p>	Not necessary	<p>ONLINE: 256 kilobits per second (kbps) using fixed landline or wireless broadband (paid/subscribed under regular office's budget or piggybacked with current or future DOST initiatives)</p> <p>OR</p> <p>OFFLINE: for Google Earth Caching</p>	<p>ONLINE: 256 kilobits per second (kbps) using fixed landline or wireless broadband (paid/subscribed under regular office's budget or piggybacked with current or future DOST initiatives)</p>
Map Information	Municipal maps, topography maps if available	Spot maps or old community resource maps if available	Municipal maps, topography maps if available	Provincial maps, topography maps of available
Required Manpower Training	<ul style="list-style-type: none"> • Tasked on the Engineering or Information Technology (IT) background • Trained personnel capable of doing the following: <ul style="list-style-type: none"> ➢ Caching on Google Earth and Satellite data Capture ➢ Use of QGIS 	<ul style="list-style-type: none"> • Able to use and manipulate a PC computer running on at least Windows XP or newer operating system (OS) • Trained BLGU Secretary or Treasurer on the use of QGIS 	<ul style="list-style-type: none"> • Tasked on the Engineering or Information Technology (IT) background • Trained personnel capable of doing the following: <ul style="list-style-type: none"> ➢ Caching on Google Earth and Satellite data Capture ➢ Use of QGIS 	<ul style="list-style-type: none"> • Tasked on the Engineering or Information Technology (IT) background • Trained personnel capable of doing the following: <ul style="list-style-type: none"> ➢ Use of QGIS
Tarpaulin Printing	Municipal level stakeholders are also tasked to do the Tarpaulin Printing	Not tasked		

C. The ECRM Phases

124. The ECRM can be divided into four (4) major phases, which are ECRM 1, ECRM 2, ECRM 3, and ECRM 4. The workflow and submission procedure is shown in figures 4.1, 4.2, 4.3 and 4.4.

125. In principle, the ECRM in order for it to be effectively implemented, a seamless coordinative effort must be done between the barangay level and the municipal level stakeholders.

1. ECRM 1: Preparation of Base Resource Maps - Concerned Entity/ies, Municipal Level

126. During ECRM 1, the municipal level stakeholders and its appropriate GIS trained personnel shall have a major role in the implementation of all the procedures outlined in ECRM 1. The designation of the MLGU as the main implementer of ECRM 1 is due to the fact that at the MLGU, all the necessary components and support infrastructure are present and organic to its functions and services. These components include existence of ICT/computer facilities, internet connectivity, technical manpower (i.e. municipal engineers or IT personnel). ECRM 1 should be implemented in consonance with the principles of the CEAC Stage 1.

127. ECRM 1 is said to be the “preparatory stages” for the actual community (barangay-level) resource mapping activity, which happens during ECRM 2.

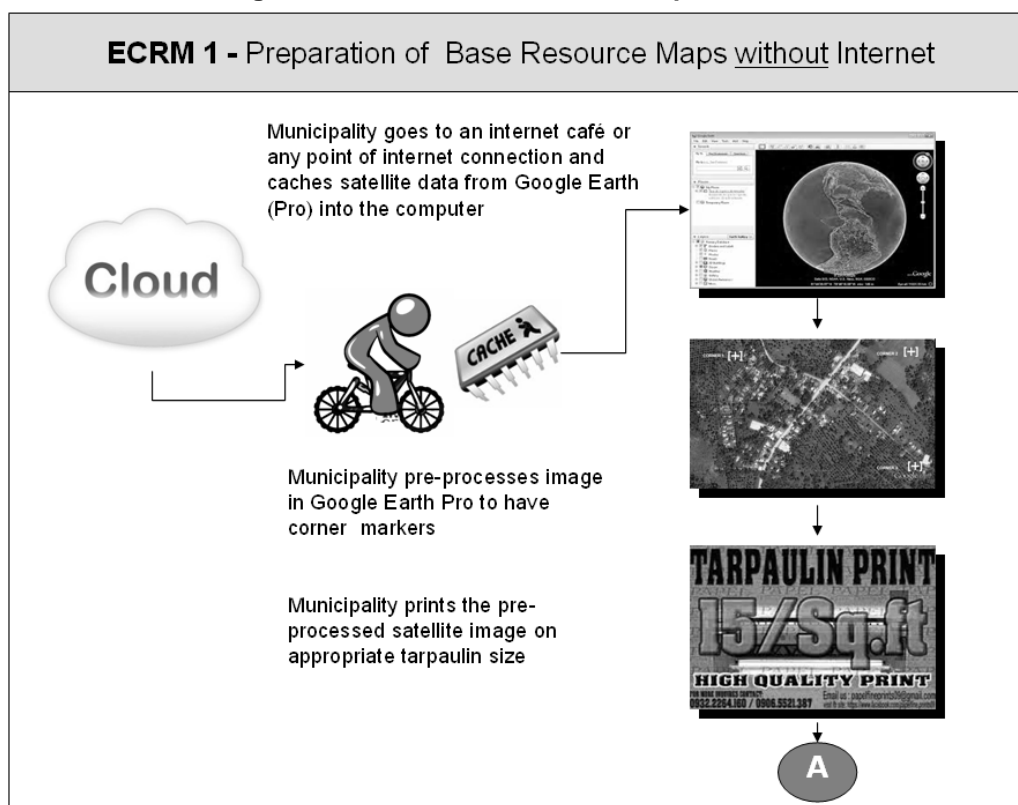
128. A major consideration during this process and must be determined by the concerned municipality, is the acquisition of the appropriate satellite image that would be needed by a particular community or several communities under its jurisdiction.

129. In principle, ECRM 1 has the following major component activities.

- i. Downloading Google Earth Pro
- ii. Caching of Google Earth Pro
 - Offline Caching in Google Earth Pro
 - Manually Caching Google Earth Data
- iii. Georeferencing of Google Earth-derived images
- iv. Opening and Manipulating Images in QGIS
- v. Transforming Images in QGIS
- vi. Printing the Map on Tarpaulin

130. As mentioned earlier, in cases when real-time, online internet connection is unavailable in a particular community (due to the mere absence of internet whether wired or wireless broadband), the “offline” mode of map data capture (in ECRM 1) such as offline caching of Google Earth Pro satellite image, can be used. Offline Data Caching is described in greater detail in Appendix 3.

Figure 4.1: ECRM 1 and its various processes.



2. ECRM 2: Actual Community Resource Mapping - Concerned Entity/ies, Barangay Level

131. The Resource and other social maps are essential components of the KC-NCDDP PSA process. A Resource Map provides the "top view" of the community. The map shows the distribution of resources of the community, e.g., forest cover, rivers, springs, irrigated land, crops, residential areas, watersheds, grazing land, etc.

132. The chore of resource mapping which is ECRM 2, is done by community members and PSA volunteers themselves and often facilitated by highly-trained Area Coordinating Teams (ACTs).

133. By tradition, resource mapping is done by these ACTs using the "paper-and-pen" method, where community volunteers are asked to draw a community resource map, information contained therein are usually drawn and mapped from memory.

134. In this current proposed process intervention, the same but somewhat modified process will be used. A base map (which is derived from Google Earth Pro and printed on tarpaulin and described in previous sections) now serves as the primary resource information for community stakeholders to work on. Community stakeholders may in the process, and are not prevented to validate information provided by the base map, as well as, modify the latter if information from their inherent knowledge and memory provides more up-to-date and more valid information as that provided by the base map. Also, instead of the Manila paper, clear plastic book cover (or

transparency) is used. As in the traditional method, permanent marking pens of different colors are used.

3. ECRM 3: Digital Photography (Digital Capture) and Georeferencing of the Traced Community Resource Maps - Concerned Entity/ies, Barangay Level
a. Digital Photography and Georeferencing

135. ECRM 3 is to be implemented by the barangay level stakeholders. The Barangay Secretary and/or Treasurer are the BLGU staff that must be initially capacitated and trained in the use (at least) of GIS software, since these two personnel are the usual operators of computers in barangays, as required by the nature of their jobs. This particular strategy supports the earlier cited issue on “Absence of GIS-trained staff at the BLGUs”.

136. Note, however, that the above approach may be highly dependent on the level of technical know-how of the barangay officers who may take on the job of digitizing and georeferencing the digital photograph of the traced map plastic transparency.

137. It should be noted that nationwide, not all barangays and their officials have the readiness to adopt the procedure, and therefore the KC-NCDDP must be sensitive as to which barangay to mainstream the above approach. The process of georeferencing the photographed image is also highly dependent on the presence or absence of a computer at the barangay in the first place. Hence, in barangays where fundamentally there is no PC, the chore of georeferencing the digital photographed image of the traced plastic transparency will be personnel from the municipal level (MLGU and/or ACT).

138. The capacitation on the process of ECRM 3 is suggested to proceed in three (3) phases or “waves”, coinciding with the start of a new CEA cycle for that particular community. This is in conformity with the principle of “build-operate-transfer or BOT”, that is, the players or stakeholders in the whole process are somewhat “weaned” first on the technology or the ECRM process, through a series of enabling and training sessions, and later once trained and technically-equipped, are left alone to independently do the process by themselves. This is diagrammatically shown in Table 4, the process proceeding from left to right.

Table 4: Suggested Phases/Waves for weaning stakeholders of ECRM 3

CEAC 1, Stage 1	CEAC 2, Stage 1	CEAC 3, Stage 1
Inception workshop and training. The Municipal level stakeholders (MLGU particularly the technical personnel/engineers from the planning and engineering offices of MLGU) are trained on ECRM 3	Training of barangay level personnel, to include BLGU and PSA volunteers on ECRM3	Training of barangay treasurer and/or secretary. MLGU and ACT will continue to provide technical assistance on ECRM 3

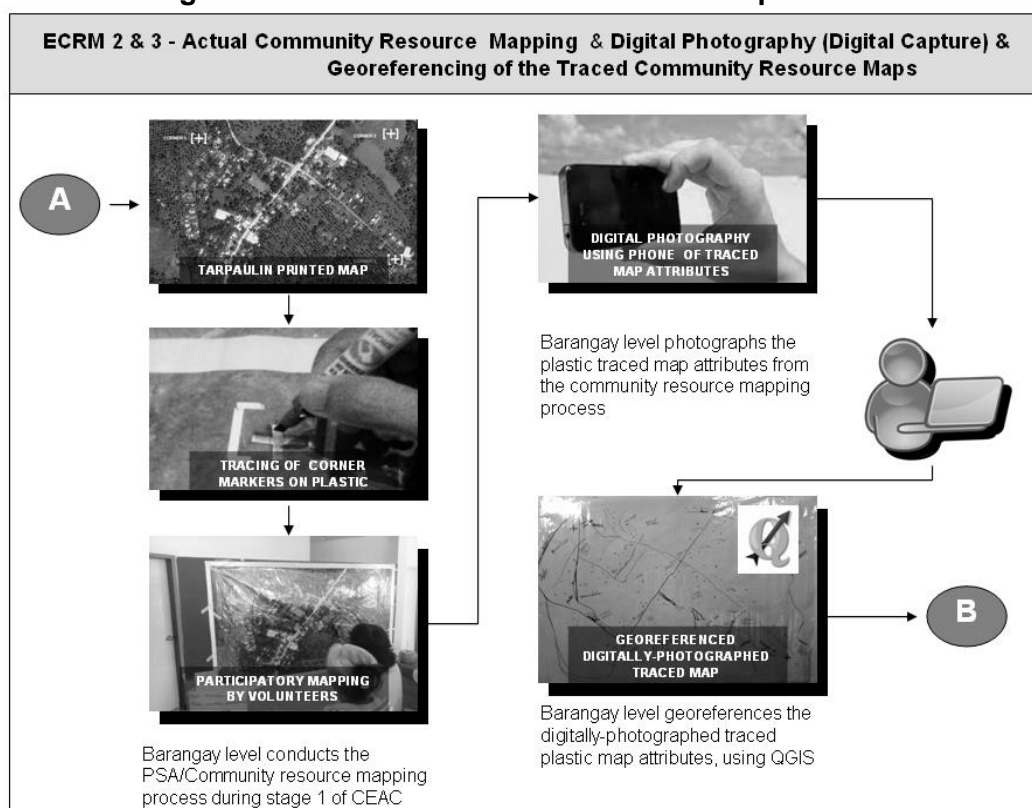
b. Sending the Digitally-Photographed and Georeferenced Image to Municipal Level Stakeholders

139. **Sending Online.** At this point, the traced image has been digitally-photographed and georeferenced by either the barangay level staff and PSA volunteers. The digital file will now

have to be conveyed to the next phase of the process. It is also at this phase that internet connectivity is essential, especially in cases when the community is located in extremely remote areas (but covered by wireless broadband internet signals) and land or water travel is a major obstacle. Digital files can be sent as email attachments or uploaded to free file hosting/sharing sites like Google Drive, Dropbox, etc.

140. **Manual Sending (Courier-type).** Nevertheless, in places where internet is unavailable, then the community has no other practical option but to convey the digitally-photographed and georeferenced traced images by saving the file in digital media such as writable CD-ROMs or USB thumb drives, and manually bringing these media (couriered) to the municipal level stakeholders for the next phase of the process which is ECRM 4.

Figure 4.2: ECRM 2 and 3 and their various processes



4. ECRM 4: Digital Manipulation and Map Attribute Extraction - Entity Concerned: Municipal Level

141. ECRM 4 shall again be the chore of stakeholders/players at the municipal level, particularly by the municipal planning and development office and/or the municipal engineering office. This is in cognizance of the fact that at the barangay level, there are limited to nil presence of computer-literate personnel. Hence, the chore of digitizing/converting the photographed, mapped clear plastic transparency may have to rest on municipal local government, as expounded in earlier portions of this report.

142. ECRM 4 is essentially concerned with further processing of the digitally-photographed and georeferenced traced map coming from the previous process of ECRM 1, 2, and 3. At this point the generated digital file is already usable in GIS software (i.e. QGIS), and can now be manipulated and information can be extracted for further GIS analyses.

143. Therefore, in order to capacitate the municipal local government office, the training of the concerned municipal planning and development officer(s) and/or the municipal engineering office in the basic use and manipulation of QGIS, particularly in:

- i. Georeferencing of the digital photo file of the traced plastic transparency from the resource mapping process.
- ii. Creating new vector layers in QGIS
- iii. On-screen digitization (using QGIS) of the digital photo file of the traced plastic transparency, to convert the digital photo file (which is in raster format) into vector data, that is usable format for various GIS applications.

144. Detailed description of the ECRM 4 process can be found in Appendix 3 of this report.

Figure 4.3: ECRM 4 and its various processes

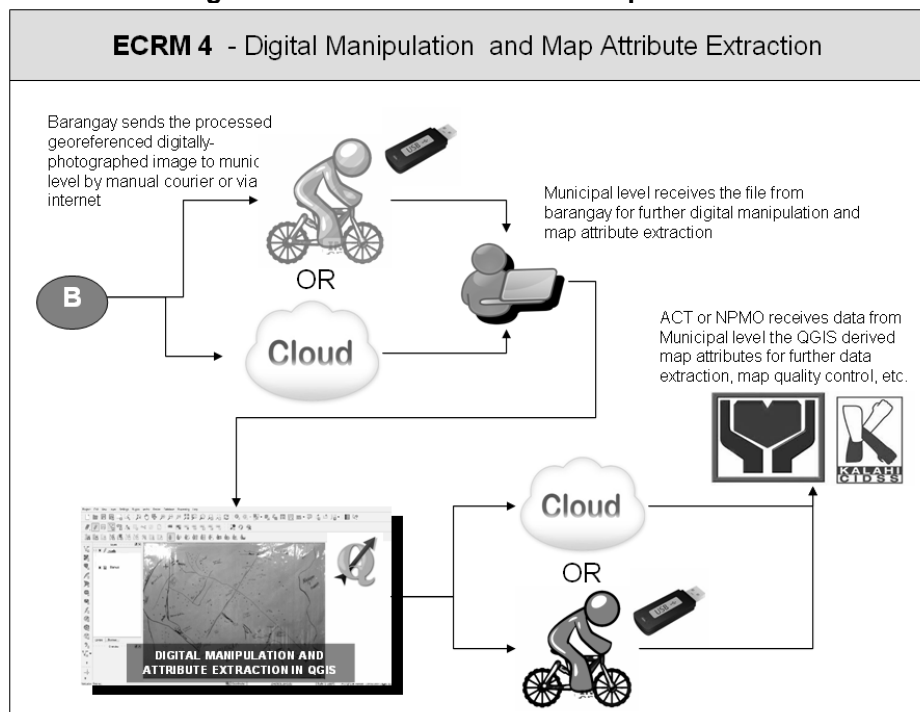
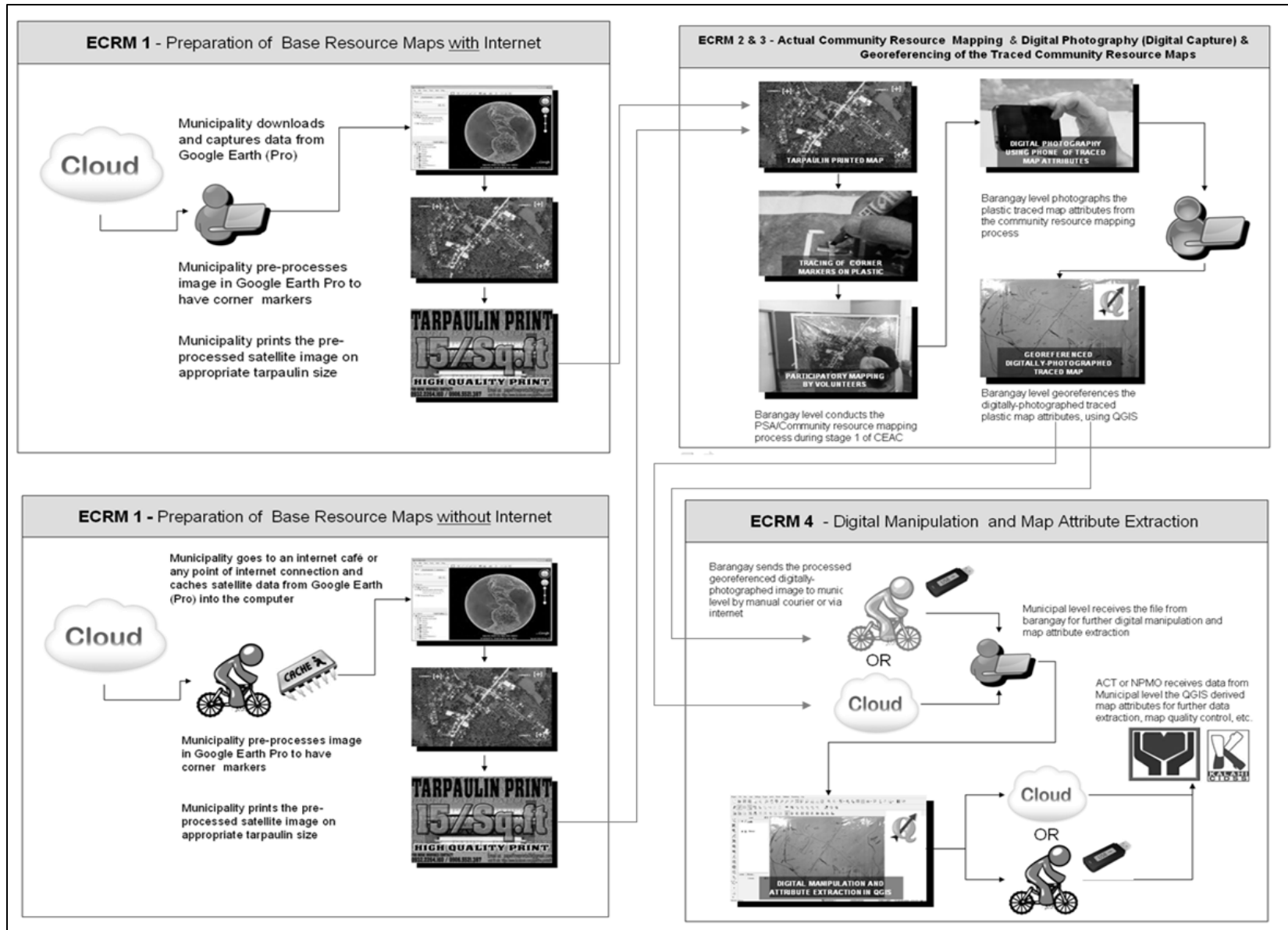


Figure 4.4: The ECRM Process and its Four Phases



D. Post-ECRM and Submission Process

145. The digital maps generated from the whole process of ECRM has two basic destinations. These are:

i. As input into the KC-NCDDP's program intended to integrate the outputs of the enhanced community resource mapping into a standardized geodatabase. This will support the ongoing geotagging and web-based GIS system which is now functional at the national level.

Consolidation of the digital outputs of the ECRM follows the hierarchical structure of the KC-NCDDP, whereby data is first consolidated by ACTs, then by MCTs, followed by PMOs, the RPMOs, and finally consolidated by the NPMO. It is on the assumption that starting from the municipal levels up to the national level, all the levels are interconnected through the internet, so that there is a "seamless" relay of digital map data from one level to the next.

ii. As input to the succeeding cycles of the CEAC. The treatment of the digital maps generated by the ECRM would be the same as to how implementers of the CEAC would handle classical or traditional paper-and-pen developed maps, only this time, the community resource maps are viewed in front of a computer.

146. Please note that once completed during stage 1 of the CEAC Cycle 1, and on the assumption that the community resource map will have been digitized and ready for Stage 2 of the CEAC Cycle 1, the ECRM need not be repeated again. That is to say, ECRM 1, ECRM 2, ECRM 3, and ECRM 4 need not be done again since the community maps at Stage 2 of the CEAC will have been digitized already. In succeeding cycles, the digitized versions will have to be displayed on computer monitors (or projectors for mass community viewing) for these maps to be further analyzed, reviewed or updated by the community.

147. Furthermore, future updating of community maps is assumed to be done on the computer since digital community resource maps will have been produced by this time, and human resources at the different levels will have been capacitated through training, in the use of GIS software (i.e. QGIS).

VI. SUSTAINABILITY OF KC-NCDDP'S PGIS

148. In order to sustain the proposed PGIS for KC-NCDDP and be able to mainstream the process in similar government and private-led initiatives and capitalize or leverage on the strengths of ongoing programs or projects present in the region. Below are some of the proposed or suggested strategies that are envisaged to help sustain KC-NCDDP's PGIS:

A. Harmonization of TVWS initiatives in Bohol with KC-NCDDP stakeholders in the same area in order to pilot the newly developed resource mapping technique

149. Among the salient findings during the field surveys done in Santa Josefa, Agusan del Sur and that of Gloria in Oriental Mindoro, are low to poor wireless broadband internet services in those areas. The hesitation for private telecommunications companies, the likes of Globe and Smart to improve or upgrade the communications infrastructure in those places may be due in

part to the small client base of internet users in those areas, and as such a slow rate of return in these companies' capital investments.

150. Cognizant of this very basic issue of lack of internet connectivity, several possible solutions can be considered by KC-NCDDP in order to digitally connect the different tiers of local government (from barangay, municipal, provincial, regional to national levels) and community stakeholders, which are the vital sources of resource data, for immediate and seamless transfer of GIS data.

151. The project had established three (3) TVWS Base Stations at the existing ICTO-TELOF telecommunications facilities in the municipalities of Talibon, Ubay and Tubigon in Bohol, Central Visayas,. The base station is designed to set up a white space communication link between the base and client (CPE) radio units that operates in two operation modes supported by the system: "two-way streaming mode" for radio link testing (requires no Internet connection) and "access point mode" for normal operation (requires Internet connection). The project targets internet/broadband connectivity of DOST-ICTO's "test license" in the island of Bohol serving at least 100 sites in area coverage of approximately 900 square kilometers.

152. A quick scan of the KC-NCDDP initiated projects in these cited municipalities indicated that there are at least 45 KC-NCDDP projects of various modalities in Talibon, 119 KC-NCDDP projects in Ubay, and 95 KC-NCDDP projects in Tubigon. These KC-NCDDP-initiated projects based in these 3 municipalities can therefore be harmonized with the TVWS initiatives as they are within the effective range of radio signals of the TVWS system now in place in the island of Bohol. Below are some of the suggested steps to harmonize the KC-NCDDP projects with those of the TVWS:

- i. Initiate talks with DOST-ICTO proponents;
- ii. Enter into a memorandum of understanding or agreement (MOU or MOA) with
- iii. DOST-ICTO on the terms of use (TOU) of the TVWS in Bohol; and
- iv. Conduct a pre-feasibility study on the collaboration to show the benefits and justifications of a joint collaboration as well as a demonstration project for both collaborators

153. Harmonization of these projects may take the form of applying internet connectivity to better manage, monitor and sustain existing or established KC-NCDDP projects through enhanced communication among community stakeholders and the different tiers of the local government. Likewise, harmonization in this sense would be for its foremost application of internet to support the geotagging and GIS database buildup of the communities in the purview of these three municipalities of Talibon, Ubay and Tubigon.

B. Capitalizing on the presence of Internet Cafés in Communities as Hubs for Community Access

154. It had been observed that in the 3rd class municipalities of Santa Jose and Gloria, there is the thriving business of small-scale internet cafes, with computers numbering from 5 to 10 workstations. With the assumption that these internet cafés have subscribed to a relatively stable internet access, these cafés can be commissioned to act as "local hubs" for internet access in the communities where they are located. Take the case of Santa Josefa in barangay Poblacion where 6 internet cafés are operating. If these 6 internet cafés can be enhanced to be WMNs having an

effective range of 100-meter radius of WIFI connectivity, the estimated effective area that can be covered by 1 WMN is around 31,415.93 square meters or equivalent to 3 hectares. If all 6 internet cafés are converted to WMNs, then the total area covered by WIFI connectivity by these 6 WMNs is around 18 hectares.

155. This configuration can be achieved by these internet cafés' establishing WIFI hotspot or a group of hotspots, forming a WMN that is designed to extend the range of a particular point of access by cascading the signal. A detailed description of a WMN can be found in earlier text of this study.

C. Tap into public school ICT infrastructure and internet connection and educational systems for build-up, long-term sustainability and maintenance of the GIS database

156. The existence of ready, turn-key ICT equipment (such as but not limited to computer desktops/ laptops, printers and projectors) in most public schools and internet connectivity can be tapped into by KC-NCDDP by partnering with these schools.

157. The building infrastructure as well as the innate security offered by public schools can be leveraged by KC-NCDDP, for the latter to provide the following:

- i. GIS server back-up - for community-developed, community-generated resource maps, as well as related GIS data and software;
- ii. Venue for community-focused GIS training/ seminars. Public schools have the appropriate set of ICT equipment to conduct GIS capacitation among community stakeholders.
- iii. Assured Internet Connectivity - as it is now imperative that all public schools be connected to the internet, it may be assumed that in the near future, public schools and their connections to the internet can be tapped into by KC-NCDDP for efficient communications within KC-NCDDP, as well as for conveyance of GIS-related information and applications.

158. The establishment of GIS in the village is necessary to embed GIS in the planning, implementation, and management of future GIS-based programs, projects, and activities in the village. This would require passing a village ordinance to make GIS legally part of the village's development plans. The village needs to assign a person to head the GIS program.

159. Institutionalization of a village GIS can be successful through a village wide effort. At the forefront are the GIS champion, GIS advocates, and visionary officials who desire to apply emergent technologies to solve rural development challenges. GIS is largely unknown by rural village personnel. As its simplest function, GIS is a mapping tool. Rural people can easily take advantage of this feature. Nevertheless, resistance to change is expected. Another may be the level of interest of village officials in this new technology and financial capability of the village to make the initial shoestring investment in hardware and training. A problem may lie also in integrating GIS in the village's traditional institutional, manpower, and organizational setup. Skills acquired during GIS training could easily stagnate or be forgotten if not used regularly. Non-availability of funding for the village's development project goals may discourage village planners.

160. Thus villages will have to devise strategies to realize and sustain their own development plans with minimal outside financial help. The temptation to get into high-tech expensive methods immediately will likely frustrate local project participants.

161. Absence or slow internet connection could impede the use GIS, especially when data is sourced from the internet. In such case, downloading free online data needs to be done in internet café or elsewhere where there is capable internet connection. GIS data processing could then be done with a stand-alone, internet-unconnected computer system. Sustaining trained village GIS technicians may also be a problem.

162. This paper has laid out an introduction to enhancing the community resource mapping process in rural villages.

163. A village GIS can be built by first enhancing the resource mapping process, and further processing them into readily usable information, and building a warehouse of easily accessible spatial data. This warehouse then supports GIS-engaged development projects in the rural village. GIS project planning, implementation, integration, and institutionalization requires the cooperation and participation of the village population led by village officials. Rural village empowerment is the ultimate goal of GIS. An empowered village is less dependent upon municipal, provincial, or national government for political or financial support. It is about time villages learn to set its own direction and to attain its own vision and goals with less outside support and political interference. The process to empower villages through GIS will not be easy and will encounter many hurdles. But the results will be worth the effort for its present and future citizens.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. Conduct of online survey to the rest of the KC-NCDDP covered municipalities

164. Earlier in the text it was mentioned that the TA was conducted in just 2 municipalities out of the 846 municipalities under KC-NCDDP nationwide. Hence, it is hoped and in order to be able to provide a more comprehensive picture of the over-all readiness of KC-NCDDP communities to adopt the proposed PGIS, a nationwide survey must be conducted. This could be achieved through the conduct of an online survey, exploiting various web-based survey systems as well as social media (i.e. Survey Monkey, Facebook).

B. Pilot testing

165. Upon finalization of this current TA report, the developed PGIS protocol (a.k.a. ECRM) will need to be pilot-tested in the 2 municipalities of Santa Josefa and Gloria. The pilot testing of the ECRM is necessary in order to test the design of GIS and mapping procedures, as well as, identify gaps in the PGIS procedure which can then can be adjusted should there be a need to do so.

C. Overlay of existing data sets from other sources: OpenStreetMap

166. One of the possible future sources of free and open source data that can be used to further enhance the PGIS protocol, is that of the Open Street Maps. OpenStreetMap is built by a community of mappers that contribute and maintain data about roads, trails, cafés, railway stations, and much more, all over the world. OpenStreetMap is open data: you are free to use it for any purpose as long as you credit OpenStreetMap and its contributors. OpenStreetMap

emphasizes local knowledge. Contributors use aerial imagery, GPS devices, and low-tech field maps to verify that OSM is accurate and up to date.

D. Possible uses of PGIS

167. Once developed, there are other possible uses and applications of the KC-NCDDP PGIS, among which are the following:

- i. Demarcation of traditional boundaries; for land and other natural resource claims
 - Legal recognition of customary land rights
 - Identify areas of use and occupancy
 - Priorities for claims, between different communities
 - Evaluation of communities' scenarios of alternative land management systems
- ii. Identification, location, and analysis of specific natural resources
 - Forest and woodland resources
 - Trees, vegetation & non-timber forest products outside the forest
 - Environmental services
 - Water resources and management, such as traditional irrigation
 - Livestock management
 - Soils and especially traditional knowledge of soils
 - Land suitability, and land evaluation
 - Wildlife management and hunting, terrestrial areas
 - Mining and minerals extraction
- iii. Tourism and eco-tourism.
 - Local Knowledge of Hazard Management and Disaster Risk Assessment
 - Environmental hazard areas, e.g. landslides, volcanic activities, pests
 - Preparation, and warning signals, etc.
 - Post-disaster mitigation mapping

E. Limitations of PGIS implementation

168. This study had identified two other major issues that can become main impediments in the successful implementation and sustainability of the KC-NCDDP PGIS. These are the issues of 1) Retention of Technical Personnel in ICT and GIS, 2) Availability and Stability of Electricity Issues. These issues were not dealt nor discussed fully in this study, since these are issues beyond the scope of the TA. Hence, future TA that should try to tackle sustainability mechanisms of PGIS may endeavor to look deeper into these two main issues.

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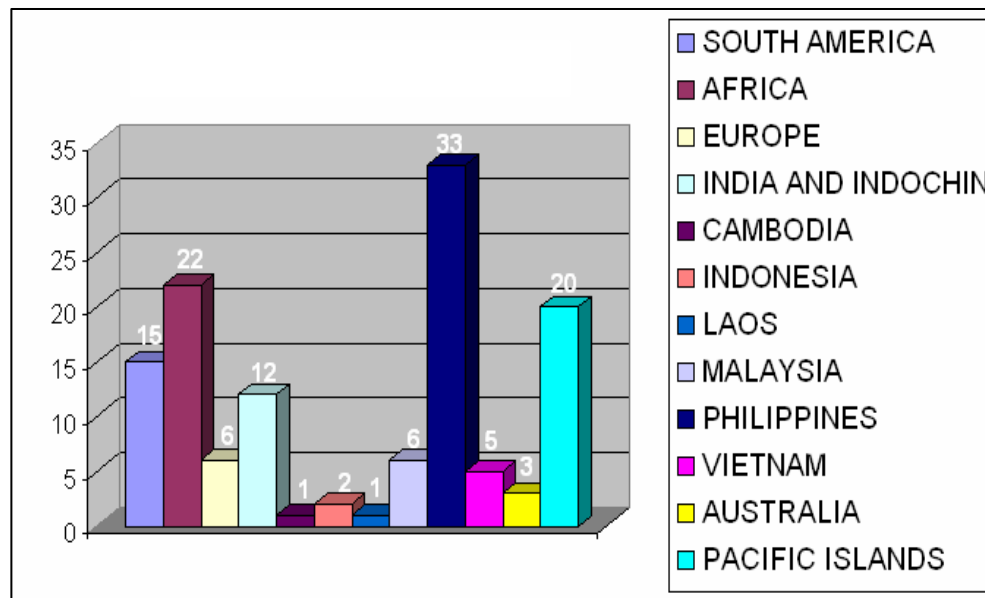
Wikipedia (2015) *Wireless Mesh Network*, from Wikipedia, from
https://en.wikipedia.org/wiki/Wireless_mesh_network

GLOBAL INITIATIVES IN PGIS

A. Global Distribution of PGIS

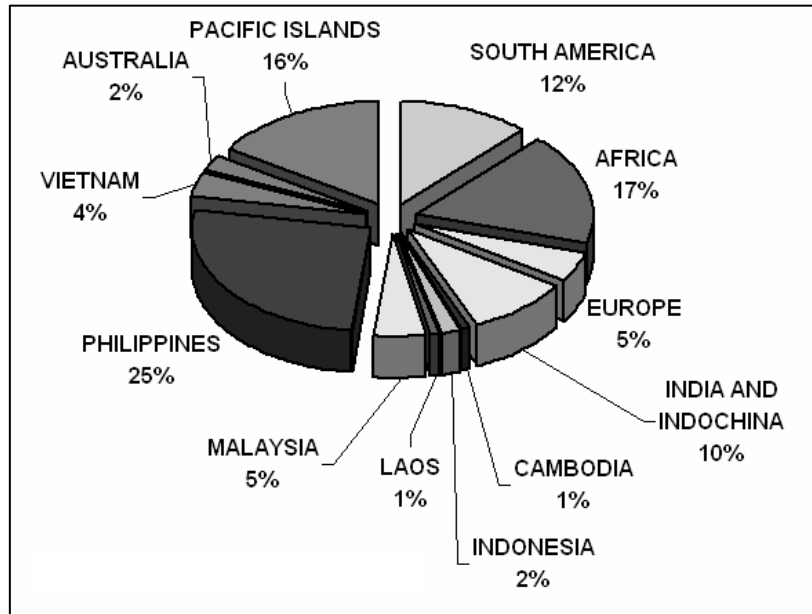
1. Based on literature review and documented information, to date there are around 126 Participatory Geographic Information Systems (PGIS) projects worldwide. A great majority of which use participatory three-dimensional modeling (P3DM) as a means of portraying geographic information and local knowledge in different communities (Figure A1.1).

Figure A1.1: Participatory Geographic Information System Globally



2. To date, in the Philippines, a total of 33 PGIS projects have been implemented for the last three decades, starting from the early 1990s. These 33 PGIS programs nationwide, account for around 25% of the PGIS activities globally, making the Philippines the trailblazer in the use of PGIS among its neighboring countries and within the region (Figure A1.2). The continent of Africa, as a whole, trails after the Philippines, at 17% of PGIS initiatives worldwide.

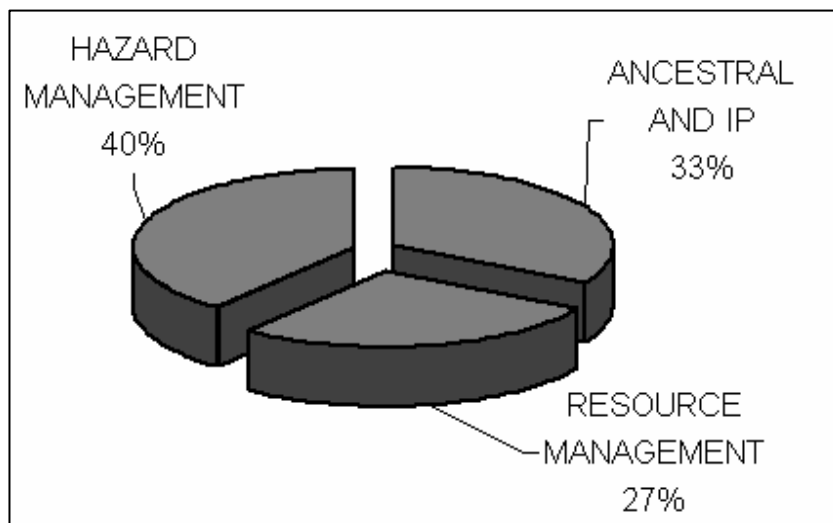
Figure A1.2: Percentage Share of Countries Using Participatory Geographic Information System Globally



B. PGIS Application

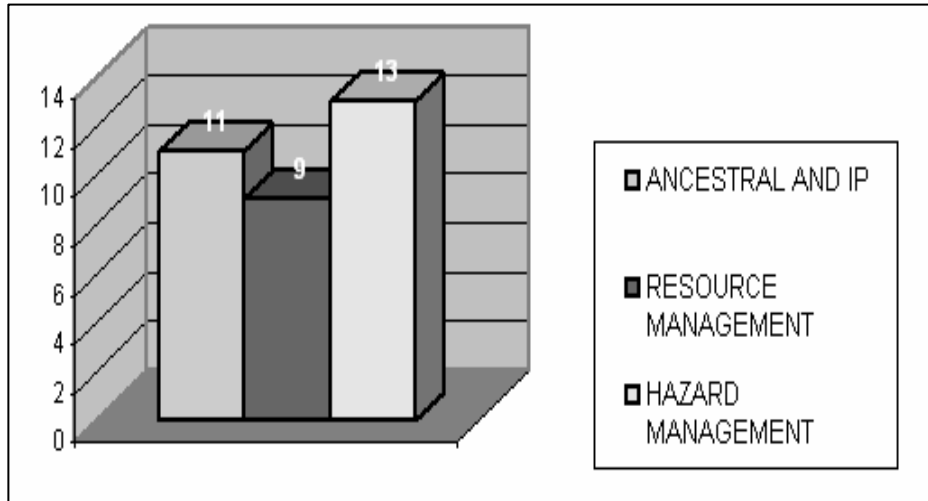
3. In terms of the applications of PGIS, these can be categorized in to three (3) major applications, which are: *Hazard Management (or Disaster Mitigation)*, *Resource Management* (such as but not limited to forestry, agricultural, and fishery applications), and settling of *Ancestral Claims* (and disputes) and *Indigenous Peoples (IPs)*. See Figure A1.3.

Figure A1.3: Categories of Participatory Geographic Information System in the Philippines and their Percentages



4. In the Philippines, the major applications of PGIS on hazard management projects account for the 40% (13 projects), followed by PGIS applications on settling disputes related to ancestral domains (33%, 11 projects) and indigenous peoples. Lastly, PGIS applications on resource management account for about 27% (9 projects). It is noteworthy that all 33 PGIS initiatives made use of P3DM (Figure A1.4).

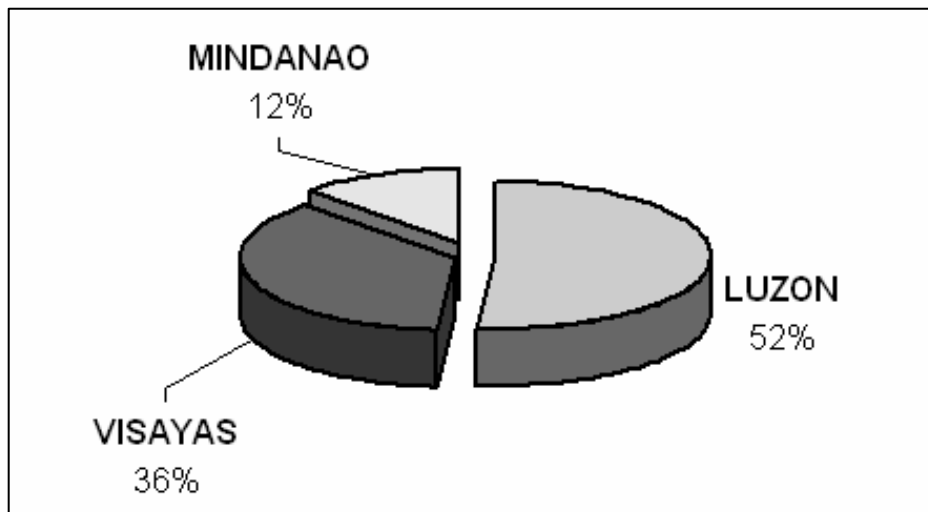
Figure A4.4: Major Applications of Participatory Geographic Information System in the Philippines



C. PGIS Distribution

5. In terms of distribution, of the 33 PGIS projects implemented in the Philippines, majority of the projects were in Luzon (52%, 17 projects), followed by PGIS projects conducted in the Visayas (36%, 12 projects), and lastly, in Mindanao (12%, 4 projects). See Figure A1.5.

Figure A1.5: Percentage Distribution of Participatory Geographic Information System in the Philippine Main Island Clusters



SURVEY OF LOCAL GIS AND COMMUNITY-FOCUSED PROJECTS

A. Agencies Scanned

1. Review of on-line literature was undertaken among key government agencies and non-government organizations (NGOs) that are in one way or the other, using Geographic Information Systems or Technologies (GIS/GIT) in the delivery of their mandated service or the further development of such in research and development undertakings. The scanning exercise also tried to capture relevant information and communication technology-based (ICT) initiatives, such as but not limited to the provision of computer and related accessories, broadband, mobile and next generation access (NGA) technologies to the internet, among others.

2. The following agencies were scanned (for the presence or absence) of community-based, local government-focused projects, services and initiatives:

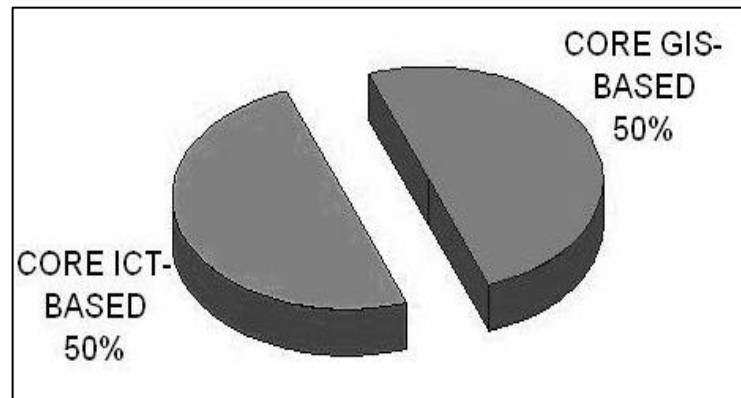
- i. Department of Agriculture and its line agencies
 - Bureau of Soils and Water Management (BSWM)
- ii. Department of Agrarian Reform and its line agencies
- iii. Department of Environment and Natural Resources and its line agencies;
 - Environmental Management Bureau (EMB)
 - Ecosystems Research and Development Bureau (ERDB)
 - Forest Management Bureau (FMB)
 - National Mapping and Resource Information Authority (NAMRIA)
 - Mines and Geosciences Bureau (MGB)
- iv. Department of National Defense and its line agencies
 - Office of Civil Defense (OCD)
- v. Department of Transportation and Communications and its line agencies
- vi. Department of Interior and Local Government and its line agencies
 - Metro Manila Development Authority (MMDA)
- vii. Department of Science and Technology and its line agencies
 - Information and Communications Technology Office (ICTO)
 - Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
 - Philippine Council for Industry, Energy and Emerging Technologies Research and Development (PCIEERD)
 - Philippine Council Agriculture and Natural Research and Development (PCARRD)
 - Philippine Council for Health Research and Development (PCHRD)
 - Philippine Institute of Volcanology and Seismology (PHIVOLCS)
- viii. Department of Social Welfare and Development and its line agencies
- ix. Department of Trade and Industry and its line agencies
- x. Housing and Land Use Regulatory Board (HLURB)
- xi. University of the Philippines System
- xii. Ateneo de Manila University System

B. Community-Focused GIS and ICT Projects

3. There are basically eight (8) community-focused projects, where community participation is a vital component in their implementation, and in order for them to achieve the over-all success of the project's implementation. Of these, four projects (50%) have at their cores GIS/GIT or

derivatives of GIS/GIT in the collection of data from the community (or participating entities, otherwise known as crowd-sourced data) and, likewise, in the delivery and dissemination of processed information among their stakeholders and users. The other four projects (50%) are basically ICT-based initiatives, with GIS/GIT not necessarily an essential component of their systems (Figure A2.1).

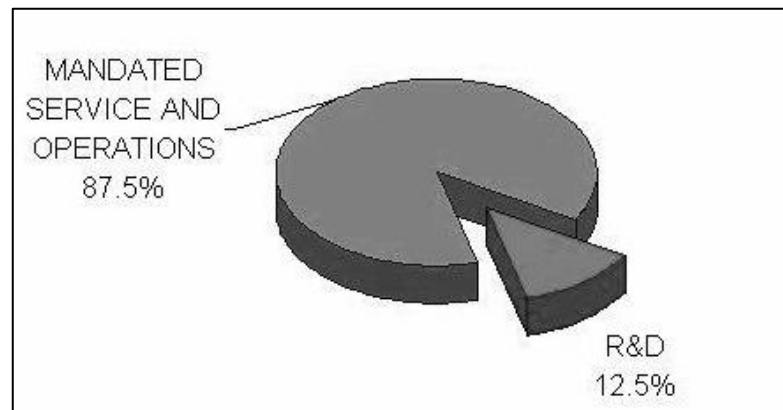
Figure A2.1: Percentages of Community-Focused Geographic Information System and Information and Communication Technology Projects



C. Nature of Activity

4. In terms of the type or nature of the community-based activities, only one project (13%) can be classified as falling in the status or phase of research and development (R&D), while the rest (7 projects; 87%) are inherent functions or mandated services of the concerned government agency.

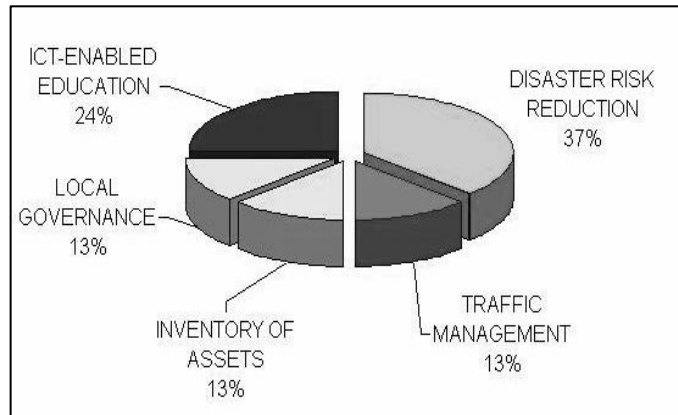
Figure A2.2: Percentages of the Two Types/Nature of Community-based Activities



D. Applications

5. Also, out of these eight (8) community-driven/community-focused projects, majority of the projects (3 projects; 37%) focus on their applications and use in disaster and risk reduction (DRR), while others have applications on traffic management in urban areas (1 project; 13%); inventory of assets and resources (1 project; 13%), local governance (1 project; 13%); ICT-enabled education and digital literacy (2 projects; 24%). See Figure A2.3.

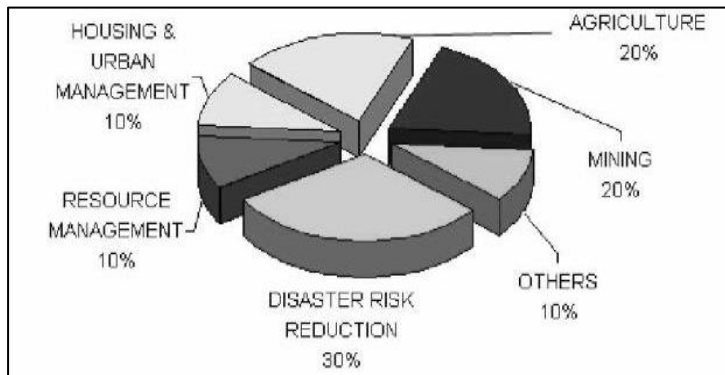
Figure A2.3: Major Applications of Community-Based Projects



E. Basic GIS Projects (Non-community based or Non-participatory)

6. From the scanning exercise, there are ten (10) projects that have been initiated by government and private entities, the basic purpose of which is for the build-up of appropriate GIS databases, but are NOT necessarily community-based or community driven initiatives (Figure A2.4).

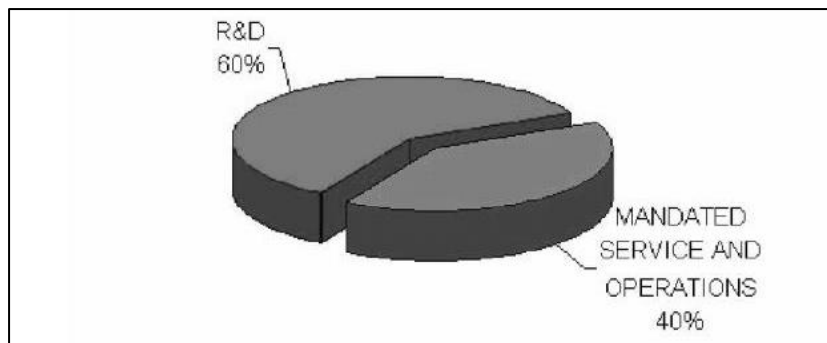
Figure A2.4: Major Applications of 10 Non-Community-based Geographic Information System Projects



F. Nature of Activity

7. Of these 10 projects, six projects (60%) are R&D in nature, while four projects (40%) may be classified to have been initiated as basic mandates and services of the concerned government entity.

Figure A2.5: Nature of Activity of the 10 Non-Community-based Geographic Information System Projects



MAP DATA CAPTURE AND ECRM

1. The following pages provide a method for capturing Google Earth Pro datasets which would provide the templates for future base maps for use in the Enhanced Community Resource Mapping (ECRM) process.

A. Downloading Google Earth and Google Pro

2. Google Earth/ Google Earth Pro is a virtual globe, map and geographical information program that was originally called EarthViewer 3D created by Keyhole, Inc., a Central Intelligence Agency (CIA) funded company acquired by Google in 2004. It charts the Earth by the superimposition of images obtained from satellite imagery, aerial photography and geographic information system (GIS) onto a virtual 3D globe. It was originally available with three different licenses, but has since been reduced to just two: Google Earth (a free version with limited function) and Google Earth Pro, which is now free (it previously costs \$399 a year) and is intended for commercial use. The third original option, Google Earth Plus, has been discontinued.

3. The product, re-released as Google Earth in 2005, is available for use on personal computers running Windows 2000 and above, Mac OS X 10.3.9 and above, Linux kernel: 2.6 or later (released on June 12, 2006), and FreeBSD. Google Earth is also available as a browser plugin which was released on May 28, 2008. It was also made available for mobile viewers on the iPhone OS on October 28, 2008, as a free download from the App Store, and is available to Android users as a free app in the Google Play store. In addition to releasing an updated Keyhole based client, Google also added the imagery from the Earth database to their web-based mapping software, Google Maps. The release of Google Earth in June 2005 to the public caused a more than tenfold increase in media coverage on virtual globes between 2004 and 2005, driving public interest in geospatial technologies and applications. As of October 2011, Google Earth has been downloaded more than a billion times.

4. For large parts of the surface of the Earth only 2D images are available, from almost vertical photography. Viewing this from an oblique angle, there is perspective in the sense that objects which are horizontally far away are seen smaller, like viewing a large photograph, not quite like a 3D view.

5. For other parts of the surface of the Earth, 3D images of terrain and buildings are available. Google Earth uses digital elevation model (DEM) data collected by NASA's Shuttle Radar Topography Mission (SRTM). This means one can view almost the entire earth in three dimensions. Since November 2006, the 3D views of many mountains, including Mount Everest, have been improved by the use of supplementary DEM data to fill the gaps in SRTM coverage.

6. Google Earth supports managing three-dimensional Geospatial data through Keyhole Markup Language (KML).

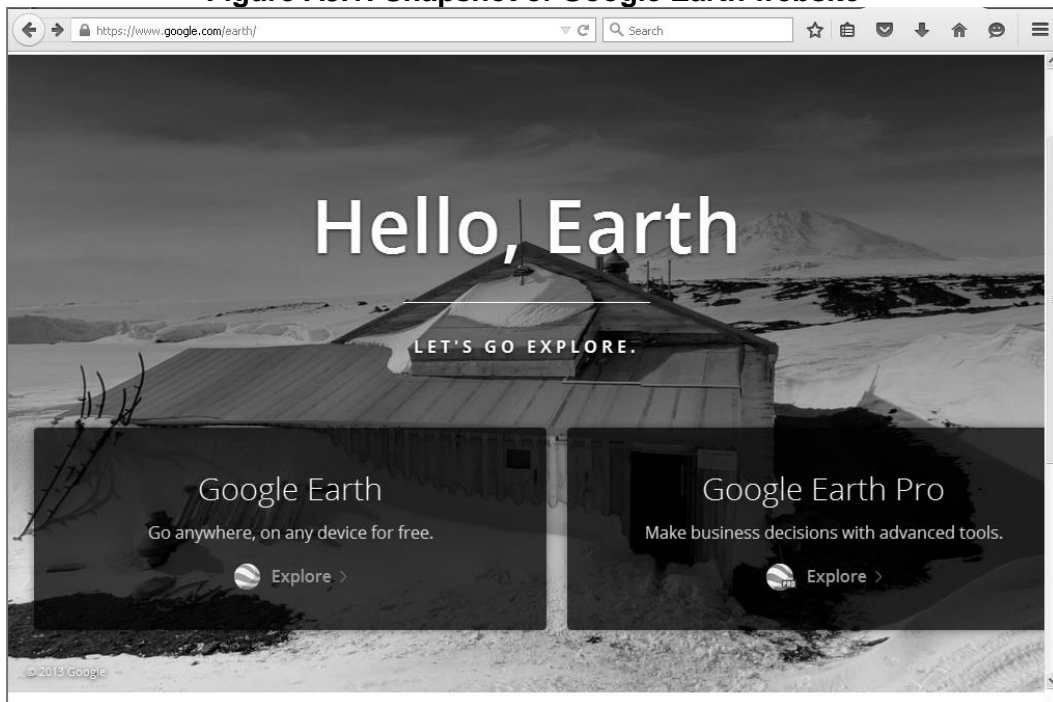
7. Use of Google Earth Pro requires a valid license key. As of January 20, 2015, Earth Pro licenses are now free. After getting your Earth Pro license, you can register, download, install, and sign in to start using Earth Pro's advanced features.

8. If you do not have a key, use your email address and the key GEPFREE to sign in.

9. Google Earth and Google Earth Pro can be downloaded from the link: <https://www.google.com/earth/>

10. Download and install Google Earth or Google Earth Pro in your Windows-based computer and follow the installation prompts.

Figure A3.1: Snapshot of Google Earth website



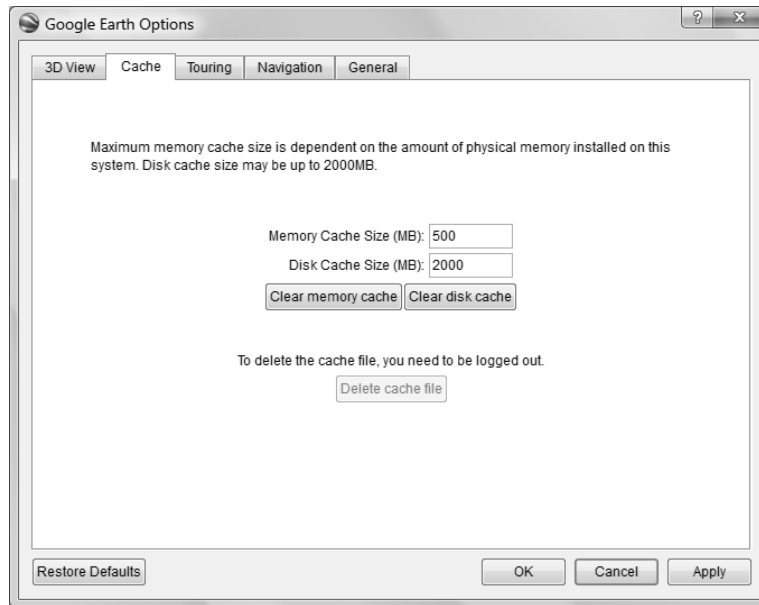
B. Offline Caching in Google Earth Pro

11. When you view a location in Google Earth Pro, it caches the imagery data (but not the elevation data), storing it locally so that as you scroll back and forth across different areas, it doesn't have to download the same imagery over and over again from the server on the Internet. There are actually two sets of locally cached data:
 12. **Memory Cache:** Data stored in system RAM (Random Access Memory). This information can be retrieved very quickly, but vanishes when you exit the application.
 13. **Disk Cache:** Data stored on the hard drive, and which persists after program exit. So if you have data cached for a particular area in Google Earth Pro, exit the program, and then return to the same area the next time you use Google Earth Pro, GEP will load the imagery information directly from the hard drive cache – a lot faster than having to download it again over the Internet.
14. The size of these caches can be set in the Tools => Options section, under the Cache tab:
15. The maximum values are the ones above, 500MB for memory cache, and 2GB (2000MB) for disk cache; apparently, Google doesn't want people to download the entire imagery dataset for the whole planet to their systems :). If you've got the disk space, and most modern systems do, you should definitely set the disk cache size at this maximum value. Optimum value for the memory cache will depend on how much RAM you have installed on your system, and how much your OS uses. If you have a system with a relatively small amount of RAM (512 MB to 1 GB), making this memory cache too large might impede performance. On most modern systems, with 2GB or more of RAM, the maximum memory cache size of 500MB shouldn't cause any problems.

16. Disk cache data is stored by default in the:
17. C:\Users\your_user_name\AppData\Local\Google\GoogleEarth directory in Windows Vista.
18. If you can't find it there, you can determine the actual location using the registry entry HKEY-CURRENT-User/Software/Google /Google Earth Plus, under the CachePath entry. There are two files: dbCache.dat which contains the actual data, and dbCache.dat.index, which presumably is the index file for the data. You can clear out all the disk cache data using the "Clear disk cache" button, which removes all the data but keeps the files there. To delete the files completely, you need to either log out of the server (File => Server Log Out) and then click the "Delete cache file" button you see above, or exit Google Earth and delete those two files directly from the cache directory. You can also copy them to another directory to hang on to them.
19. Why would you want to delete or copy these files? Two reasons:
 - i. If you're having crashing or graphics issues with Google Earth, Google recommends deleting the disk cache files as one possible fix.
 - ii. You can "pre-cache" a set of data for a particular area of interest, then copy them to a different directory on your hard drive. Then, when you want to look at this area in detail in Google Earth, you can copy these files back to the original directory, and Google Earth will access this data from the hard drive, a lot faster than downloading it again from the Google Earth server.
20. If you have a decent Internet connection all the time, this is likely to be more trouble than it's worth. But if you have a slow connection, this can speed things up enormously. And if you'd like to use Google Earth on your laptop, in a location that has no Internet connection, using cached data is your only option; Google Earth can access and use cached data when no Internet connection is present or available. You can copy this cache data from one computer to another as well.
21. *Note:* This only caches image terrain data from Google Earth, not data from KML/KMZ files. If the KML/KMZ files are self-contained, you can load them into Google Earth and view the data, but if they're network links, and you're not connected to the network, the data in the links won't show up.

C. Manually Caching Google Earth Data

22. To create a localized Google Earth or Google Earth Pro cache file manually:
 - i. Start up Google Earth while connected to the Internet
 - ii. Go to Tools => Options, and select the Cache tab:

Figure A3.2: Screenshot of the tools option to select the Cache tab

- iii. Click the “Clear disk cache” button to remove all data from the cache and cache index files. This maximizes the available amount of space for your cached data, so that you can cover more area with the cached data.
- iv. Set the Memory Cache Size to the minimum allowable value of 16MB; this will force Google Earth to put data in the disk cache more quickly. Click the “Clear memory cache” button, then exit the Options screen
- v. In Google Earth Pro, navigate to your area of interest.
- vi. Set your viewing altitude (the “Eye alt”) for the desired imagery resolution. Higher altitudes mean lower resolution, but the data will take up less space. Lower altitudes give you higher image resolution, but at the cost of more disk space. If there are major changes in elevation over the area, you may have to change your altitude to match them to keep your relative height; if the terrain elevation drops, but your “eye alt” stays the same, the image resolution will decrease because you are further away from the surface.
- vii. Wait for the “data loading” indicator at lower right to show that all the data for that area and resolution has been downloaded; it will display as a solid light-blue circle when downloading is complete for that area. You’ll also see the imagery change from blurry to sharp.
- viii. With the mouse or cursor keys, move the view to an adjacent area that overlaps the first area at least partially, and wait for the “data loading” indicator to show once again that all the data has been downloaded.
- ix. Repeat this process until you’ve covered your entire area of interest.
- x. If want data at several different resolution levels, you could repeat steps 5-9, but at different viewing altitudes.
- xi. When you’re finished with steps 5-10, you might consider zooming all the way in to the closest level at one point, then all the way out to the planetary view level. It seems to me

that this prompts Google Earth Pro to write all of its data cached in RAM to the disk cache, but I could be wrong about this. It also seems as though there can be a time delay between viewing a location, and when it's cached to disk, so waiting 10 minutes after you've finished covering the area of interest might be a good idea.

23. You now have a set of Google Earth Pro data for that area saved in the disk cache. If you take your computer offline and start up Google Earth Pro, it will tell you that it can't log on to the server and download data, but it can still read in whatever data it has in the cache. You can copy this cached data (see this previous post for where to find it) into a different directory, and then copy it back into the cache directory when you need it, or even copy it to a different computer.

24. For small areas, manual caching of data won't take too long, but for larger areas, manually scrolling to an area, waiting for the data to download, then scrolling to another area gets old very quickly.

D. Georeferencing Google Earth Derived Images

25. Georeferencing an image is to define its existence in physical space that is establishing its location in terms of map projections or coordinate systems. The term is used in establishing relationship between raster (pixel-based) and vector images and their coordinate information and when determining the spatial location of other geographical features.


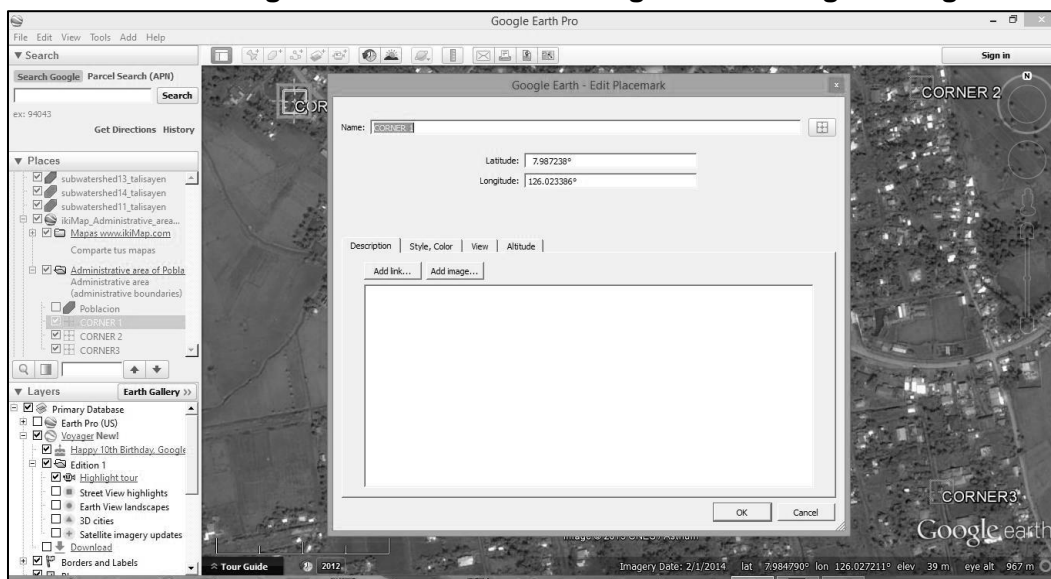
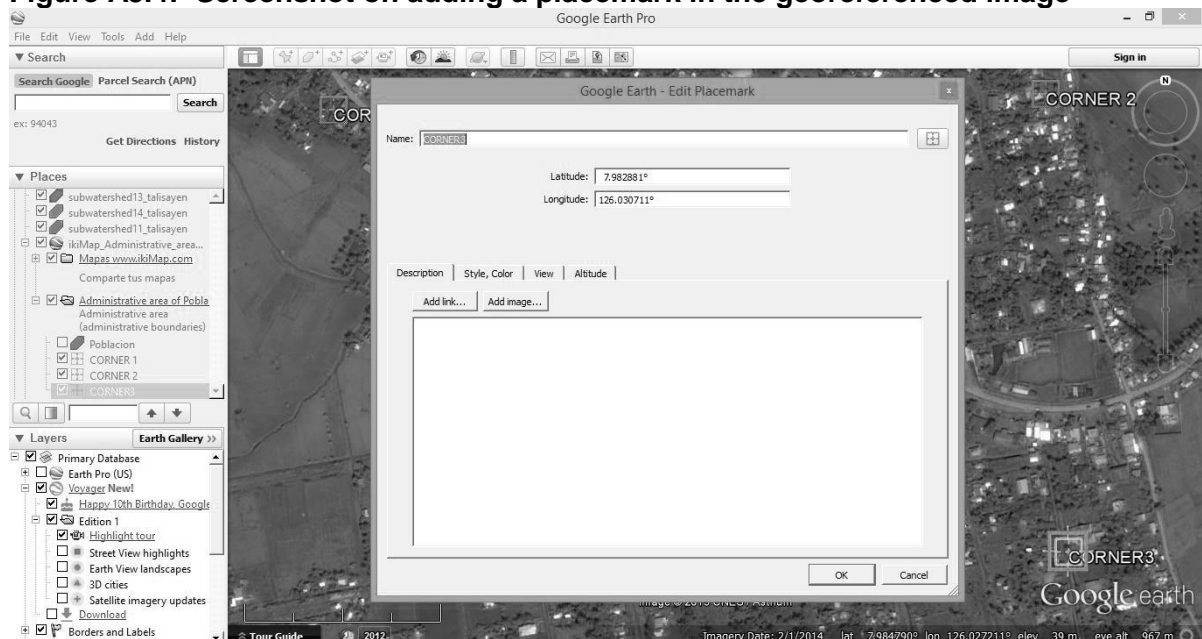
- i. ZOOM in to the image where you have an area of interest (AOI) using the zoom controls found in the bottom right portion of the Google Earth Pro interface. This may be your local barangay, your province or any other place of interest for deriving image for map production and GIS.
- ii. Click ADD PLACEMARK ICON, denoted by the symbol  on the icon menu of Google Earth Pro. Locate a point in your AOI, in our example we have Barangay Banus of the municipality of Gloria, in the Province of Oriental Mindoro. This chosen corner will be used later as coordinates for georeferencing later.
- iii. Rename this as CORNER 1. Press OK button.

Figure A3.3: Screenshot of georeferencing an image

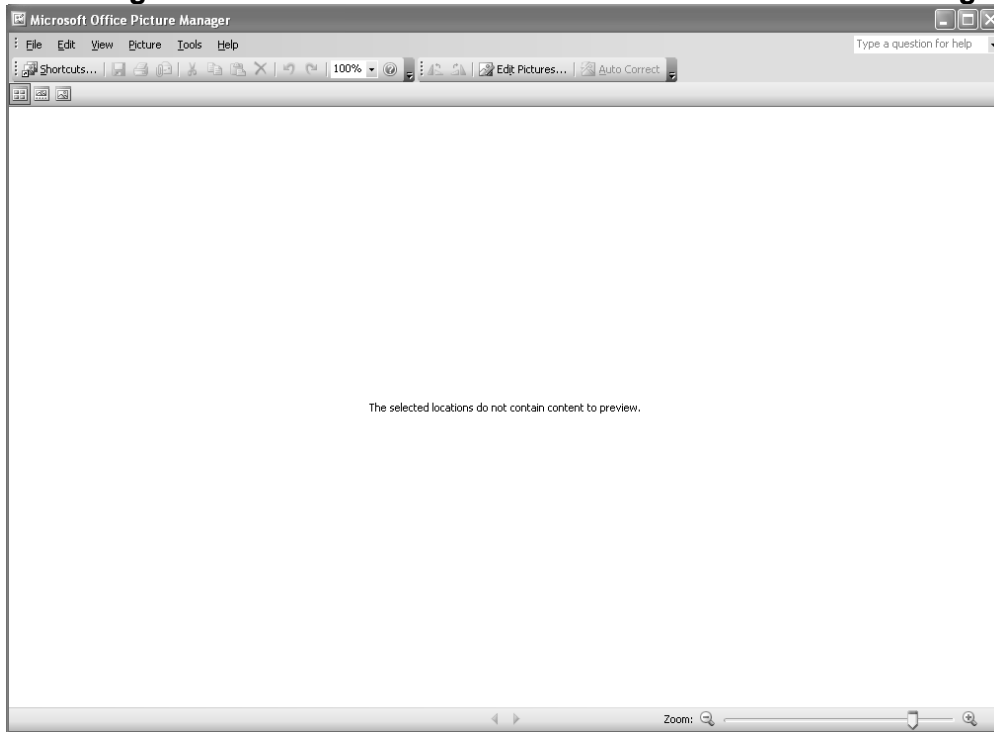


- iv. Change the symbol of the placemark as a crosshair as [+]. Drag the placemark icon to the upper right hand corner of the image. Press OK button.
- v. Copy the latitude and longitude coordinates. It is best to take of these coordinates by copying and pasting the same on an open Word document or a Notepad file document. A simple pen and paper would also do. Press OK button.
- vi. Click ADD PLACEMARK icon again as in number one. This time label the placemark as CORNER 2. Drag this placemark to the upper right hand corner of the image. As before, note the latitude and longitude coordinates. Press OK button.
- vii. Again, Click ADD PLACE MARK. Click ADD PLACEMARK icon again as in number one. This time label the placemark as CORNER 3. Drag this placemark to the upper right hand corner of the image. As before, note the latitude and longitude coordinates. Press OK button.

Figure A3.4: Screenshot on adding a placemark in the georeferenced image



- viii. Still in Google Earth Pro, Click the EDIT Menu and select COPY IMAGE. This loads the image on the computer's memory.
- ix. Open any photo editing software. This can be the PHOTOPAINT software or MICROSOFT OFFICE PICTURE MANAGER which usually comes as a bundled software in all Microsoft-based operating systems. If you have other more sophisticated software such as ADOBE PHOTOSHOP, this will similarly be useful.

Figure A3.5: Screenshot of the Microsoft Office Picture Manager

- x. PASTE the copied image from Google Earth on the photo editing software, in this case we are using Photopaint.
- xi. Once pasted, SAVE the file. Click on FILE menu then SAVE AS. Save this with an extension of .TIF file. You can name it with your preferred file name. In this exercise, let us name the file as BANUCOR.TIF. Click OK and close or minimize Microsoft Office Picture Manager program.

Figure A3.6: Screenshot of Google Earth on the photo editing software

E. Opening Images in QGIS

26. QGIS (previously known as "Quantum GIS") is a cross-platform free and open-source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis capabilities.

27. Similar to other software GIS systems, QGIS allows users to create maps with many layers using different map projections. Maps can be assembled in different formats and for different uses. QGIS allows maps to be composed of raster or vector layers. Typical for this kind of software the vector data is stored as either point, line, or polygon-feature. Different kinds of raster images are supported and the software can perform georeferencing of images.

28. QGIS allows use of dxf, shapefiles, coverages, and personal geodatabases. MapInfo, PostGIS, and a number of other formats are supported in QGIS. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.

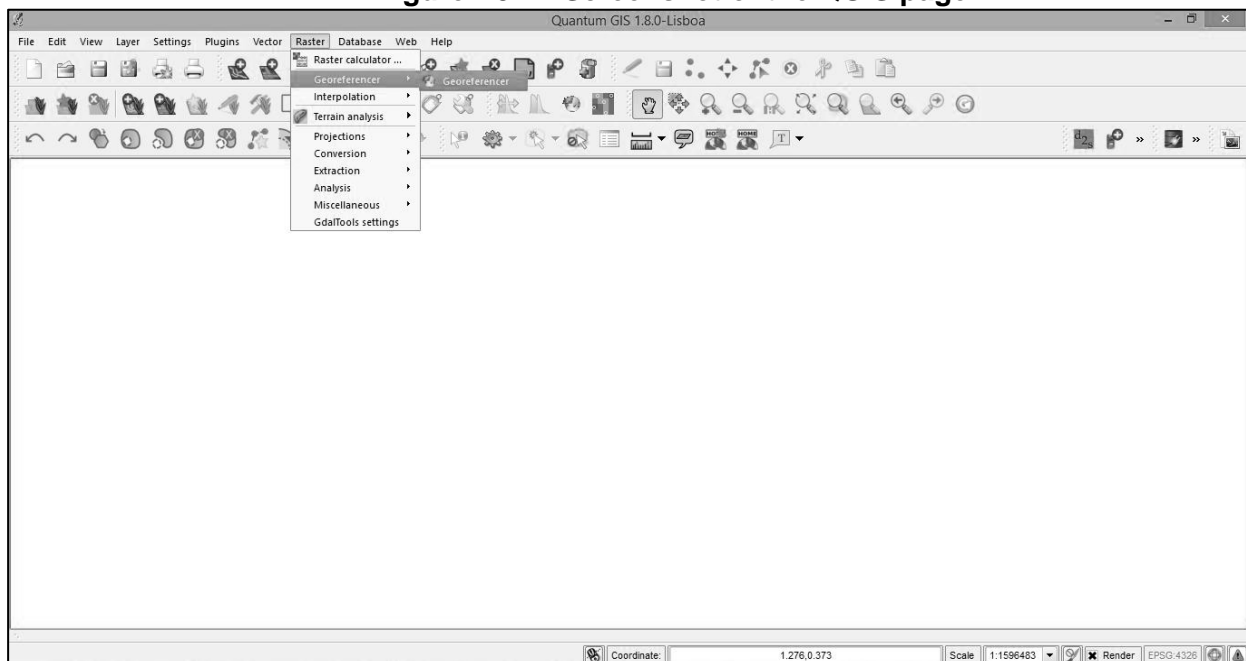
29. The latest version of QGIS can be downloaded from the site:

<http://www.qgis.org/en/site/>

30. You are now ready to open in QGIS the Google Earth derived image called BANUCOR.TIF in QGIS. For consistency, as of this writing the QGIS version used in this manual is *QGIS 1.8.0-Lisboa*. Some menus and icons may have changed from previous and future versions of QGIS.

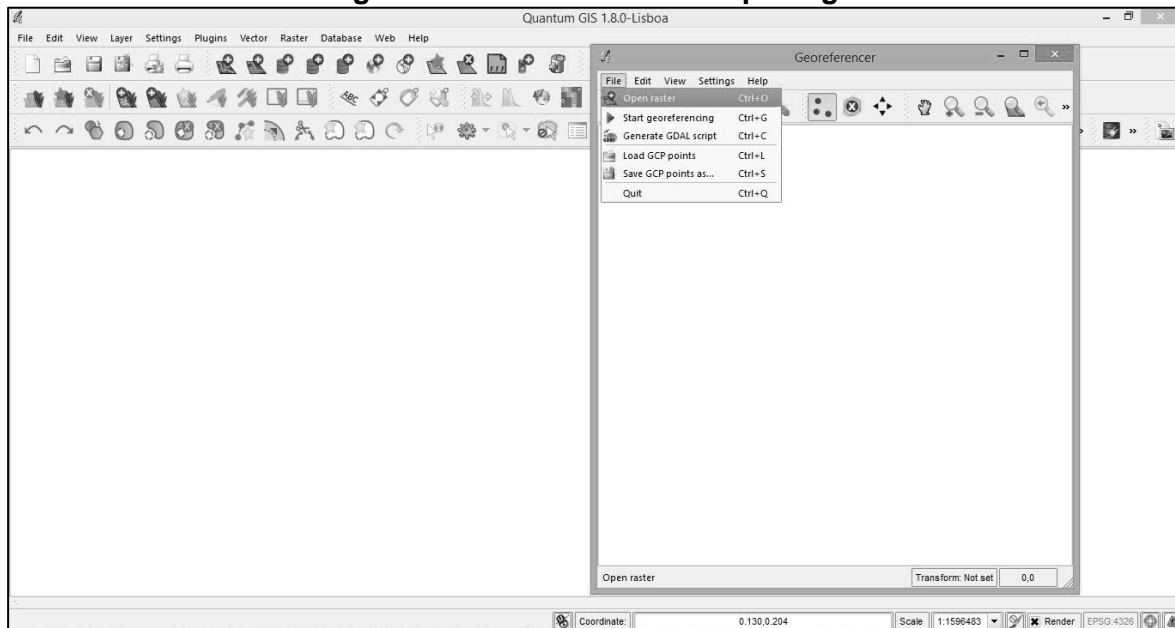
- i. Open QGIS by clicking on the icon on your desktop. Click RASTER menu and choose GEOREFERENCER. Click OPEN RASTER.

Figure A3.7: Screenshot of the QGIS page



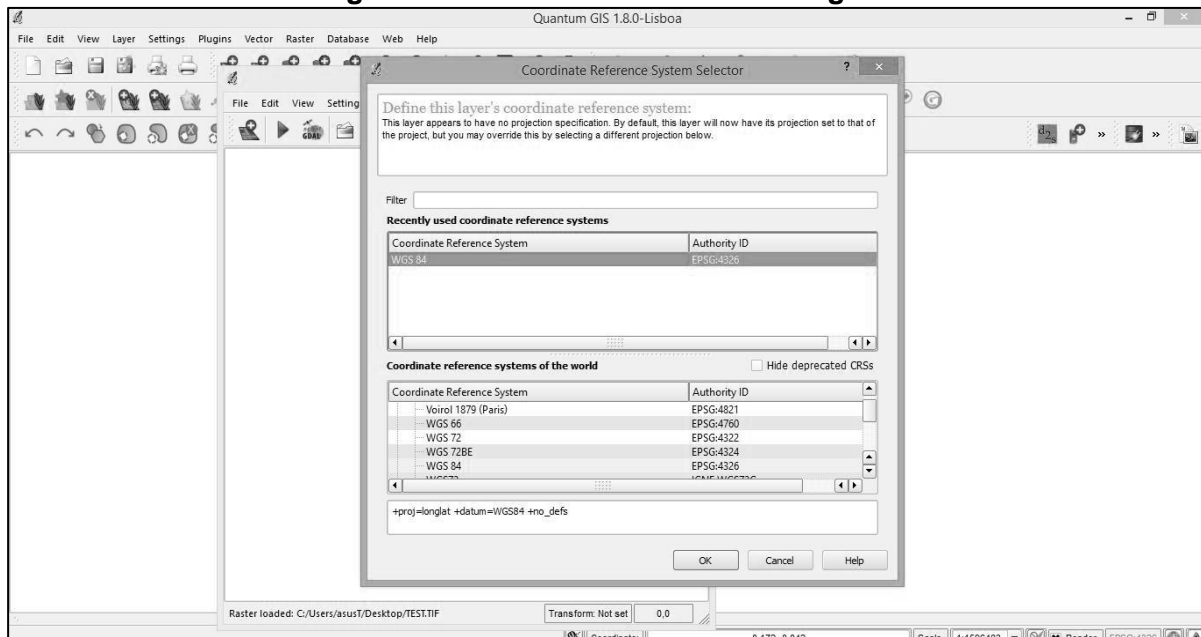
- ii. Choose the file you had just created in Google Earth named BANUCOR.GIF.

Figure A3.8: Screenshot on opening the file on QGIS



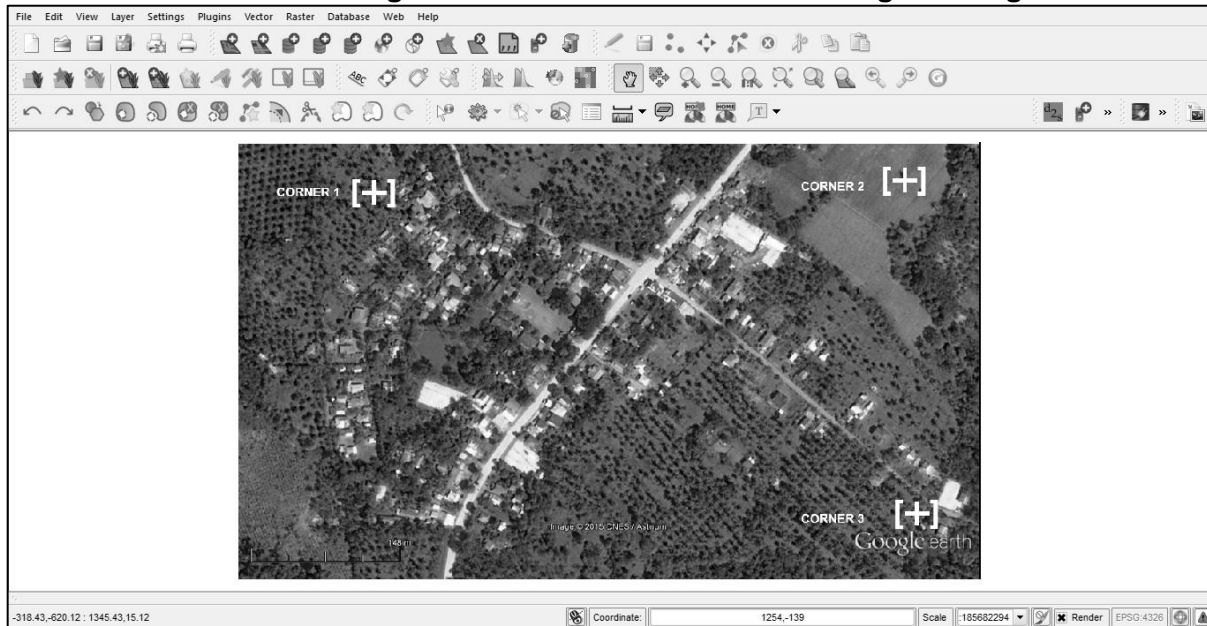
- iii. Select WGS84 and click OK.

Figure A3.9: Screenshot on selecting the file on QGIS



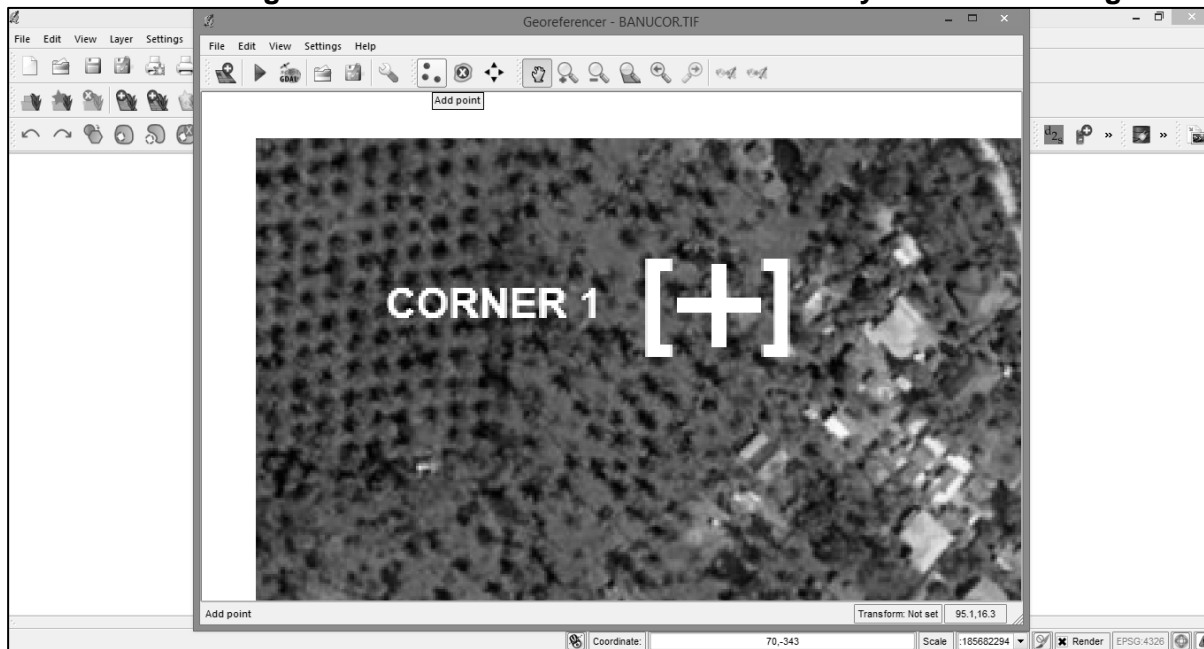
- iv. ZOOM to CORNER 1. You can zoom in and out of the image by clicking the ZOOM button.

Figure A3.10: Screenshot on zooming the image



- v. Click on ADD POINT menu. Click on the crosshair or [+] symbol representing CORNER 1.

Figure A3.10: Screenshot on the crosshair symbol for zooming in



- vi. In the box, labeled “*Enter Map Coordinates*”, the X values represent the longitude you have earlier taken note of for CORNER 1, while Y values represent the latitude values.

Figure A3.11: Screenshot of the box labeled “Enter Map Coordinates”

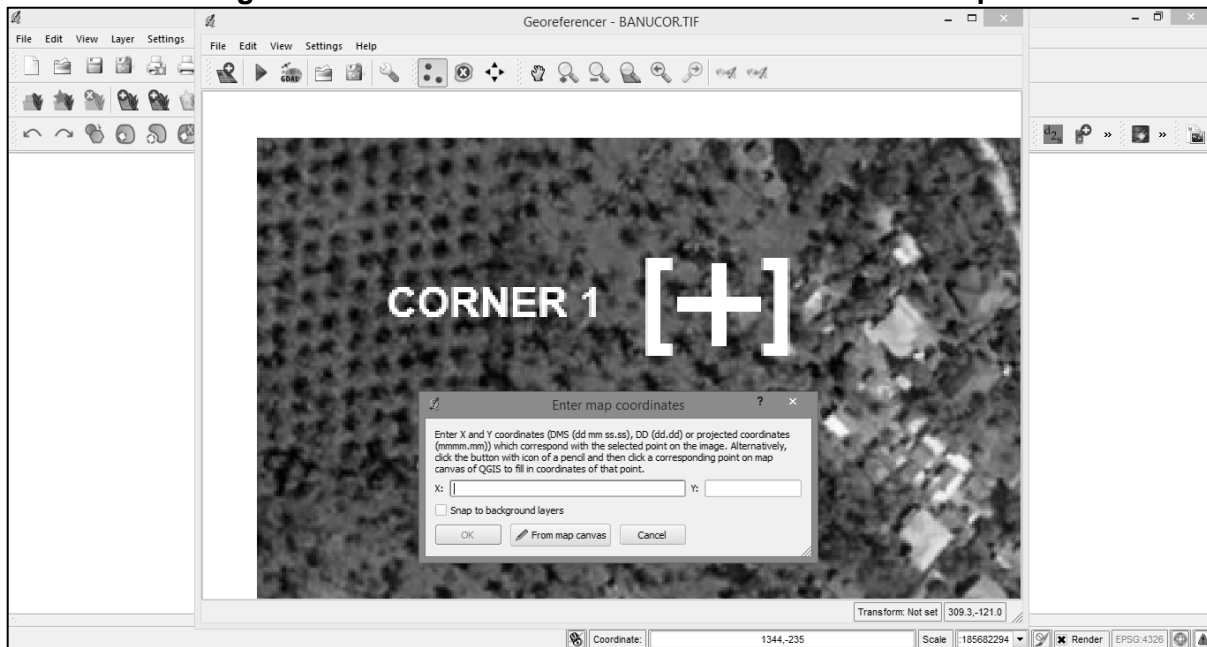
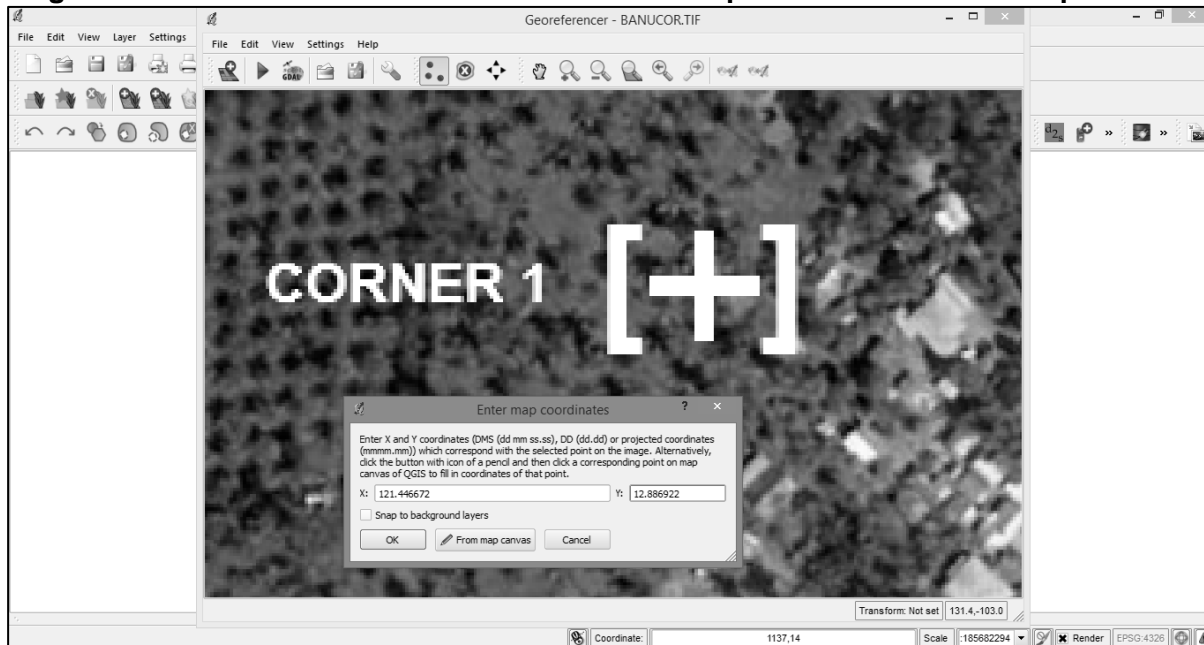
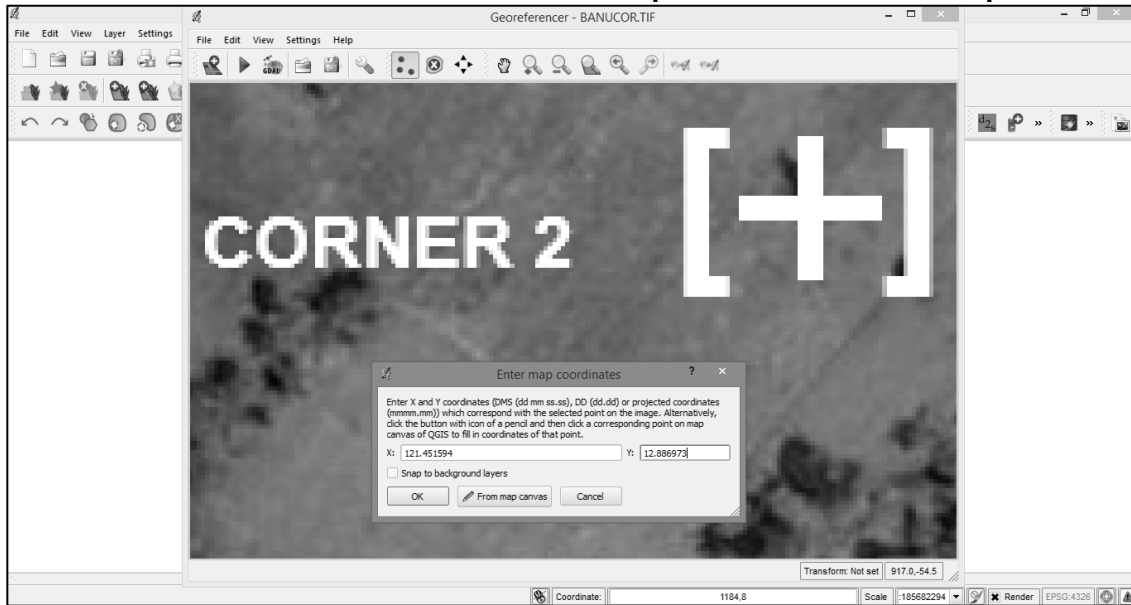


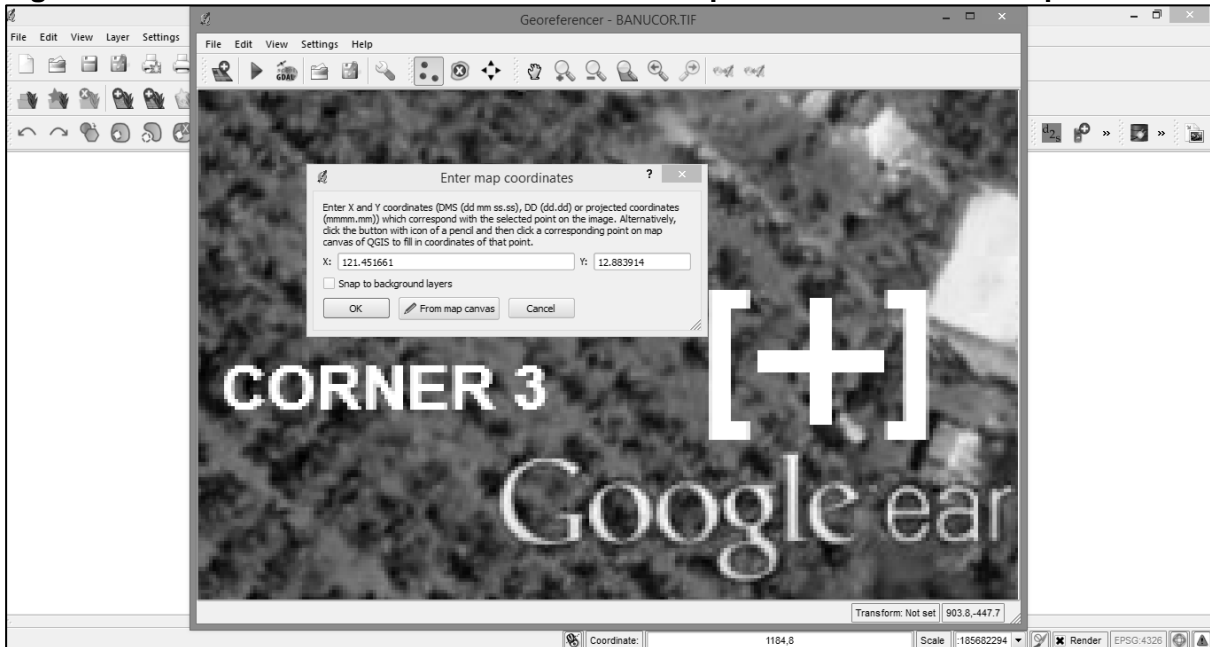
Figure A3.12: Screenshot of Corner 1 with filled up box labeled “Enter Map Coordinates”



- vii. Click OK once the values have been entered. A RED DOT should appear near the cross-hair.
- viii. Click ZOOM TO LAYER, to have a full view of the whole image.
- ix. ZOOM to CORNER 2. Similar to step 6, click on ADD POINT menu, then click on the crosshair symbol near CORNER 2. Subsequently, “Enter Map Coordinates” for CORNER 2. Click OK once the coordinates for CORNER 2 have been entered. Similarly, a red dot should appear near CORNER 2.

Figure A3.13: Screenshot of Corner 2 with filled up box labeled “Enter Map Coordinates”

- x. Do the same for CORNER 3. Once you have entered the values for CORNER 3, click OK an ZOOM OUT to full view of the image by clicking on the ZOOM TO LAYER icon.

Figure A3.14: Screenshot of Corner 3 with filled up box labeled “Enter Map Coordinates”

- xi. You can save the ground control points (GCPs) you just made by clicking on the SAVE GPS POINT icon. Give it the name TEST_GCP.points. Click the OK button when you are satisfied with the given file name.

Figure A3.15: Screenshot of the Control Ground Points



F. Transforming the Image

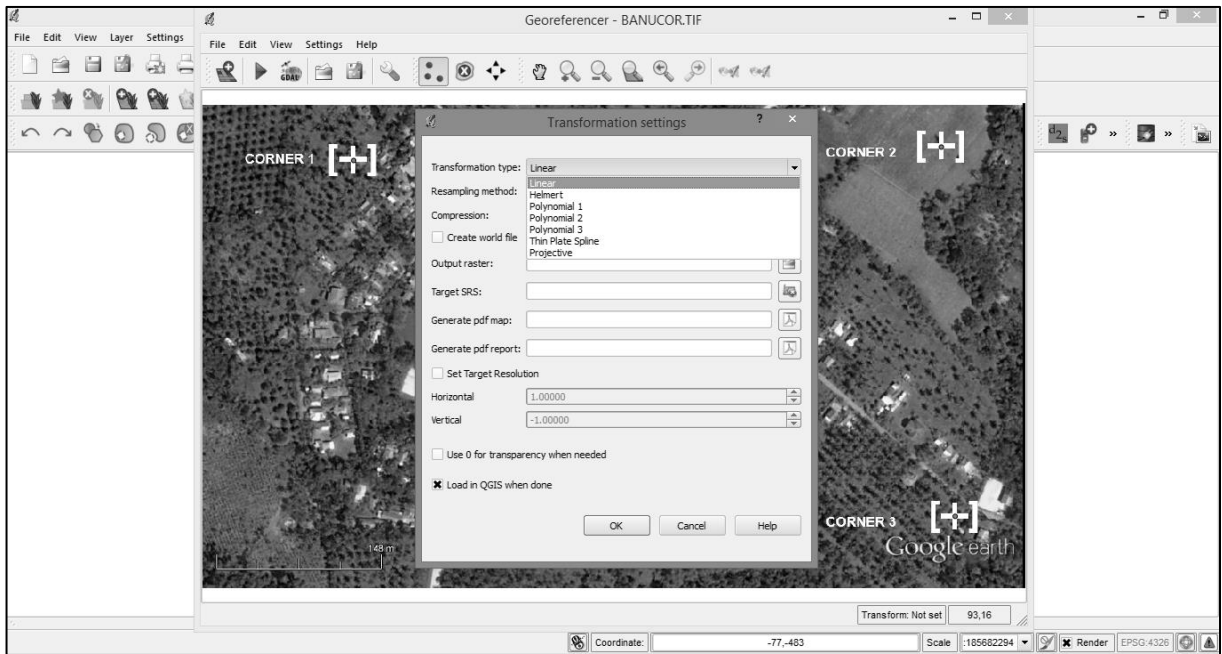
- i. At this point you are about to transform the image with the GCPs you have gathered. Still in the GEOREFERENCER window, click on the TRANSFORMATION SETTINGS icon (Note: This is the icon which looks like an OPEN WRENCH).

Figure A3.16: Screenshot of the Ground Control Points with the transformation settings icon



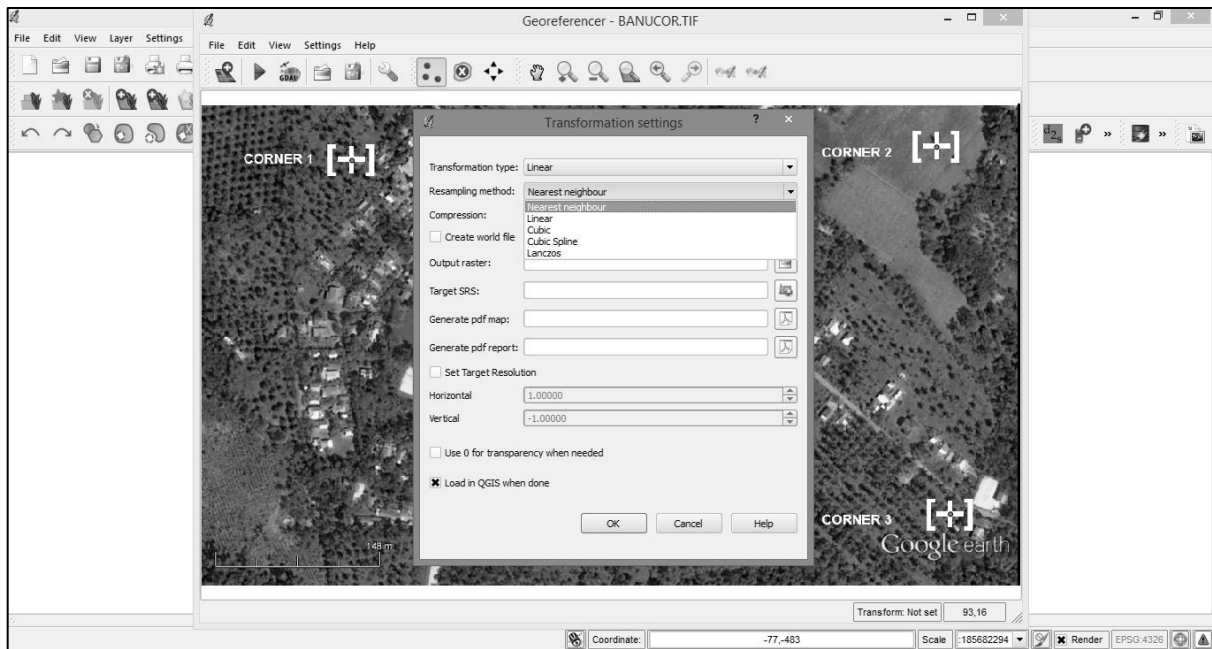
- ii. For the TRANSFORMATION TYPE, choose from the drop down menu the RESAMPLING METHOD LINEAR.

Figure A3.17: Screenshot on how to select the Transformation Type with the Resampling Method Bar



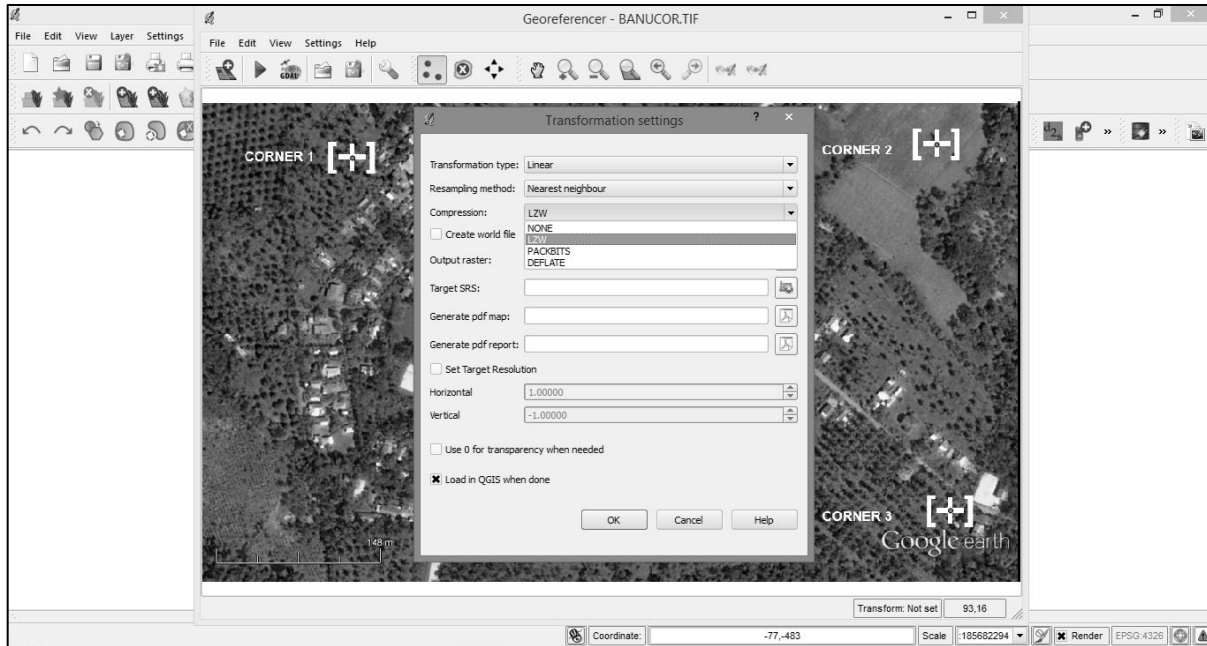
iii. For the RESAMPLING METHOD, choose NEAREST NEIGHBOR.

Figure A3.18: Screenshot on how to select the 'Nearest Neighbor' for Resampling Method



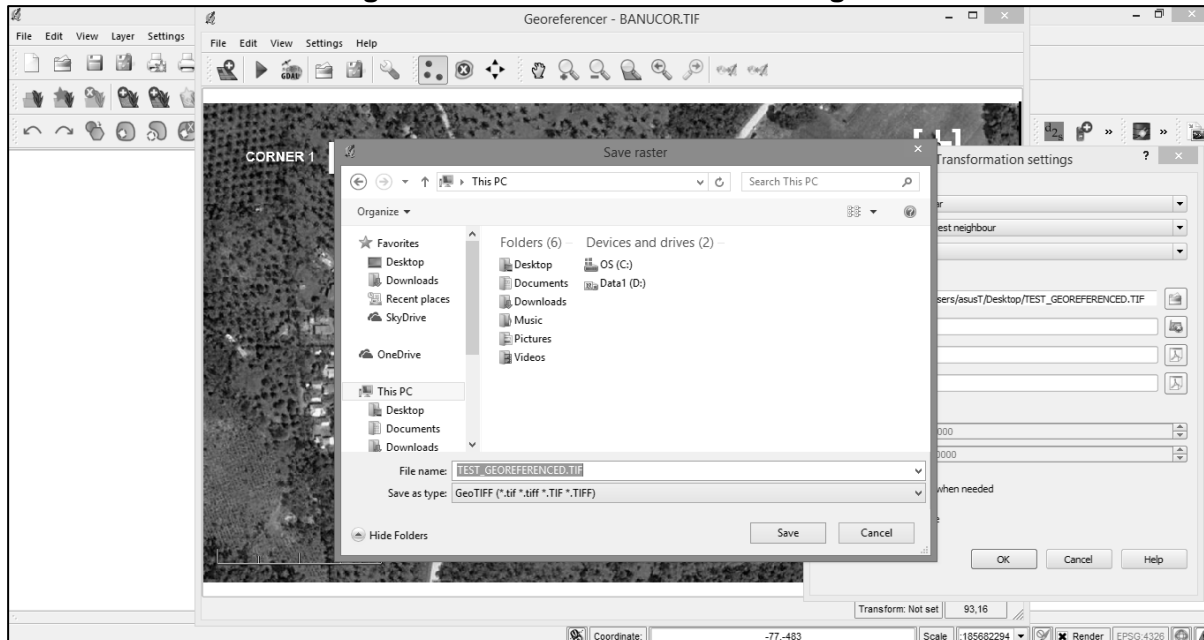
iv. For the COMPRESSION, choose LZW.

Figure A3.19: Screenshot of the Transformation Settings for 'Compression'



- v. To SAVE the new raster file, choose the OUTPUT RASTER destination directory and file by clicking on the icon. Give the new raster file the file name TEST_GEOREFERENCED.TIF. (NOTE: You can choose as to which directory to save the file as long as you can locate and open the new file.)

Figure A3.20: Screenshot on Saving the Raster File



- vi. Before clicking the OK button, make sure that you tick the box labeled, "LOAD IN QGIS WHEN DONE". Click OK when done.


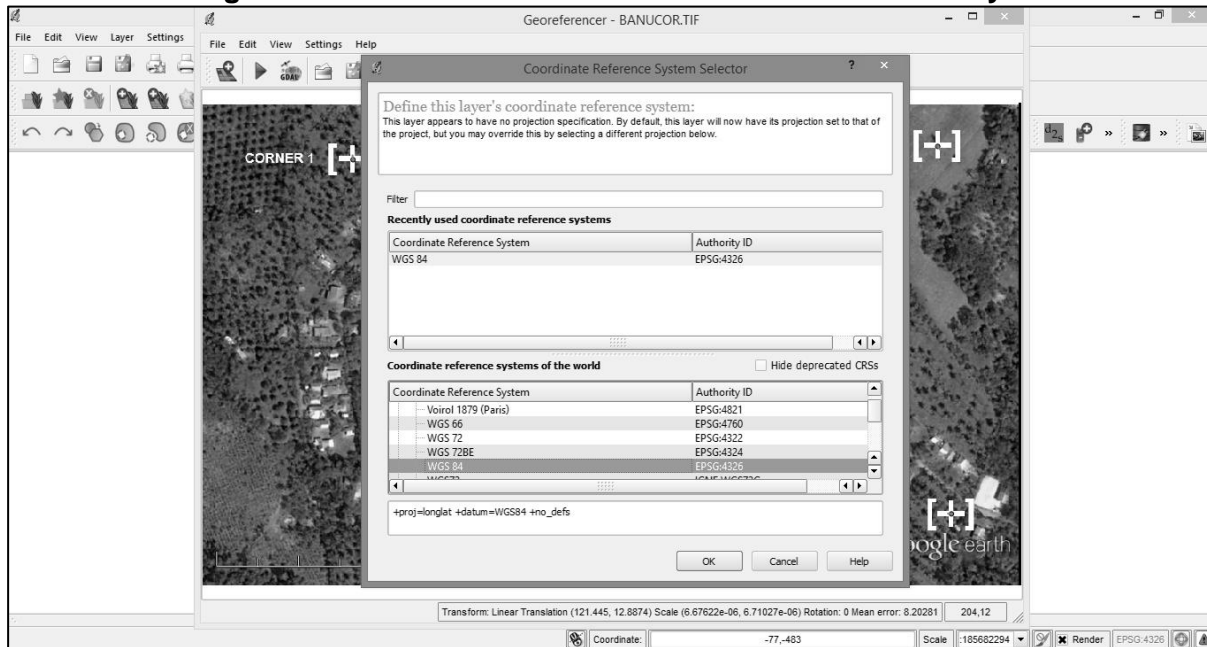
- vii. Click on the START GEOREFERENCING icon (this looks like the PLAY button, with a green arrow pointing to the right, as such ).

Figure A3.21: Screenshot on where the Georeferencing icon is



- viii. A COORDINATE REFERENCE SELECTOR WINDOW pops up. Choose WGS84 as the coordinate system. Click OK when done.

Figure A3.22: Screenshot of the Coordinate Reference System Selector



- ix. At this point close the GEOREFERENCER WINDOW. Click on the FILE menu and a drop-down menu appears. Click on QUIT.

Figure A3.23: Screenshot on how to exit the Georeferencer Window



- x. The new and georeferenced image appears in the background in the main menu of the QGIS system. As you move around the image using your mouse, you can see that the coordinate values change from a change in position of the mouse. The SCALE of the image is also shown as in below.

Figure A3.24: Screenshot of the Scale of the georeferenced image



G. Printing the Map on Tarpaulin

31. Color tarpaulin computer printing is so ubiquitous nowadays and are very cheap. Some twenty years ago, such technology was very expensive nonetheless inaccessible to many, and was confined to corporate uses only. Nowadays, the technology has reached the masses and is a commonplace to have personal events (such as birthdays and baptisms) to be printed on this very durable material.

32. Because of these characteristics, tarpaulin map printing has been eyed as a possible technology intervention to capture and enhance the community-based resource mapping process.

33. The Department of Trade and Industry (DTI) online e-Business Name Registry System (eBNRS) provides a convenient way of consolidating tarpaulin printers nationwide. Based on the eBNRS, there are 266 duly registered tarpaulin printing companies/shops throughout the Philippines.

34. The DTI eBNRS can be accessed at the link below:

35. <http://www.bnrs.dti.gov.ph/web/quest/search>

36. You can check if there is a tarp printing shop near your community. A complete listing of these tarpaulin printing shops can be found in Appendix 5.

H. Enhanced Community-Based Resource Mapping (ECRM)

37. The Resource and other social maps are essential components of the KC-NCDDP participatory PSA process. A Resource Map provides the "top view" of the community. The map shows the distribution of resources of the community, e.g., forest cover, rivers, springs, irrigated land, crops, residential areas, watersheds, grazing land, etc.

38. The chore of resource mapping is done by community denizens themselves and often facilitated by highly-trained Area Coordinating Teams (ACTs).

39. By tradition, resource mapping is done by these ACTs using the "*paper-and-pen*" method, where community volunteers are asked to draw a community resource map, information contained therein are usually drawn and mapped from memory.

40. In this current proposed process intervention, the same but somewhat modified process will be used. A base map (which is derived from Google Earth Pro and printed on tarpaulin and described in previous sections) now serves as the primary resource information for community stakeholders to work on. Community stakeholders may in the process, and are not prevented to validate information provided by the base map, as well as, modify the latter if information from their inherent knowledge and memory provides more up-to-date and more valid information as that provided by the base map. Also, instead of the Manila paper, clear plastic book cover (or transparency) is used. As in the old method, permanent marking pens of different colors are used.

I. Preparing the Base Map and the Clear Plastic Transparency/Book Cover

41. As such, in this proposed method, a clear plastic transparency is laid over the base map. The plastic cover material can be purchased from any bookstore/school supply stores and come in different sizes. It is a very common material used to cover books of school-aged children in order to protect the books from wear. In some Philippine households, the same material is used as over-the-top table cover to prevent unwanted spillage on table cloths.

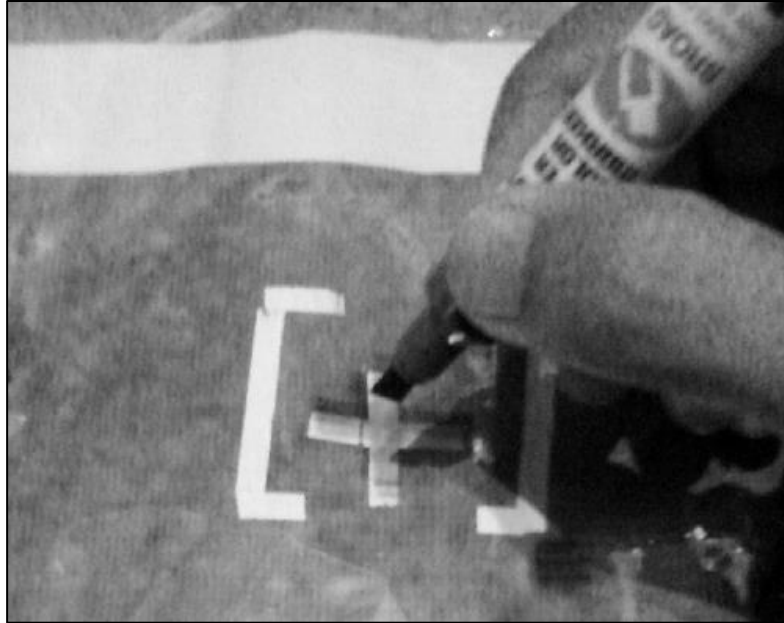
- i. The base map is placed and spread evenly (as much as possible without creases) on a flat wall, and posted rigidly using conventional masking or clear tape.
- ii. Once the base map has been taped firmly on the wall, the clear plastic book cover can now be placed over the base map. Make sure that the plastic has ample size to cover the whole area of the base map. Place firmly masking or clear tapes on the edges of the clear plastic, again avoiding to have prominent creases on the plastic itself.



J. Co-registering the 3 Placemarks on the Traced Clear Plastic Transparency

42. The community resource mapping process is almost ready to commence. But before this, it is necessary to co-register the base map with that of the clear plastic book cover. This is simply done by marking or tracing with a permanent pen the 3 corners which were determined earlier in steps in section III and IV.

43. The above step is necessary, since later, you will need to re-encode (see succeeding steps in Section VIII) the same set of corner coordinates (for corners 1, 2, and 3) when the photographed plastic transparency image is processed in QGIS.



K. Assigning the Number of Layers to Represent the Themes in the Resource Map

44. The clear plastic book cover is now ready for marking. In order to initiate the marking process, it should be clear as to how many layers or “themes” that will come out of the resource mapping process. These layers should represent the basic resources such as the following:

- i. Layer 1 may represent agricultural resources (e.g. rice fields and coconut plantations)
- ii. Layer 2 may represent built-up structures (e.g. houses, government and private buildings and roads, etc.)
- iii. Layer 3 may represent water bodies (e.g. rivers, lakes, or seas/oceans)
- iv. Layer 4 may represent forests and other naturally-occurring vegetation



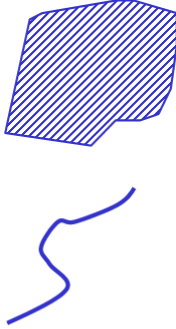
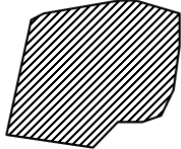
45. Hence, for each representative layer, a separate clear plastic cover must be used. For the above case, with 4 layers to be extracted from the base map, 4 pieces of plastic transparencies should be used.

L. Assigning Legends and Pen Color Convention

46. For each identified layer early on, it is necessary to assign a distinct permanent pen color to make the digitization (data conversion) easier. It is also useful to assign a distinct symbol (shape or figure) for each theme to be mapped.

47. As a matter of convention, the following symbols are to be followed:

Table A3.1: Symbols for map layering

Layer/Theme Represented	Marking Pen Color To Be Used	Symbol Description	Symbol
Layer 1- Agriculture	Green	Irregularly-shaped, closed and shaded polygon	
Layer 2 – Built-up structures	Red	Dots for houses and buildings; Lines for roads/bridges	
Layer 3 – Water bodies	Blue	Irregularly-shaped, closed and shaded polygon for large rivers, lakes and seas; Lines for small streams	
Layer 4 – Forests and natural vegetation	Black	Irregularly-shaped, closed polygon	

48. If there are 4 layers which represent the different themes of the resources available in a community, at the end of the process, there should 4 traced clear plastic transparencies, each layer one transparency.



49. Using the Google Earth Pro-derived and tarpaulin-printed base map provides distinct advantages over the traditional paper-and-pen method, among which are the following:

- i. Provides inherent and very accurate Map Scale
- ii. Provides inherent coordinate information (i.e. latitude and longitude) of the area
- iii. Reproducible/Repeatable
- iv. Highly-durable and weatherproof material on to which map information is printed on

M. CONVERTING RESOURCE MAPS TO DIGITAL FORM

1. Taking Photograph of Tarp and Traced Clear Plastic Transparency

50. Data can now be extracted and entered into a Geographic Information System. While transferring from one medium to the other your concern should be minimizing data loss or erroneous geo-referencing. They should be fully familiar with its attributes summarized in the legend in the form of scale, symbols and the definitions used.

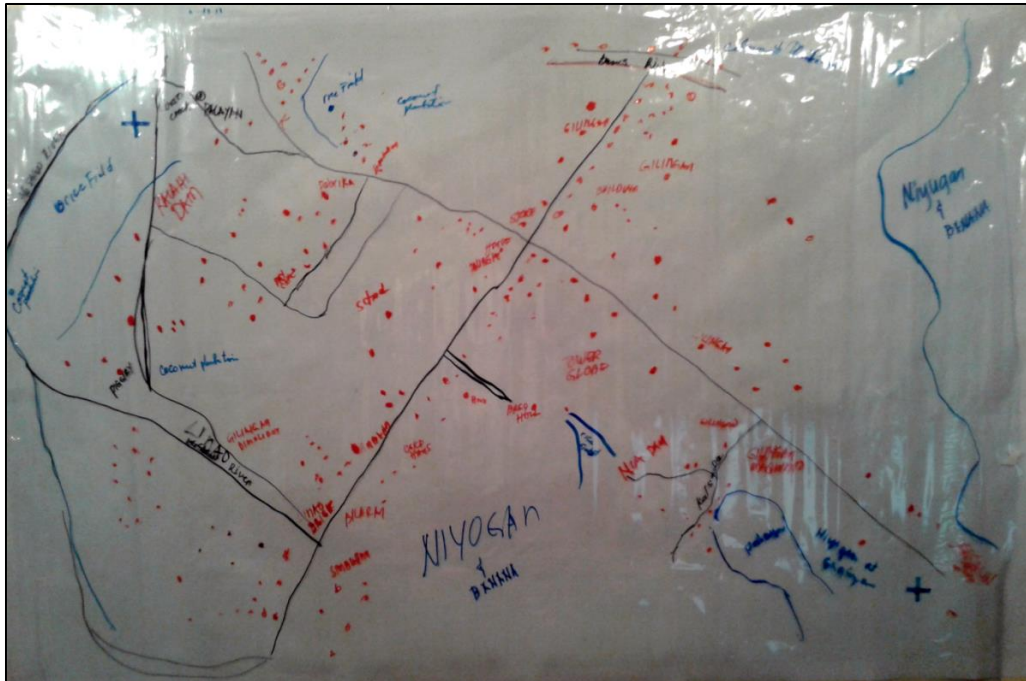
51. This technique involves moving the camera at a set distance from an object, such as the tarpaulin map printout.

52. Each picture should be shot perpendicularly to the tarpaulin surface. A convenient alternative to take photographs is to post the tarpaulin maps on a flat wall with plastic. Use a high resolution (high mega-pixel) conventional digital camera or a phone camera. With the preponderance of high-performance phone cameras, high-definition images can now be captured on the fly. As of this writing 41-megapixel cameras are now available in the market.

53. Place a high-resolution digital camera on a tripod (or any stable mount to reduce unwanted hand movement that may cause blurring) at a distance from the tarpaulin surface or the traced clear plastics. The distance of the camera from the tarp surface or the plastic may be relative, as long as it can capture the whole scene in a single photo frame or shoot. Take pictures with ample lighting (not in low light conditions which may cause blurring), ensuring that the whole surface is lighted evenly. Avoid shadows being casted on the surface to be photographed. Scattered/Diffused natural (sunlight) light is preferred, since such conditions cast less shadows.

54. Set the camera to the maximum resolution (e.g. 2272 x 1704 pixels) and compression capacity. This setting will provide high quality images of approximately 2 megabytes (MB) each. The number of images that can be stored on the Compact Flashcard or SD card, depending on its storage capacity. A 4 gigabyte SD card can store up to 2000 images or photographs (at around 2 MB each photograph).

55. The saved image(s) are now in raster image format ready for digital extraction, correction and georeferencing. This requires their conversion to vector format through the use of QGIS.




2. Georeferencing the Photograph of the Plastic Transparency in QGIS

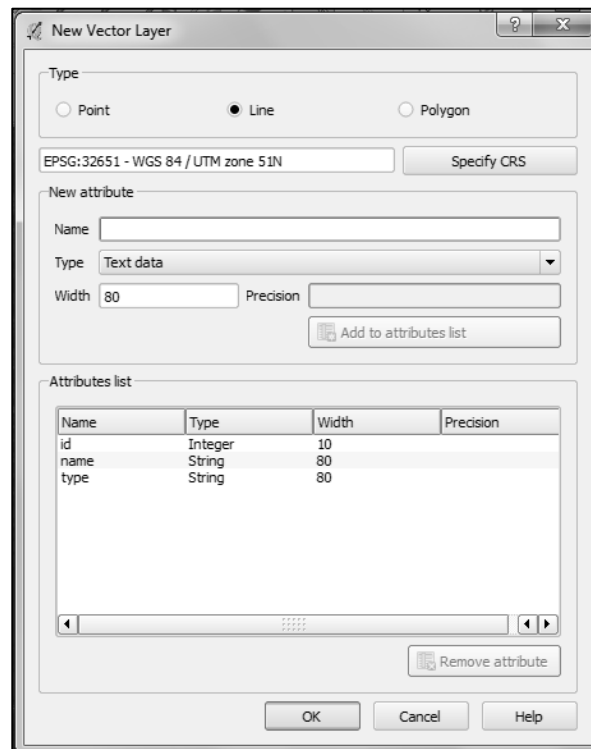
56. Georeferencing the photographed plastic transparency is the same as georeferencing the Google Earth Pro-derived image. This time however, you are georeferencing the image which was derived from the community-based, resource mapping process.

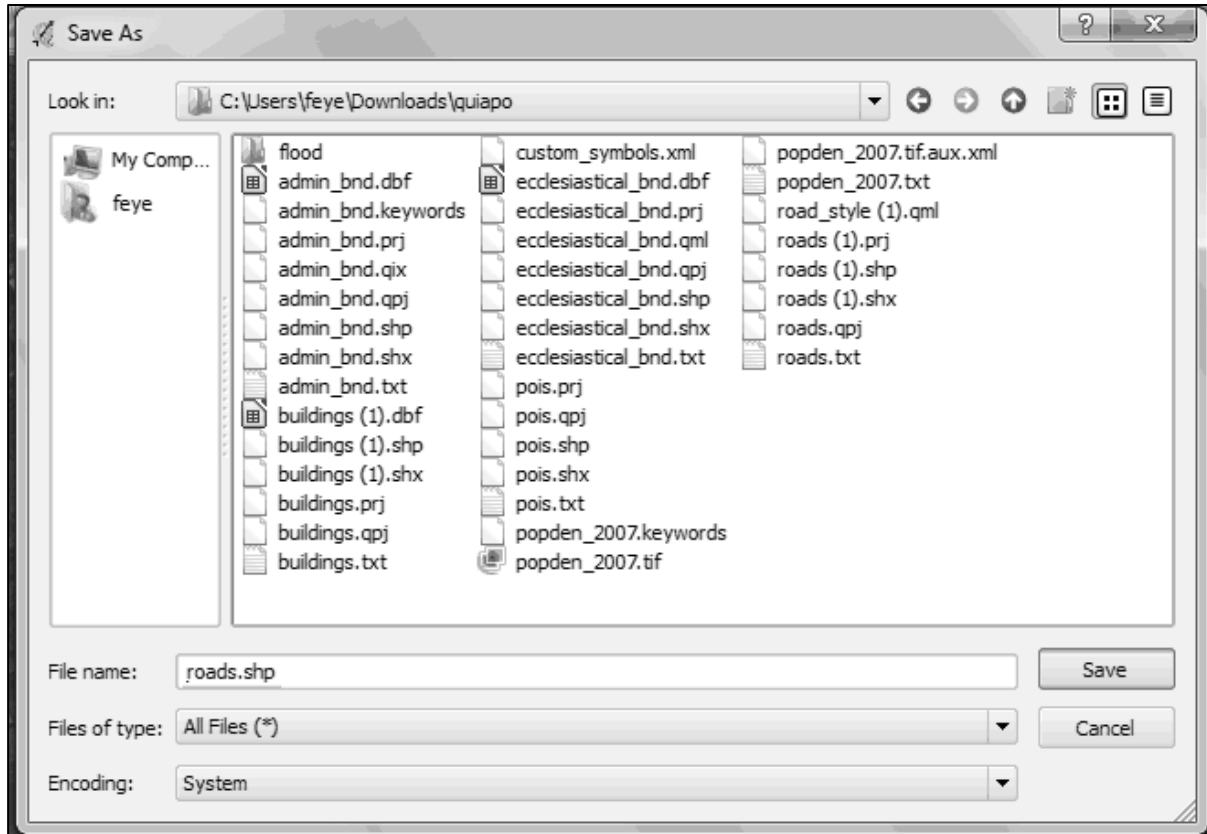
57. Repeat steps in Section IV, this time however, use the marked 3 corners of the photo of plastic transparency and input the corresponding corner coordinates.

3. Creating a new vector layer

58. We will now create a new vector layer, to digitize roads. We will use a line layer to represent this data.

- i. To create a new vector layer select Layer ▸ New →  New Shapefile Layer.
- ii. In the Type option, choose *Line*.
- iii. In the Specify CRS, select WGS 84 / UTM Zone 51N.
- iv. In the New attribute, add name in the Name field and choose Text data as the data type. Then, click Add to attributes list. The newly added attribute field is added in the list.
- v. Add another attribute column. In the New attribute, add type in the Name field and choose Text data as the data type. Then, click Add to attributes list. In the name attribute field, we will encode the name of the feature. In the type attribute field we encode the type of road (either primary, secondary, residential, etc.). Click *OK*. Tip: Limit field names to maximum of 10 characters and avoid special characters (such as &, #, @ {}) and spaces.
- vi. A new window will appear for the filename and location of the data within your directory. Use the filename, roads.shp.





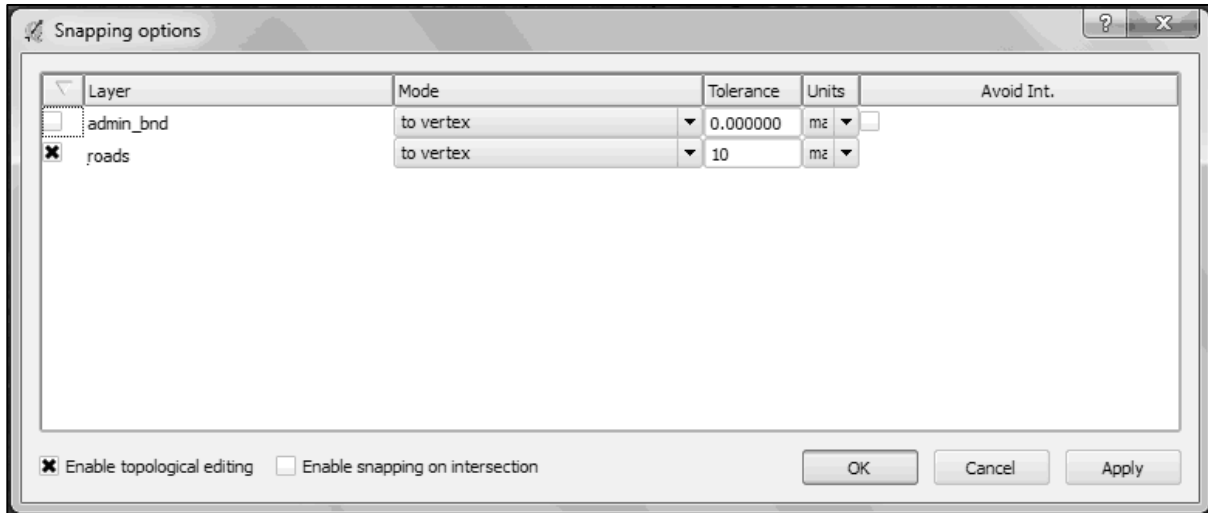
Click Save. You now have a blank roads layer.

4. Setting options for Digitizing

59. Before we can begin digitizing, we must set the snapping tolerance to a value that allows us an optimal editing of the vector layer geometries.

60. Tip: Snapping tolerance is the distance QGIS uses to search for the closest vertex and/or segment you are trying to connect when you set a new vertex or move an existing vertex. If you aren't within the snap tolerance, QGIS will leave the vertex where you release the mouse button, instead of snapping it to an existing vertex and/or segment.

- i. To set the snapping tolerance, select Settings ▸ Snapping options. Within the Snapping options window, activate the Enable topological editing by adding a check mark.
- ii. In the list of layers, add a check mark to the roads. This activates snapping in respective layer. Set the snapping tolerance to 10 map units for roads layer. Select Apply → OK.




When you start editing the roads layer, new vertices will snap if it is within 10 map units or 10 meters of another vertex.

- iii. 3. Save your project.

5. On-Screen Digitizing

61. We will now start digitizing roads.


62. Note: This process is called heads-up or on-screen digitizing. This is an interactive process, in which a map is created using a previously digitized or scanned information. It is called “heads-up” digitizing because the attention of the user is focused on the screen.

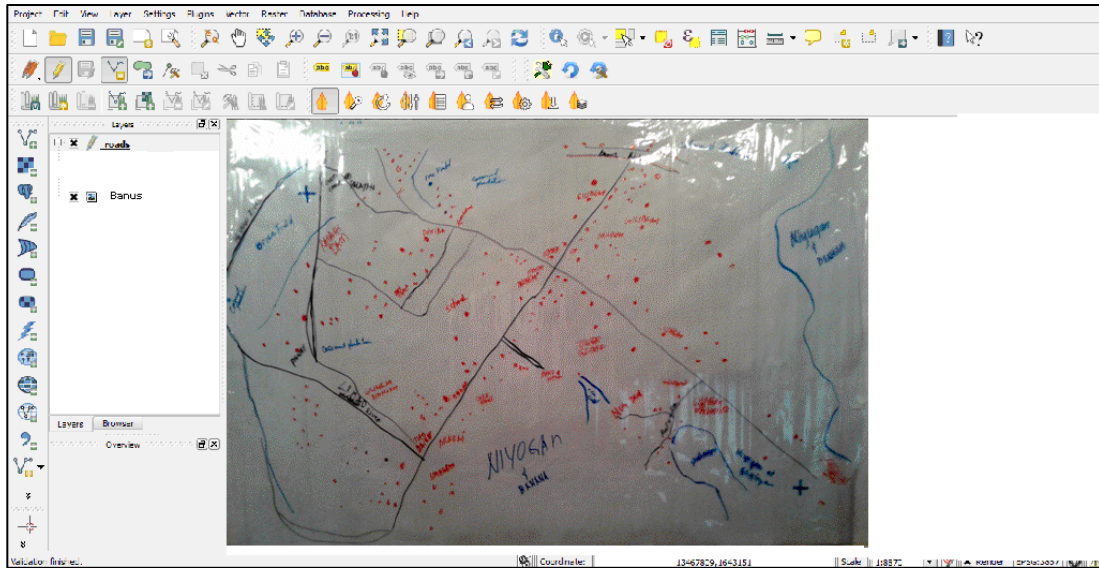
- i. Make sure the roads and the photographed traced plastic transparency representing the roads (or built infrastructure such as houses and buildings) layers are visible. Click the checkbox preceding the name of the layer in the Map Legend view to hide/show layers.
- ii. Zoom-in to an area, where the roads on the image are visible.
- iii. Select the roads layer, right-click and select  Toggle Editing. Once the layer is in edit mode, additional tool buttons on the editing toolbar previously greyed-out will become



available


For each feature, you first digitize the geometry, then encode the attributes.

- iv. To digitize the geometry, click the  Add Feature, left-click on the map area to create the first point/vertex of your new feature.




63. For lines and polygons, keep on left-clicking for each additional vertex you wish to capture. When you have finished adding vertices, right-click anywhere on the Map View to confirm you have finished entering the geometry of that feature.

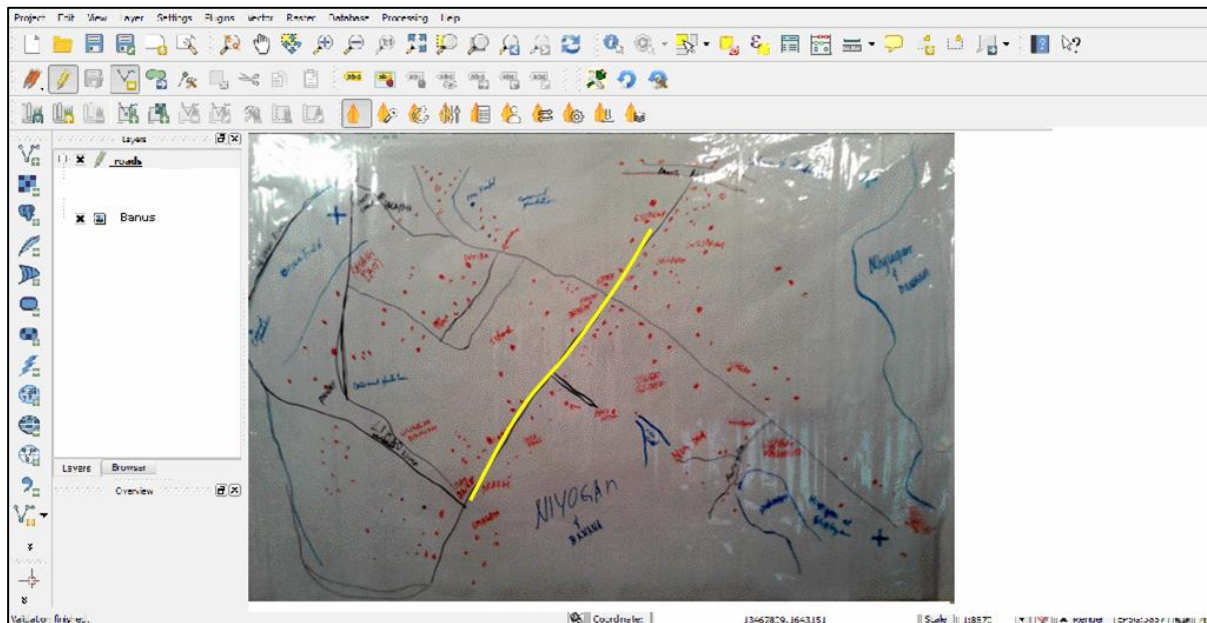
64. The attribute window will appear, allowing you to enter the information for the new feature. Add the type of road in the type field and the name of the feature in the name field.

65. To save your editing session,  Toggle Editing and click Save.

66. *Tip:* In some cases, you will reach the edge of the Map View but you would like to continue adding new vertices. When this happens, use the arrow keys or press the spacebar while using your mouse to pan across the Map View.

The Node Tool

67. The  Node Tool provides manipulation capabilities of feature vertices similar to CAD programs. It is possible to simply select multiple vertices at once and to move, add or delete them all together. The node tool also works with on-the-fly projection turned on and supports the topological editing feature. This tool is, unlike other tools in Quantum GIS, persistent, so when some operation is done, selection stays active for this feature and tool.




Basic operations

68. Start by activating the Node Tool and selecting some features by clicking on it. Red boxes appear at each vertex of this feature. Functionalities are:

- i. Selecting vertex: Selecting is easy: just click on vertex and the color of this vertex will change to blue. When selecting more vertices, the Shift key can be used to select more vertices. Or the Ctrl key can be used to invert selection of vertices: if selected already then it will be unselected and when not selected, the vertex will be selected. More vertices can be selected at once when clicking somewhere outside feature and opening a rectangle where all vertices inside will be selected. Or just click on an edge and both adjacent vertices should be selected.
- ii. Adding vertex: Just double click near some edge and a new vertex will appear on the edge near the cursor. Note that the new vertex will appear on one side, not necessarily on the cursor's position. Move it as necessary.
- iii. Deleting vertex: After selecting vertices for deletion, click the Delete key and vertices will be deleted.
- iv. The rest of the basic editing tools are explained below:




Toggle editing - Enable editing of the selected vector layer.

 Save Edits - save your editing session in the currently selected layer. This is different from Saving your project.


 Add Feature - Point - add point features.


 Add Feature - Line - add line features.


 Add Feature - Polygon - add polygon features.


 Move Feature - move location of a selected feature.

 Node Tool - activate Node tool functions.

 Delete Selected - delete selected one or more features.

 Cut Features - delete a selected feature(s) from the existing layer and place it on a “spatial clipboard”.

 Copy Features - place selected feature(s) into the “spatial clipboard”.

 Paste Features - paste feature(s) from the “spatial clipboard” to the currently selected and editable layer.

Full description of the editing tools and other advanced features available in the QGIS User's Manual.

- v. Finish editing the roads layer.
- vi. Save your project.

69. The shapefile can then be viewed and edited, such as adding fields and attributes to its table using the same software. Data fields can be added and housing attributes encoded to each record, such as house number, street address, owner or tenant name, number of occupants, number of voters, and other socio-demographic information.

70. Having developed a warehouse of readily usable GIS data, information can easily be graphically displayed or queried. With adequate GIS knowledge and additional data themes, the village is ready to pursue GIS-based development projects.

DETAILS OF FIELDWORK IN THE MUNICIPALITIES OF SANTA JOSEFA AND GLORIA

A. Municipality of Santa Josefa Field Survey

1. Background

1. Santa Josefa is a third class municipality in the province of Agusan del Sur, Philippines. According to the 2010 census, it has a population of 25,156 people.

2. Santa Josefa is politically subdivided into 11 barangays, namely:

- i. Angas
- ii. Aurora
- iii. Awao
- iv. Concepcion
- v. Pag-asa
- vi. Patrocinio
- vii. Poblacion
- viii. San Jose
- ix. Santa Isabel
- x. Sayon
- xi. Tapaz

Figure A2.1: Map of Santa Josefa



3. It is bounded in the north by the municipality of Bunawan, in the south by Monkayo, Compostela Valley, in the west by Veruela, and in the east by Trento.

2. Workplan of Field Survey

4. A four-day workplan was planned out prior to the trip that would take the team from Butuan City, Agusan del Norte to Sta Josefa in Agusan del Sur and nearby environs.

5. The primary objective of the four-day field survey was to establish/determine baseline information on the readiness of communities to create a platform of spatial information which leads to greater transparency BLGUs and the municipal local government units (MLGUs), and allow these communities to retrieve, update and use the information as basis for local decision-making. Additionally, the survey aimed to assess the readiness and receptiveness of these communities to the introduction of new materials and tools for resource mapping; the communities' tools for spatial data collection, visualization, analysis, and sharing; as well as the introduction of standardized means of conducting resource mapping in the context of the KALAHI-CIDSS PSA process.

6. In the morning of July 6, a courtesy call was made at the Department of Social Welfare and Development (DSWD) Regional Office. This is to coordinate with the RPMO as well as to conduct initial interviews with the concerned staff, particularly with the KC Engineering Office, which fields out the necessary KALAHI -CIDSS infrastructure and related projects.

7. The prepared questions were asked in a logical and systematic manner. These consisted of the following major lines of questioning which are the initiatives of DSWD Regional Office on:

- i. Support to Planning and the CEAC Project Cycle
 - Social Preparations and Capacity Building
 - Project Identification and Conceptualization
 - Project Selection and Prioritization
 - Project Implementation, Monitoring and Evaluation
- ii. Support to Project Coordination and Communications

8. This was followed by two-hour land journey to the Agusan del Sur Provincial Office, located in Prosperidad. The discussions were with staffs from the provincial assessors office, the provincial engineering office and the Provincial Information Management Office (PIMO).

9. Processing and analysis of the results of the field survey made use of a common technique dubbed, the SWOT analysis.

3. Major Findings

a. Provincial Local Government Unit of Prosperidad, Agusan del Sur

10. The discussions were focused on the following points as they relate to the operations of the Provincial Office of Agusan del Sur:

- i. Map Analysis
- ii. Map creation, acquisition and updating
- iii. GIS platform and storage
- iv. Human resources
- v. Other initiatives of the provincial office as regards GIS and its uses
- vi. GIS Facilities within the province

11. Prosperidad is a first class municipality in the province of Agusan del Sur, Philippines. It is the capital of the province. According to the 2010 census, it has a population of 76,628 people. Prosperidad was created on June 18, 1960 by virtue of Republic Act No. 2650

12. Prosperidad is the seat of for provincial governance for the province of Agusan del Sur. The provincial governor's office is an ICT hub to reckon with and may be considered highly advanced in its development and use of ICT-based systems in order for the provincial government to fulfill its duties and provide quality service.

i. Ample GIS Trainings among Provincial LGU Staff

13. Discussions with a number of mid-level provincial staff indicate that there are staff who have already been trained in the use of GIS technologies. These were training received through the years from international non-governmental organizations (NGOs) such as but not limited to AusAID, CRID both of Australia, among others. The HLURB had also conducted training, primarily on the use of QGIS.

14. The Provincial government has an ancillary unit called the Provincial Information Management Office (PIMO), which is composed of staff who are relatively young (late to 20s to early 30s), technically-competent and highly-motivated staff, which are key ingredients for the Provincial government being able to develop its own CBMS. Despite these gains however, the age-old issue of trained personnel retention looms and may still be an issue in this Office, since majority of these staff have been employed on a contractual or project-based system.

ii. The Caraga State University (CSU) and NOAH Project

15. Not so known to many and even to the provincial government of Agusan del Sur, that the CSU in Butuan City is now a regional hub for the development of map products under the Nationwide Operational Assessment of Hazards (NOAH) of the Department of Science and Technology (DOST). CSU has partnered with NOAH to enable them to map the river systems of four regions in the island of Mindanao.

16. With these developments, the provincial governments of Agusan del Norte and Sur are ready recipients of a steady flow of trained manpower in advanced GIS, as well as the ready-made map products coming out of NOAH. Of particular importance are the various hazard and vulnerability maps which NOAH will have produced and which will be useful in local government infrastructure planning and disaster response management.

iii. Existence of Geographic Data

17. There are conflicting information as regards *shapefile* data being warehoused in the Provincial Government's Office. While the Planning (PO) and Assessor's Offices (AO) conveyed that they have ample shapefile data with them, such data are said to be disorganized and are not yet systematically archived in a single data server. On the other hand, later discussions with the PIMO, the latter had demonstrated a highly-organized ArcMap-based system, as will be cited in the latter parts of this document.

18. Such incongruent information from the same organization can be sourced from the fact that while the PO and AO are linked via a LAN, the data services from the latter two are not linked to the PIMO.

19. Map updating is done in-house through frequent field GPS surveys conducted by the AO using GPS and recently, using mobile tablet android devices. It was also noted that it would be ideal if local governments could have access to cheap/free satellite data for easier updating of maps.

iv. In-house Development of CBMS

20. The Provincial Office of Prosperidad boasts of a fully-functional, in-house-developed Community-Based Monitoring System (CBMS). The CBMS is an organized way of collecting information at the local level for use of local government units, national government agencies, non-government organizations, and civil society for planning, program implementation and monitoring. CBMS is one of the tools developed in the early 1990s to provide policymakers with a good information base for tracking the impacts of various economic reforms and policy shocks on the vulnerable groups in the society. To date, CBMS is being adopted by local government units in 51 provinces, 502 municipalities and 39 cities covering at least 13,152 barangays in collaboration with the National Anti-Poverty Commission (NAPC), the Department of Interior and Local Government (DILG), and selected non-government organizations.

21. Current applications and uses of CBMS are on local planning and budgeting, design of poverty reduction and related development programs, focused targeting, localizing the millennium development goals, and program-impact assessment.

22. The in-house developed CBMS boasts of unique and very important features that easily capture and record salient information from the field, which include but not limited to:

- i. CBMS apps that reside on mobile android devices such as tablets and android cellphones;
- ii. Real-time geo-tagging capability provided by the built-in global positioning system (GPS) in the android devices as well as the developed Java apps in the system;
- iii. Real-time data transfer using the short message service (SMS) protocols of telecommunications providers;
- iv. Real-time tracking of (location data) and status updates about field encoders or enumerators
- v. Dedicated SMS server that is housed in the PIMO of the provincial government.

23. The mobile/tablet field gathering devices work seamlessly with the CBM system and real-time information can be viewed in the PIMO headquarters on the fly. The CBMS covers 13 municipalities under the aegis of the province of Agusan del Sur.

24. The CBMS as of the moment is only for sole use of the Provincial government. It was noted that despite huge gains in the development of CBMS have been made by the PIMO at the provincial government level, the municipalities, on the other hand, need further retooling in the use of the CBMS as well as other ICT related initiatives of the Provincial government. As of current, the municipal local governments of Agusan del Sur are not yet using said system or are not yet connected to the CBMS system centrally housed in Prosperidad.

25. The Provincial government has also initiated similar innovative ICT-based systems that enhance the office's provision of services to its constituents. Among which is the "Paperless Appraisal of Property Taxes" for the whole province of Agusan del Sur. The provincial government has invested on state-of the-art GIS servers, such as the industry standard ArcGIS map server and elated paraphernalia. A competent and highly-motivated herd of IT staff backstops the PIMO.

26. The eventual goal of the in-house developed CBMS, the GIS and the development of maps at the provincial government, is for these systems to be able to support preparations and initiatives by the provincial government in climate change adaptation strategies and disaster resilience. The PIMO in particular, continues to develop useful and timely apps that would address the latter two issues outlined.

v. Budget

27. The Provincial government earmarks around 500,000 pesos annually, for ICT related activities and projects of the province. As such, it may be surmised that with an assured yearly budget, GIS as well as ICT initiatives of the Provincial government are highly sustainable.

28. Below is the SWOT Matrix of the Provincial Government of Agusan del Sur.

Table A4.1: SWOT Matrix of the Provincial Government of Agusan del Sur

Strengths	Weaknesses
<ul style="list-style-type: none"> • Upper management champions in the use if ICT-driven provision of services by the local government • Well-designed, highly-functioning MIS Server and ICT Control Room at the Provincial government Office • Ample GIS training among staff in various software and systems (i.e. QGIS and ArcGIS/ESRI products) • Highly-motivated and technologically hardcore IT staff capable of in-house systems development • In-house developed and tailor-made CBMS which is highly-advanced and regularly used, maintained and updated with field data • Existence of a yearly budget of PP500,000 to sustain the operations of all ICT-related activities of the Provincial government • Existence and use of a Paperless Appraisal of Property Tax • Pervasive use of ICT-based local government information for the provision of basic local government services 	<ul style="list-style-type: none"> • Boundary maps between neighboring provinces and municipalities still in dispute and have not been resolved • Apparent intra-office miscommunication (i.e. between the developments at the Provincial Assessor's Office and Planning Office with that of the PIMO) on the existence of salient geographic data (i.e. shapefiles) • The PIMO, AO and PO have yet to be linked via a LAN to maximize geographic data use within among the Offices and to harmonize existing data (shapefiles) residing in those offices • MLGUs of Agusan del Sur are not yet linked to the CBMS centrally located in Prosperidad
Opportunities	Threats
<ul style="list-style-type: none"> • Highly-trainable, young, and highly-motivated ICT staff at the PIMO • Huge pool of future ICT manpower from the CSU and with the presence of NOAH proponents in the same university • Map and data products derivable from the operations of NOAH at the CSU • Access to higher resolution (satellite) and "free or cheap" data for map updating would 	<ul style="list-style-type: none"> • Inability for the systems/protocols to trickle down to the lower tiers of the local government (i.e. going down to the municipal, barangay local government units); MLGUs do not have this CBMS as of current • Intra-Office miscommunication between and among offices in the Provincial government • Retention issues of trained ICT staff due to the temporary/contractual nature of job-items

<p>be useful and ideal</p> <ul style="list-style-type: none"> • Ability to access/acquire pertinent maps through online government portals and data/map archiving in an in-house server (<i>i.e.</i> CBMS) • Ability to update maps using GPS and mobile tablet android devices 	<ul style="list-style-type: none"> • Local maps are not shared due to issues of political boundaries among neighboring municipalities • Frequency of electricity/power outages in Agusan del Sur and in the whole Mindanao
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b. Municipal Local Government Unit of Santa Josefa

i. GIS Competence

29. There are ample indications that at the municipality of Santa Josefa, staff have had basic training and use of GIS tools and techniques. A good number of staff indicated that they have been trained in the use of such software packages as *Manifold*, *ArcGIS*, and *AutoCAD*. In particular the Housing and Land Use Regulatory Board (HLURB) had conducted training in *QGIS*. *QGIS* (previously known as "Quantum GIS") is a cross-platform free and open-source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis capabilities. On the other hand, the Department of Environment and Natural Resources (DENR) trained said personnel in *Manifold* (Manifold System is a geographic information system (GIS) software package developed by manifold.net that runs on Microsoft Windows. Manifold System handles both vector and raster data, includes spatial SQL, a built-in Internet Map Server (IMS), and other general GIS features. Manifold System has an active user community with a mailing list and online forums.

30. Currently, this office uses GIS and a plethora of tools for real property tax mapping (dubbed as Real Property Tax Information System or RTIS). Such staff are also knowledgeable in the use of such paraphernalia as a GPS and laser guider. They also have indicated heavy use of *Google Earth* services and products in combination with geo-tagging activities, which have particular use in and support for their tax mapping activities. The chore and function for map updating rests on the personnel of the Assessor's Office who are knowledgeable in GIS software manipulation.

31. It was also noted that they make use of hazards maps from the Mines and Geosciences Bureau (MGB) of the DENR, and these serve as basis for disaster-related decisions made at the level of the municipality.

32. The survey also took note that a CBMS (developed by the DILG) is up and functioning at this level of the local government. The CBMS server acts both as data server for data that have been sourced from GIS-related activities as had been described above. It is also noteworthy that the Municipal Assessor's Office and the Treasury are linked via a local area network for efficient exchange of information to and between said offices. However, even the existence of a laudable intranet at the Municipal Office, they do not have a website or internet presence, which may be thought to enhance information dissemination about the municipality of Santa Josefa, as well as a gateway for the provision of services by the local government. Budget issues are said to be the main stumbling block in the office's inability to subscribe to the internet and maintain its own website.

33. External acquisition of maps (*i.e.* topographic maps) are through the websites of the National Mapping and Resource Information Authority (NAMRIA) website. Updating of maps are done by periodic field works using GPS, and lately by using mobile handheld devices such as android tablets.

34. As regards printing of maps, these are done through private printing service.

ii. Internet Connectivity

35. Also at the Municipal level (in the Poblacion areas), the pervasiveness of mobile/wireless access was observed. The main cellular telecommunications provider is that of Globe Telecoms, which people access using bundled packages (i.e. WIFI and wireless modem) and working on 3G or 4G LTE modes.

iii. Human Resources

36. The major setback at the Mayor's Office as regards human resources trained and knowledgeable in GIS is the high turn-over-rate. With the departure or transfer of trained GIS staff, the technology goes with the said staff. As in most cases, GIS work is done on a job order basis or that the position created to do GIS work has a temporary/contractual nature.

37. SWOT Matrix of the LGU of Santa Josefa in Table A4.2.

Table A4.2: SWOT Matrix of the Municipal Government of Santa Josefa

Strengths	Weaknesses
<ul style="list-style-type: none"> • Existence of trained staff in GIS software and techniques (i.e. QGIS, Manifold, ArcGIS, AutoCAD, use of GPS, laser guider, etc.) • Existence of GIS software and basic hardware • Applications of GIS on tax mapping and Geo-tagging activities are being undertaken already • LAN/Intranet which connects some of the offices with the local government office • Existence/Pervasiveness/Presence of wireless/mobile access to the internet via cellular phone providers. • Ability to access/acquire pertinent maps through online government portals and data/map archiving in an in-house server (i.e. CBMS) • Ability to update maps using GPS and mobile tablet android devices 	<ul style="list-style-type: none"> • Absence of autonomous GIS server platform for data storage and acquisitions • Absence of GIS positions that are permanent or government plantilla • GIS work are on job-order or temporary staff basis which hampers technology transfer and GIS knowledge continuity • Absence of a municipal website / No internet presence • Absence of a mechanism for a bottoms-up approach of resource mapping; resource maps from BLGU are not consolidated to form part of the MLGUs resource map
Opportunities	Threats
<ul style="list-style-type: none"> • Creation of plantilla or permanent positions related to GIS work • Highly trainable staff with basic knowledge on the principles, use and applications of GIS • Creation of municipal website to enhance information dissemination and service provision by the municipal office • Access to higher resolution (satellite) and "free or cheap" data for map updating would be useful and ideal 	<ul style="list-style-type: none"> • Retention issues of trained ICT staff due to the temporary/contractual nature of job-items • Local maps are not shared due to issues of political boundaries among neighboring municipalities • Frequency of electricity/power outages in Agusan del Sur and in the whole Mindanao

c. Santa Josefa District Schools and Local Internet Service Providers (ISPs)

38. This part of the interview process aimed at assessing the capacity of local schools to be tapped as possible key players in the overall process of resource mapping being designed by DSWD. In this scheme, local schools are envisioned to be involved in KC processes such as geo-tagging, mapmaking, ground truthing and other geographically-related learning activity. Likewise, the ICT infrastructures (computers and connectivity to the Internet) that support learning and teaching were also gauged, and how these systems can be tapped for information management and communications in the context of the PGIS.

39. The ultimate goal is a holistic redesigning and re-crafting of the educational curriculum and various learning systems particularly those related to subjects in Science/Social Science (*i.e.* Earth Science, Environment, Health, *Araling Panlipunan*, etc.) which may be considered as useful data input sources in the process of community resource mapping.

40. The other set of interviewees consisted of members from the Santa Josefa Public School, headed by the District Supervisor of the Department of Education (DepEd) . Among the salient points of discussions were the following:

- i. ICT readiness for resource mapping and analysis of public and private schools in the municipality of Santa Josefa – number of computers in the municipality schools and their connection to the internet
- ii. Access and Use of ICT for Resource Mapping

41. Among the information collected from the meeting with the DepEd officials were the following:

i. The DICP of DepEd

42. In 2009, the Department of Education has initiated what is dubbed as the DepED Internet Connectivity Project (DICP), which aimed to connect all public high schools to the Internet. However, the DICP hit a snag in its implementation, particularly at the municipal level of Santa Josefa. Equipment purchase and deployment for Santa Josefa are still pending as of this writing.

43. In any case, Santa Josefa’s public elementary and high schools are mandated to have at least one (1) ICT school coordinator and one (1) ICT District Coordinator.

ii. The LIS of DepEd

44. The Learner Information System (LIS) was implemented in government schools and Community Learning Centers (CLCs) in September 2012 through DepEd Order Nos. 67, s. 2011 and 22, s. 2012. The implementation directed the issuance of a unique Learner Reference Number (LRN) to learners enrolled in public schools and Alternative Learning System (ALS) learners in Community Learning Centers (CLCs) for School Year (SY) 2012-2013. It also enabled the establishment of a centralized “Learner Registry” where basic learner information is captured, stored and accessed through a secured facility to enhance tracking and decision-making on learners at various levels of DepEd management.

45. With these DepEd orders, the public schools of Santa Josefa are mandated to implement ICT related systems, onto which there are huge possibilities for PGIS initiatives to ride on to. It should be noted that before the onslaught of Typhoon Sendong, the public schools of Santa Josefa were equipped with a good set of computer systems which were designed for computer-augmented teaching and learning. However, said computer lab facility was devastated by the said typhoon, and new computer acquisitions are indeed wanting.

46. The survey also revealed that as of current, there are no known collaborations with the DOST's Tech4Ed Project or any similar initiatives from government entities in the municipality of Santa Josefa.

iii. Internet Access in Barangays

47. As of current although the public schools themselves do not have a direct connection to the internet.

48. The pervasiveness of internet cafés or internet service providers even in remote barangays is quite apparent. This is made possible by the continued stream of mobile-based wireless internet technologies, that come in highly affordable packages or bundles. In barangay Poblacion itself, it is documented that there are 6 internet cafes (2 unlicensed and 4 licensed ones) operating, and which services mostly student age clients for gaming and entertainment.

49. The ubiquitous presence of internet cafes provides a plausible strategy of linking both schools and households to the internet. Presence of private internet cafes near the schools and residential areas may provide in the future, points-of-access (POAs) to extend internet connectivity and last-mile access strategies envisioned in the PGIS of the KALAHI -CIDSS. The inherent connectivity possessed by said internet cafes can be the source from which other households that are within the range of conventional WIFI technologies, may be used to spread out signals, providing packets of WIFI zones. Depending on the speed of the connection (to the main ISP) of one particular internet café, the WIFI range can be extended endlessly, limited only by the presence or provision of electrical power sources to run the WIFI access point-routers.

iv. Schools in Santa Josefa

50. There are two (2) national public high schools and seven (7) elementary or grade schools in the municipality of Santa Josefa. With appropriate planning and redesigning of school curricula to incorporate modules that are geared towards incorporating competence in geographic information principles, systems and technologies, as well as positional information (i.e. conduct of school science fairs, talks and basic trainings in geo-tagging and geocaching - is an outdoor recreational activity, in which participants use a GPS receiver or mobile devices and other navigational techniques to hide and seek containers, called "geocaches" or "caches", anywhere in the world.) such as those needed in the PGIS project of the KALAHI -CIDSS, these schools can become useful and inevitable partners to achieve the goal of a bottoms-up approach in the development of community-based geographic information.

51. Table A4.3 shows the SWOT Matrix of the Educational Profile and Internet Presence in Santa Josefa.

Table A4.3: SWOT Matrix of the Educational Profile and Internet Presence in Santa Josefa

Strengths	Weaknesses
<ul style="list-style-type: none"> • Existence and implementation of two (2) mandated DepED projects/programs which are the DICP and LIS which can be tapped into by the PGIS as a means for data communication from the barangays up to the different levels of the information chain (up to the provincial and national levels) • Existence/Pervasiveness/Presence of wireless/mobile-based access to the internet • Pervasiveness of privately-owned internet cafes near schools and residential areas 	<ul style="list-style-type: none"> • Slow procurement process for acquisition of ICT equipment for educational/teaching and learning purposes of public schools
Opportunities	Threats
<ul style="list-style-type: none"> • Interphasing with and re-designing of school Science curricula to incorporate modules and schemes that would inculcate student learning in geotagging and geographic information principles, systems and technologies, and in the process use “student power” for updating KC’s PGIS <ul style="list-style-type: none"> • Participation in annual school fairs • Training of trainers (TOTs) on Geotagging & GIS • Career talks on GIS, remote sensing, Geography • Presence of private internet cafés near the schools and residential areas may provide in the future, points-of-access (POA) to extend internet connectivity and last-mile access strategies • Receptiveness of teachers and education officials to collaborate and be trained on new and emerging GIS technologies and techniques 	<ul style="list-style-type: none"> • Frequency of electricity/power outages in Agusan del Sur and in the whole Mindanao • Intermittent mobile internet signals or commonness of “blind spots” and low/weak signals in certain parts of Santa Josefa

d. Barangay Local Government Units and PSA Volunteers

52. The third component of the field survey consisted of in-depth discussions with the various barangay officials and PSA volunteers in the three barangays under the jurisdiction of the municipality of Santa Josefa. These included barangays Poblacion, Sayon and Awao.

53. The interviews consisted of two segments or parts; initial discussions were done with barangay officials of each barangay stated earlier, then followed by discussions with the PSA volunteers.

54. Regarding the lines of questioning for the barangay officials, the following were the main themes:

- i. Existence and Usage of Maps
- ii. Map Creation, acquisition and updating
- iii. GIS Platform and storage
- iv. Human Resource capability and requirements

i. Existence of Purok Spot Maps

52. In all three barangays, it was determined by the survey that all have what are called “spot” maps, that the barangays would usually refer to. In this spot maps can be found salient segmented information of the “*purok*” (which is the smallest unit comprising the barangays). Information such as gender, senior citizens, pregnant women, children can be found in this spot maps. Most often as had been determined by the survey, these spot maps and the information contained therein are often used and updated by the barangay health workers of the Department of Health (DOH).

53. In barangays Sayon and Awao, spot maps were developed through a technical cooperation with the Heed Foundation and Balai Mindanao. The spot maps have been printed and compiled and contain a lot of attributes, including number of members in a household, types of plants being farmed, major roads, community structures. These spot maps are now being used by both barangays in most of its community-based decisions, such as but not limited to disaster response and evacuation procedures. However, as in most cases, these spot maps still lack the basic characteristics of a true map, which are, scale and geographic coordinates or georeferenced data. These maps nonetheless, will be useful, in that they can serve as future templates in the PGIS being envisioned by the KALAHI -CIDSS, and as such these communities need not start from scratch.

ii. Process in Barangay Poblacion, Sayon, and Awao

54. At the community level, the usefulness of the PSA cannot be overemphasized, since it is the major venue through which community issues and problems are vented out by members of the community in a “no holds barred” context. Both community resources and assets, as well as community-related issues and problems are actually placed into the open, in a timely and systematic manner, through the use of participative devices and techniques, such as but not limited to problem tree, transect walk, as well as resource mapping.

iii. Challenges in PSA and Resource Mapping

55. Among the problems identified with the current resource mapping techniques of pen and paper technique include the following:

- i. Resource maps and files are most often lost after the project stops. Most maps are just left to gather dust, and in even worst cases cannot be located due to poor or absence of filing management systems at the level of the communities. The age-old issue of map custodianship is nowhere else more felt than in the barangays where government resources are scarcer than at the municipal, provincial and upper tiers of the local government hierarchy.
- ii. The whole process of resource mapping is repeated at each process of the CEAC cycle, making the process and the experience for most PSA participants tiresome and exhaustive, since they will need to recall from memory the fine detail and attributes of their community's resources.
- iii. It was also noted from the interviews that in most cases, the current resource mapping process does not refer to previous map products developed from previous CEAC resource mapping processes. It would be useful if comparisons can be made from current and previous resource maps, so that changes and developments that will have been done in the previous cycle can easily be spotted or monitored during the current resource mapping process.
- iv. What is usually reflected in the resource maps are not the community's resources themselves, but rather most of the time a "hodgepodge" of community issues, problems and needs. Resource information comes secondary to the community issues.
- v. The time allocated to the segment of resource mapping is also limited, notwithstanding that the participants will also have to do a plethora of other participative techniques and outputs during the PSA. It was noted that during the PSA process, only around 3 hours are allocated for resource mapping which many volunteers think are not enough time to develop a well-thought over resource map, considering they are starting from scratch.
- vi. What could have been a useful tool during times of disasters or calamities, the PSA-developed resource are never used for community-based planning and evacuation of people.

56. Although the resource maps produced by the current PSA process lack the basic map qualities of scale and being geo-referenced, these community-developed resource maps which are nonetheless very reliable, as they actually reflect the indigenous knowledge of the community, and the latter's inherent collective knowledge of the area's resources.

iv. Pervasiveness of Internet Cafes even in Remote Barangays

57. It was also apparent that in all three (3) barangays, there is the ubiquitous presence of privately-owned internet cafes, which are being eyed for possible use in the conveyance of community-based and community-developed resource map information.

v. Receptiveness of Communities to be Trained in New Technologies

58. There is a general receptiveness of communities to use and be trained on new technologies, particularly those that pertain to the use of computer-based resource mapping and/or mobile-based techniques. The communities do believe that a huge number of barangays and even purok/sitio-based boundary disputes can be resolved through the use of technology-based, systematic means of resource mapping.

59. Likewise, people are very much receptive to be capacitated in developing their own barangay/ municipal website. Take the case of barangay of Awao, which has shown interest to develop its own website that is hoped to showcase its pristine and little known ecotourism sites such as the Awao caves and its nearby falls. The same desire was expressed by denizens of barangay Josefa, of developing their own community website, for the main purpose of regulating prices of their agricultural produce (in this case the price of “Kalamansi” or “Lemonsito”, or Philippine Lime in English) to break middlemen-induced farm-market price disparities.

60. Table A4.4 shows the SWOT Matrix of the three (3) study barangays in Santa Josefa.

Table A4.4: SWOT Matrix of Barangays Poblacion, Sayon and Awao

Strengths	Weaknesses
<ul style="list-style-type: none"> • Existence of Purok/Sitio SPOT maps which serves a basic geographic knowledge of the area and which contain salient information on human statistics at each purok/sitio. • Existence/Pervasiveness/Presence of wireless/mobile-based access to the internet • Pervasiveness of privately-owned internet cafes near schools and residential areas • Resource maps developed from the PSA process are highly reliable since they reflect inherent collective knowledge of the communities' resources 	<ul style="list-style-type: none"> • Repetitive/Iterative nature of current resource mapping technique (<i>i.e.</i> paper and pen) without making due reference to or comparison with the resource maps developed in the previous CEAC cycles • Absence of a systematic map filing and management system (both analog/printed or digital/computer-based) • Limited time of 3 hours only to do resource mapping during the PSA process. • Current resource maps lack the basic map qualities of SCALE and GEOREFERENCED information • Slow procurement process for acquisition of ICT equipment for barangay level use • Resource maps are never used for disaster planning and mass evacuation during calamities/disasters
Opportunities	Threats
<ul style="list-style-type: none"> • Presence of private internet cafes near the schools and residential areas may provide in the future, points-of-access (POA) to extend internet connectivity and last-mile access strategies • Receptiveness of local barangay staff and denizens to be trained/retooled in new PGIS Technique (<i>i.e.</i> Tarp Method) and emerging GIS technologies and techniques (both mobile and computer-based) • Receptiveness of communities to be trained/retooled in the development, maintenance and use of websites for their barangays, mainly to showcase local ecotourism and to regulate agricultural goods' farm-market trade and pricing disparities • These spot maps (developed in cooperation with international NGO) can serve as starting points for barangays Sayon and Awao in enhancing their resource maps preparatory to KC's new PGIS. 	<ul style="list-style-type: none"> • No appropriation of funds for ICT-related spending at the barangay level • Frequency of electricity/power outages in Agusan del Sur and in the whole Mindanao • Intermittent mobile internet signals or commonness of “blind spots” and low/weak signals in certain parts of Santa Josefa • Existence of boundary disputes at the purok/sitio levels

vi. Introduction of the Enhanced Community Resource Mapping Method

61. One of the purposes of the field survey was to provide community stakeholders, particularly the PSA volunteers, a foretaste of the technology intervention that is planned to be used by the KALAHI-CIDSS, in order for the latter to achieve harmonization of the geotagging process, the resource mapping that occurs during the PSA, as well as the sophisticated GIS systems being designed and developed at the national levels of DSWD.

62. At the last leg of the discussions with the BLGUs and PSA volunteers of the 3 pilot barangays of Poblacion, Sayon and Awao, the Enhanced Community Resource Mapping (ECRM) Method was introduced among the community members. The ECRM is a Google Earth-derived, Tarp-printed base map designed to better modify the conventional community resource mapping process. Initial comments, reactions and suggestions from the community for its improvement were noted, vis-à-vis the currently used resource mapping technique, which is the paper and pen technique.

63. On the whole and in all three barangays, there is openness of the community-based stakeholders to the use of the Google Earth-derived tarpaulin map (vis-à-vis the paper based resource maps produced during the PSA process), since the latter provides relative ease in identifying community structures and landmarks, reproducibility, as well as the convenience in providing geo-referenced data.

- i. latter provides Ease in identifying community structures and landmarks
- ii. Reproducibility
- iii. Convenience in providing geo-referenced data.

64. Among the feedbacks received from the community PSA volunteers are:

- i. Need for clearer satellite images, on order for them to see their houses and identify relevant structures in their communities/sitios;
- ii. Less annotations on the Google-earth derived map in order not to overwhelm the PSA volunteers with too much information at a single glance and on a single platform;
- iii. Increase in the area/size of the tarpaulin print out to cover the respective sitios/puroks at a larger scale and with greater detail;

B. Municipality of Gloria Field Survey

1. Background

65. Gloria (formerly Maligaya) is a third-class municipality in the province of Oriental Mindoro, Philippines. According to the 2010 census, it has a population of 42,012 people.

66. The town was previously a barangay called Maligaya, the largest barangay during the administration of President Diosdado Macapagal. Local politicians, led by former guerrilla chief Nicolas Jamilla, Sr., battled for the conversion of Maligaya into a new town. They renamed it after the ten-year-old daughter of the President, Gloria Macapagal-Arroyo, who later on herself became the fourteenth President in 2001. Jamilla became the first mayor of the town, which kept the old name "Maligaya" as the name of a barangay in the poblacion.

67. Gloria is divided into 27 barangays: nine (9) barangays are situated along the national highway; six (6) are coastal barangays; and twelve (12) interior barangays on the west side.

- | | |
|------------------------|------------------------------|
| i. Agsalin | xv. Malamig |
| ii. Agos | xvi. Malayong |
| iii. Alma Villa | xvii. Maligaya (Poblacion) |
| iv. Andres Bonifacio | xviii. Malubay |
| v. Balete | xix. Manguyang |
| vi. Banus | xx. Maragooc |
| vii. Banutan | xxi. Mirayan |
| viii. Buong Lupa | xxii. Narra |
| ix. Bulaklakan | xxiii. Papandungin |
| x. Gaudencio Antonino | xxiv. San Antonio |
| xi. Guimbonan | xxv. Sta. Maria (Bulbugan) |
| xii. Kawit | xxvi. Santa Theresa |
| xiii. Lucio Laurel | xxvii. Tambong |
| xiv. Macario Adriatico | |

Figure A2.1: Map of Gloria, Oriental Mindoro



68. Gloria is bounded in the north by the municipality of Pinamalayan, in the south by Bansud, in the west by shared mountains with the municipality of Sablayan, Occidental Mindoro, and in the east by the Sibuyan Sea.

2. Workplan of Field Survey

69. A three and a half -day workplan was planned out prior to the trip that would take the team from Batangas Ferry port to Calapan City, and eventually to Gloria, Oriental Mindoro.

70. As in the previous field survey, the primary objective of the field survey was to establish/determine baseline information on the readiness of communities to create a platform of spatial information which leads to greater transparency in barangay local government units (BLGUs) and the municipal local government units (MLGUs), and allow these communities to retrieve, update and use the information as basis for local decision-making. Additionally, the survey aimed to assess the readiness and receptiveness of these communities to the introduction of new materials and tools for resource mapping; the communities' tools for spatial data collection, visualization, analysis, and sharing; as well as the introduction of standardized means of conducting resource mapping in the context of the KC PSA process.

71. In the morning of August 11, a courtesy call was made at the Department of Social Welfare and Development (DSWD) Regional Office (covering MIMAROPA) located in Malate, Manila. This is to coordinate with the RPMO as well as to conduct initial interviews with the concerned staff, which fields out the necessary KALAHI-CIDSS infrastructure and related projects.

72. A one-and a- half bus ride travel to Batangas City International Seaport ensued. This was followed by two-hour sea journey to Calapan, and subsequently another 2-hour land travel to the municipality of Gloria.

73. The meeting and interview with the Provincial local government office had to be conducted on 12 August, due to some delays in the connecting ferry ride from Batangas.

74. The same SWOT analysis was applied to process the survey results of the municipality of Gloria.

3. Major Findings

a. Provincial LGU of Calapan City

75. The discussions were focused on the following points as they relate to the operations of the Provincial Office of Calapan City:

- i. Map Analysis
- ii. Map creation, acquisition and updating
- iii. GIS platform and storage
- iv. Human resources
- v. Other initiatives of the provincial office as regards GIS and its uses
- vi. GIS Facilities within the province

76. Calapan, a component city, is the capital of the province of Oriental Mindoro, Philippines. According to the 2010 Census, this coastal community has a population of 124,173 people.

77. The city serves as the gateway to the Oriental Mindoro province with the implementation of the Strong Republic Nautical Highway (SRNH) an integrated ferry project of former President Gloria Macapagal Arroyo that extends further to the southern part of the Philippines. The Calapan City Seaport is the largest and busiest seaport on Mindoro Island, which is just 45 minutes away by ferry boats and roll-on/roll-off (RORO) ships to-and-from Batangas City International Seaport.

78. Calapan is currently one of the only two cities in Region 4-B (MIMAROPA Region) the other being Puerto Princesa City in Palawan. Calapan serves as the region's administrative center. It is also the center of commerce, industry, transport, communication, religious activities and education in the entire province of Oriental Mindoro.

i. Existence of Geographic Data and International GIS Technical Assistance

79. The Calapan Provincial government is a recipient of a technical assistance from the German Technical Assistance (GTZet), where there are 4 pilot municipalities (namely Calapan, Baco, San Teodoro and Naujan) under the Participatory Land Use Development Project (PLUDP). The GIS expert is on secondment for 2 years, where expectedly, knowledge-transfer will have been achieved. The project is a community-based process and similarly conducts a PSA process to develop the PLUDP. These include the following community-based activities:

- i. Scheduling of community meetings
- ii. Resource mapping and Transect walks
- iii. Use of GPS to gather the actual locations of household

80. The Project was launched around 3 years ago (around fiscal year 2012), and of the 4 municipalities, it is only San Teodoro which was able to complete its land use maps. The base maps used in the process were derived from the municipal local government units.

81. The PLUD data is being consolidated by the provincial planning and development office (PPDO). The municipal LGUs also are given copies of the shapefiles of each municipality. There are no directives to receive shapefiles from the municipal offices, hence shapefiles are not often shared and consolidated at the provincial level.

82. It is noteworthy, however, that the Provincial government has an extensive database of consolidated road shape files, as well as basic river shape files. Data is also being shared among other government agencies. Notwithstanding the issues of quality incongruent shapefiles with information produced from different government agencies.

83. Due to the absence of monetary remuneration, quality of GPS-tagged data has suffered. There is also the issue on the convention of map referencing system at the different levels of map data capture.

84. Finalization of resource maps are made at the barangay assembly and where these are approved. A sectoral plan is also one of the products of this process. The municipal local government is tasked to digitize the resource maps through image capture (taking a photograph using conventional camera or cellular phone camera) that will have been gathered from the participatory resource mapping process of the community. An appropriate GIS such as QGIS and ArcGIS is used to manipulate the digitized resource map data. For Calapan particularly, they have been given by GTZet a tailor-fitted GIS (*i.e.* Manifold).

85. There was also mention of cadastral survey being completed for the whole of Oriental Mindoro, however, the same issues of boundary incongruencies are present.

86. Replication of the stalled PLUDP is envisaged to resume by next year, in 2016.

ii. Existence of CBMS

87. A functioning CBMS is housed by the Provincial government. Of the 15 municipalities under the aegis of the Provincial government, only 13 municipalities have completed the survey necessary for the CBMS. Currently the CBMS is being used for poverty mapping in cooperation with the statistics office of the provincial office.

iii. Ample GIS Trainings Among Provincial LGU Staff

88. On the whole the Provincial government has 3 staff trained in GIS, 1 staff is detailed at the Assessor's Office, 1 staff is with the Provincial Engineering Office (PEO), and one at the Provincial Planning and Development Office (PPDO).

89. A complete set of GIS paraphernalia are available including digital camera, an A3 and large format printers, a PC for GIS processing, 4 Garmin GPS and a number of GIS softwares. A server (not solely for GIS) is housed at the Provincial Information Management Office.

iv. Budget

90. The Provincial government earmarks budget for ICT related activities and projects of the province. As such, it may be surmised that with an assured yearly budget, GIS as well as ICT initiatives of the Provincial government are highly sustainable.

v. Wireless Broadband Quality

91. It is noteworthy that even in the urban setting of Calapan City, mobile-based, wireless broadband internet is not that reliable. Based on the experiences shared by the provincial planning officer, wireless broadband internet services have intermittent speeds and signal strengths.

92. Table A4.5 shows the SWOT Matrix of the Provincial Government of Oriental Mindoro.

Table A.4.5: SWOT Matrix of the Provincial Government of Oriental Mindoro

Strengths	Weaknesses
<ul style="list-style-type: none"> • The existence of an international technical assistance (TA) in GIS from the German government, which seeks knowledge transfer among stakeholders, as well as, standardization of geographic datasets (i.e. shapefiles) • Initial consolidation and harmonization of geographic data through the international TA • Ample GIS training among staff (3 staffs) in various software and systems (i.e. Manifold, QGIS and ArcGIS/ESRI products) • Highly-motivated and proactive provincial planning officer • Existence of a yearly budget to sustain the operations of all ICT-related activities of the Provincial government • PLUDP has been rolled out in 4 barangays though stalled for 2 years; lessons learned from the first roll-out • A CBMS is already existing with 13 out of 15 municipalities already used for poverty mapping • Existence of basic and functional GIS equipment in the Provincial government office • Electricity/Power is very stable in the whole of Oriental Mindoro; power outages are very rare in the province • Internet/Web presence of the Provincial government 	<ul style="list-style-type: none"> • Data quality issues in the data generation (i.e. shapefiles) • Boundary maps and incongruencies in geographic data (i.e. shapefiles) between neighboring provinces and municipalities still in dispute and have not been resolved • Geographic data use within and among the Offices and to harmonize existing data (shapefiles) residing in those offices • Issue on updating of PLUDP maps since updating is incumbent on the municipal LGUs • MLGUs of Oriental Mindoro are not yet linked to the CBMS centrally located in Calapan City
Opportunities	Threats
<ul style="list-style-type: none"> • Highly-trainable, young, and highly-motivated ICT staff at the PIMO • Ability to access/acquire pertinent maps through online government portals and data/map archiving in an in-house server (i.e. CBMS) • KC-NCDDP can collaborate and harmonize their geo-tagging schedules to coincide with the conduct of PLUDP to make use of the existing KC mobile devices. • Ability to update maps using GPS and mobile tablet android devices 	<ul style="list-style-type: none"> • Inability for the systems/protocols to trickle down to the lower tiers of the local government (i.e. going down to the municipal, barangay local government units); the MLGUs do not have this CBMS as of current • Retention issues of trained ICT staff due to the temporary/contractual nature of job-items. In most cases ICT/GIS positions are on job order (JO) basis • Local maps are not shared due to issues of political boundaries among neighboring municipalities • Intermittent and instability of wireless broadband internet

b. Municipal Local Government Unit of Gloria**i. GIS Competence**

93. During the interview, the municipal officers have conveyed that they are doing tax mapping, to what is dubbed as the *I-Tax* System. The *I-Tax* was developed through funding support from the provincial government, which digitally links the Municipal Assessors and Treasury Offices. However, the *I-Tax* does not have a map-based interphase or a semblance of a GIS system, that would allow faster and more systematic retrieval and identification of taxable lots within the municipality.

94. The National Household Targeting System for Poverty Reduction (NHTS) is also being used by the Gloria municipal government in identifying families and households that are below the poverty threshold. However NHTS data takes a while to acquire from provincial government sources, and therefore poses another hurdle in the provision of services by the Gloria municipal government.

95. The Municipal Agricultural Officer (MAO) of Gloria had conveyed information that they are using GIS-based techniques in the provision of services. These include such technique as geo-tagging using handheld GPS. Surprisingly, on the other hand, the Municipal Engineering Office indicated little or no knowledge in GIS or geo-tagging for that matter.

96. The Municipal Planning and Development Office (MPDO), on the other hand, had indicated that they are in possession of a substantial set of GIS data (in the form of shapefiles). The shapefiles are primarily used in developing the Gloria's Comprehensive Land Use Plans (CLUP).

97. The municipal government uses QGIS for most if not all of its mapping needs. This is in support of the CBMS which is already being used in that particular municipality. In support to the sustainable update and use of Gloria's CBMS, the municipal government for many years now has rolled out several surveys, particularly the Barangay Profile Questionnaires (BPQ). Said surveys have been conducted in collaboration with the National Statistics Office (NSO). From these surveys, a complete set of statistical data of the municipality was produced in 2008 and needs to be updated to conform with the contemporary statistics of Gloria. It is noteworthy that indeed, at the level of the municipality, they are already using digital maps, however, said maps do not conform or are not consistent with existing provincial maps. The issue of GIS data quality remains at the municipal level, due in part to data encoding, duplication and (field) enumerator problems.

98. The Municipal Environmental Resources Officer (MENRO) also indicated the application of GIS techniques, with their use of GPS in determining mature forest trees that are due for cutting, as well as for private citizens applying for permit to cut trees within the private stead.

99. The Municipal Disaster Risk Reduction and Management Office (MDRRMO) currently uses analog (printed) maps for disaster planning and management, but there are no GIS-based systems that would provide decision support especially during dire disaster situations.

ii. Internet Connectivity

100. Also at the Municipal level (in Barangay Tambong and the 3 barangays visited), the pervasiveness of mobile/wireless broadband access was observed. The main cellular telecommunications provider is that of Globe Telecoms, which people access using bundled

packages (i.e. WIFI and wireless modem) and working on 3G or 4G LTE modes. However, intermittent and extremely weak wireless broadband signal (to blind spot) areas have been observed, most especially near the coastal barangay of Tambong.

iii. Human Resources

101. The major setback at the municipal government of Gloria as regards human resources trained and knowledgeable in GIS is the high turn-over-rate. As of this writing, there are only 2 personnel who have basic knowledge on GIS. Both are employed on a temporary, contractual basis. Hence, with the departure or transfer of trained GIS staff, the technology goes with the said staff. As in most cases, GIS work is done on a job order (contracted) basis or that the position created to do GIS work has a temporary/ contractual nature. Also, because of this dilemma, the municipal CLUP has not progressed much due to the absence or lack manpower who have ample training or experience in GIS.

102. Table A4.6 shows the SWOT Matrix of the Municipal Government of Gloria.

Table A4.6: SWOT Matrix of the Municipal Government of Gloria

Strengths	Weaknesses
<ul style="list-style-type: none"> • Existence of trained staff in GIS software and techniques (i.e. QGIS, use of GPS) • Existence of QGIS software and basic GIS hardware • Existence of GIS data/shapefiles at the Municipal government • Existence/Pervasiveness/Presence of wireless/mobile access to the internet via cellular phone providers. • Ability to access/acquire pertinent maps through online government portals and data/map archiving in an in-house server (i.e. CBMS) • Geo-tagging using GPS is already being done by the MAO and MENRO of Gloria • An I-Tax System which links 2 important offices in the municipal government • Electricity/Power is very stable 	<ul style="list-style-type: none"> • Tax mapping is being done but without the use and application of GIS • Absence of autonomous GIS server platform for data storage and acquisitions • Absence of GIS positions that are permanent or government plantilla • GIS work are on job-order or temporary staff basis which hampers technology transfer and GIS knowledge continuity • Absence of a municipal website / No internet presence • Existence of a lot of databases (e.g. NHTS, CLUP) but which needs harmonization and integration to be useful and exploitable in a GIS platform
Opportunities	Threats
<ul style="list-style-type: none"> • Creation of plantilla or permanent positions related to GIS work • Creation of municipal website to enhance information dissemination and service provision by the municipal government office • Consolidation and harmonization of exiting databases into a GIS-based environment/interphase 	<ul style="list-style-type: none"> • Retention issues of trained ICT /GIS staff due to the temporary/contractual nature of job-items and hence continuity of GIS initiatives • Local maps are not shared due to issues of political boundaries among neighboring municipalities • Weak to unstable wireless broadband signal in most of the municipality of Gloria and the rest of Oriental Mindoro

c. Gloria District Schools

103. As in the previous field survey conducted in Agusan del Sur, the current survey in Gloria, Oriental Mindoro sought to assess the following:

- i. ICT readiness for resource mapping and analysis of public and private schools in the municipality of Gloria– number of computers in the municipality schools and their connection to the internet
- ii. Access and Use of ICT for Resource Mapping

104. Among the information collected from the meeting with the DepEd officials of Gloria Central School were the following:

- i. In 2010, the School was a recipient of a server-based, computer-aided teaching system exists, but is however, at the moment non-functional/defective.
- ii. There are 2 units of “pocket wifi” wireless broadband internet, which are subscribed to Globe. To augment their educational materials, most of the teachers are connected to the Internet on their own personal expense. By directive, all public school teachers are also required to input into the Learner Information System (LIS), and as such the need for them to be connected to the Internet by any means possible.

105. All Gloria public schools, are capacitated as well by the Department of Education’s Internet Connectivity Project (DICP), which was rolled out in 2009 and had the main objective of connecting all public high schools to the Internet. As in most cases and as in all government purchasing, acquisition of ICT equipment takes some time due to the rigorous bidding process.

i. Schools in Gloria

106. The Municipality of Gloria has 1 tertiary private school, 6 secondary schools (2 private and 4 public), and 22 elementary schools (1 private and 21 public schools).

107. Table A4.7 shows the SWOT Matrix of the Educational Profile of Gloria.

Table A4.7: SWOT Matrix of the Educational Profile of Gloria

Strengths	Weaknesses
<ul style="list-style-type: none"> Existence and implementation of two (2) mandated DepED projects/programs which are the DICP and LIS which can be tapped into by the PGIS as a means for data communication from the barangays up to the different levels of the information chain (up to the provincial and national levels) Stable Electricity/Power supply; very rare power outages 	<ul style="list-style-type: none"> Slow procurement process for acquisition of ICT equipment for educational/teaching and learning purposes of public schools
Opportunities	Threats
<ul style="list-style-type: none"> Interphasing with and re-designing of school Science curricula to incorporate modules and schemes that would inculcate student learning in geotagging and geographic information principles, systems and technologies, and in the process use “student power” for updating KC’s PGIS <ul style="list-style-type: none"> Participation in annual school fairs Training of trainers (TOTs) on Geotagging & GIS Career talks on GIS, remote sensing, Geography Receptiveness of teachers and education officials to collaborate and be trained on new and emerging GIS technologies and techniques 	<ul style="list-style-type: none"> Intermittent mobile internet signals or commonness of “blind spots” and low/weak signals in most parts of Gloria

d. Barangay Local Government Units and PSA Volunteers

108. As in the previous scoping done in Agusan del Sur, the same common issues and findings were found in the three barangays of Lucio Laurel, Macario Adriatico, and Banus.

109. The interviews consisted of two segments or parts; initial discussions were done with barangay officials of each barangay stated earlier, then followed by discussions with the PSA volunteers.

110. As before, the lines of questioning for the barangay officials, the following were the main themes:

- i. Existence and Usage of Maps
- ii. Map Creation, acquisition and updating
- iii. GIS Platform and storage
- iv. Human Resource capability and requirements

i. Existence of Purok Spot Maps

111. In all three barangays, it was determined by the survey that all have what are called “spot” maps, that the barangays would usually refer to.

112. It had been gathered that these spot maps are most often used during disaster planning and evacuation scenarios, since all three barangays are rice-growing barangays, and are therefore perennially flooded areas, especially during the rainy season.

113. In barangay Lucio Laurel particularly, it was noted that their spot maps are constantly being updated at a frequency of 6 months. The chore of updating these spot maps are being done by municipal health workers, as the latter conducts the regular health surveys in and around the barangays.

114. As observed previously, these spot maps though useful enough for community planning, they do not possess the qualities of scale and having georeferenced information, that would qualify for a real map. These maps nonetheless, will be useful, in that they can serve as future templates in the PGIS being envisioned by KC, and as such these communities need not start from scratch.

115. The barangays of Lucio Laurel, Macario Adriatico and Banus each have Windows-based personal computers which were sourced from the funds of the Samahan Kabataan (SK). In all cases, the barangay secretary, followed by the barangay treasurer are the most knowledgeable and computer-literate members of the community, and will most likely be the entities to be trained on GIS principles and techniques if in case the KC decides to roll-out the system at the barangay level.

ii. Challenges in PSA and Resource Mapping

116. Almost the same set of issues were brought out by the denizens of these three barangays when compared to those found earlier in the scoping survey of the municipality of Santa Josefa, Agusan del Sur. Among the similar problems identified with the current resource mapping techniques of pen and paper technique include the following:

- i. Resource maps and files are most often lost after the project stops. Most maps are just left to gather dust, and in even worst cases cannot be located due to poor or absence of filing management systems at the level of the communities. The age-old issue of map custodianship is nowhere else more felt than in the barangays where government resources are scarcer than at the municipal, provincial and upper tiers of the local government hierarchy.
- ii. The whole process of resource mapping is repeated at each process of the CEAC cycle, making the process and the experience for most PSA participants tiresome and exhaustive, since they will need to recall from memory the fine detail and attributes of their community's resources.
- iii. It was also noted from the interviews that in most cases, the current resource mapping process does not refer to previous map products developed from previous CEAC resource mapping processes. It would be useful if comparisons can be made from current and previous resource maps, so that changes and developments that will have been done in the previous cycle can easily be spotted or monitored during the current resource mapping process.
- iv. The time allocated to the segment of resource mapping is also limited, notwithstanding that the participants will also have to do several other participative techniques and outputs during the PSA.

iii. Pervasiveness of Internet Cafes even in Remote Barangays

117. It was also apparent that in all three (3) barangays, there is the ubiquitous presence of privately-owned internet cafes, which are being eyed for possible use in the conveyance of community-based and community-developed resource map information.

118. However, even with the presence of internet cafés, on the whole, the signal quality of internet wireless broadband in the municipality of Gloria can be gauged to be mediocre to poor quality. This is due in large part to low/weak signal quality and pervasiveness of blind spots, most specially in and along coastal communities of Gloria (e.g. Barangay Banus). Most denizens have personal access to the internet via wireless broadband offered by local cellular companies, which are Globe and Smart.

iv. Receptiveness of Communities to be Trained in New Technologies

119. Likewise, people are very much receptive to be empowered in developing their own barangay/ municipal website. There is a common request among all three barangays for training not only in GIS but also in website development. All three barangays as of this writing do not have websites, and community web presence is wanting. These communities envision that if they would have community websites, they can help bolster and increase traffic on ecotourism activities.

120. TableA4.8 shows the SWOT Matrix of the three (3) study barangays in Gloria.

Table A4.8: SWOT Matrix of Barangays Lucio Laurel, Macario Adriatico and Banus

Strengths	Weaknesses
<ul style="list-style-type: none"> • Existence of Purok/Sitio SPOT maps which serves a basic geographic knowledge of the area and which contain salient information on human statistics at each purok/sitio. • Existence/Pervasiveness/Presence of wireless/mobile-based access to the internet • Pervasiveness of privately-owned internet cafes near schools and residential areas • Resource maps are being used for disaster planning and mass evacuation during calamities/disasters • Very stable power/electricity source; very rare power outages • Existence of PCs (funded through SK) in barangay LGUs • Knowledgeable barangay LGU staff (i.e. Secretary) in the operation of PC 	<ul style="list-style-type: none"> • Repetitive/Iterative nature of current resource mapping technique (i.e. paper and pen) without making due reference to or comparison with the resource maps developed in the previous CEAC cycles • Absence of a systematic map filing and management system (both analog/printed or digital/computer-based) • Limited time of 3 hours only to do resource mapping during the PSA process. • Current resource and spot maps lack the basic map qualities of SCALE and GEOREFERENCED information
Opportunities	Threats
<ul style="list-style-type: none"> • Presence of private internet cafes near the schools and residential areas may provide in the future, points-of-access (POA) to extend internet connectivity and last-mile access strategies • Receptiveness of local barangay staff and denizens to be trained/retooled in new PGIS Technique (i.e. Tarp Method) and emerging GIS technologies and techniques (both mobile and computer-based) • Receptiveness of communities to be trained/retooled in the development, maintenance and use of websites for their barangays, mainly to showcase local ecotourism and to regulate agricultural goods' farm-market trade and pricing disparities • These spot maps (developed in cooperation with international NGO) can serve as starting points for the 3 barangays in enhancing their resource maps preparatory to KC's new PGIS. • Trainable barangay LGU staff (i.e. Secretary and Treasurer) in GIS principles and techniques. 	<ul style="list-style-type: none"> • No appropriation of funds for ICT-related spending at the barangay level • Poor to extremely weak wireless broadband signals in most parts of the 3 barangays • Existence of boundary disputes at the purok/sitio levels

DTI BUSINESS NAME REGISTRATION OF TARPAULIN PRINTERS NATIONWIDE

Business Name	Business Address	Status	Business Scope
3k Tarpaulin Printing		DTI-Registered	Regional
4 Myzce Tarpaulin Printing Press	Dila, Bay, Laguna	DTI-Registered	Barangay
7ar Tarpaulin Printing & Internet Shop	Poblacion, Aroroy, Masbate	DTI-Registered	Barangay
Adalem Tarpaulin Printing	Barangay 293, Binondo, NCR, City Of Manila, First District	DTI-Registered	Barangay
Adriano Tarpaulin Printing	San Rafael, Rodriguez (Montalban), Rizal	DTI-Registered	Barangay
Affordale Tarpaulin Printing	San Francisco, Agusan Del Sur	DTI-Registered	CityProv
Agc- Digital And Tarpaulin Printing	Kamuning, Quezon City, NCR, Second District	DTI-Registered	Barangay
Aging Tarpaulin Printing	Barangay 6 (Pob.), San Jose, Occidental Mindoro	DTI-Registered	Barangay
Aim Iii Tarpaulin And Sticker Printing	Lipa City, Batangas	DTI-Registered	CityProv
Aladin Tarpaulin Printing	Hen. T. De Leon, Valenzuela City, Ncr, Third District	DTI-Registered	Barangay
Aletarp Enterprises	Quezon City, NCR, Second District	DTI-Registered	CityProv
Alfonso's Balloons, Party Needs And Tarpaulin Printing		DTI-Registered	Regional
Alison Tarpaulin Printing And Installation Services	Roxas, Quezon City, NCR, Second District	DTI-Registered	Barangay
Amazing Tarpaulin Printing	Guiguinto, Bulacan	DTI-Registered	CityProv
Andrei Tarpaulin Printing	Taguig City, NCR, Fourth District	DTI-Registered	CityProv
Apdc Tarp Printing	Barangay 3-A (Pob.), Davao City, Davao Del Sur	DTI-Registered	Barangay
Apo Roque's Tarpaulin Printing & General Merchandise		DTI-Registered	Regional
Aprint Dzyn Tarpaulin Printing	Kawit, Cavite	DTI-Registered	CityProv

Business Name	Business Address	Status	Business Scope
Arjanyayie Internet Cafe And Tarpaulin Printing	Gumaca, Quezon	DTI-Registered	CityProv
Art Design Tarpaulin Printing		DTI-Registered	Regional
Asakusa Tarpaulin Printing	Valencia, Quezon City, NCR, Second District	DTI-Registered	Barangay
Aspen Matrixx Tarpaulin Design		DTI-Registered	Regional
Atd Graphics Tarpaulin Printing	Jolo (Capital), Sulu	DTI-Registered	CityProv
Barja Tarpaulin Printing Service	Pasong Tamo, Quezon City, NCR, Second District	DTI-Registered	Barangay
Benchjho Tarpaulin Printing	Pigkawayan, North Cotabato	DTI-Registered	CityProv
Benito's Tarpaulin And Internet Cafe		DTI-Registered	Regional
Bergads Tarpauline Printing And Advertising	Barangay 892, Santa Ana, NCR, City Of Manila, First District	DTI-Registered	Barangay
Bleauprint Tarpaulin Printing	Poblacion, San Fabian, Pangasinan	DTI-Registered	Barangay
Blessed Ads & Tarps Printing Shop	Mambog Iv, Bacoor, Cavite	DTI-Registered	Barangay
Carrie's Tarpaulin Printing	Barangay 862, Pandacan, NCR, City Of Manila, First District	DTI-Registered	Barangay
Cdr Ink Tarpaulin Printing	Kidapawan City, North Cotabato	DTI-Registered	CityProv
Cebu Tarpaulin & Graphics	Basak Pardo, Cebu City, Cebu	DTI-Registered	Barangay
Cheboy's Tarpaulin Printing And Graphics	Tuguegarao City, Cagayan	DTI-Registered	CityProv
Color Me Crazy Tarpaulin Printing		DTI-Registered	Regional
Colour Drop Tarpaulin Printing	Poblacion, El Salvador City, Misamis Oriental	DTI-Registered	Barangay
Colours Tarpaulin Printing	Iligan City, Lanao Del Norte	DTI-Registered	CityProv
Copykath Commercial &	Prosperidad (Capital), Agusan Del Sur	DTI-Registered	CityProv

Business Name	Business Address	Status	Business Scope
Tarpaulin Printing			
Corporative Services & Technologies For Antipolo Rizal Philippines (Corstarphil) Inc.		SEC-Registered	
Cyber Computer Center And Tarpaulin Printing	Esperanza, Sultan Kudarat	DTI-Registered	CityProv
Cyberspace Tarpaulin Center	Poblacion, Guinobatan, Albay	DTI-Registered	Barangay
Cydorial Tarpaulin	San Francisco, Agusan Del Sur	DTI-Registered	CityProv
Design Services			
Dafnie's Tarpaulin Printing	Silangan (Pob.), Calauan, Laguna	DTI-Registered	Barangay
Daone Tarpaulin Printing	Mamatid, Cabuyao, Laguna	DTI-Registered	Barangay
Dbt Tarp Express	Calabanit, Glan, Sarangani	DTI-Registered	Barangay
Diamond Tarpaulin Services	Del Pilar, San Fernando City (Capital), Pampanga	DTI-Registered	Barangay
Digifix Tarpaulin Printing Layout & Design	Imelda, Zamboanga Sibugay	DTI-Registered	CityProv
Digital Tarp, Inc.		SEC-Registered	
Dmc Tarpaulin Printing	Cabanatuan City, Nueva Ecija	DTI-Registered	CityProv
Dmd Tarpaulin Ads Express	Quezon City, NCR, Second District	DTI-Registered	CityProv
Don Tech Print Master Tarpaulin Printing	Kumintang Ibaba, Batangas City, Batangas	DTI-Registered	Barangay
E Vin Starpower Trading	Balibago, Lian, Batangas	DTI-Registered	Barangay
Em-Em's Tarpaulin Printshop	Butuan City, Agusan Del Norte	DTI-Registered	CityProv
Emr Tarpaulin Shop	Las Piñas City, NCR, Fourth District	DTI-Registered	CityProv
Emy's Digital Arts Tarpaulin Printing	San Isidro, Cainta, Rizal	DTI-Registered	Barangay
Eriel John Tarpaulin Printing		DTI-Registered	National

Business Name	Business Address	Status	Business Scope
Esalig Tarpaulin Printing	Poblacion, El Salvador City, Misamis Oriental	DTI-Registered	Barangay
Etc... Embroidery Tarpauline Creations		DTI-Registered	National
Febmik Tarpaulin Printing	Science City Of Muñoz, Nueva Ecija	DTI-Registered	CityProv
Finger Print Tarpaulin Printing		DTI-Registered	Regional
Fj's Graphix Tarpaulin Engraving	Poblacion, Alaminos City, Pangasinan	DTI-Registered	Barangay
Fj's Tarpaulin And Laser Engraving	Poblacion, Alaminos City, Pangasinan	DTI-Registered	Barangay
Fjr Tarpaulin Printing	Taguig City, NCR, Fourth District	DTI-Registered	CityProv
Four Kids Tarpaulin Printing	Antipolo City, Rizal	DTI-Registered	CityProv
Frientarprise Gourmet Foods	San Agustin, San Fernando City (Capital), Pampanga	DTI-Registered	Barangay
G. Galvez Tarpaulin Printing		DTI-Registered	National
Gab's Tarpaulin Printing	Iloilo City, Iloilo	DTI-Registered	CityProv
Garcia Tarpaulin And Printing Services	Narra (Pob.), Narra, Palawan	DTI-Registered	Barangay
Gbnofar Tarpaulin & General Merchandise		DTI-Registered	Regional
Gerilla Tarpaulin Shop	Muzon, San Jose Del Monte City, Bulacan	DTI-Registered	Barangay
Gpj Tarpaulin And Printing Services	Blk 11 Lot 34 Ph Iii-C Dagat-Dagatan Avenue Cor. Tulya Alley, N/A, Caloocan City, NCR, Third District	DTI-Registered	
Grace Tent And Tarp Trading And Services	Cadiz City, Negros Occidental	DTI-Registered	CityProv
Guinobatan Tarpaulin Center And General Merchandise	Guinobatan, Albay	DTI-Registered	CityProv
Guitarplanet Inc.		SEC-Registered	
Hap Chiong Canvas And	Binondo, NCR, City Of Manila, First District	DTI-Registered	CityProv

Business Name	Business Address	Status	Business Scope
Tarpaulin Trading			
IkM Graphics And Tarpaulin Printing	Padre Garcia, Batangas	DTI-Registered	CityProv
Imelda Tarpin Lessor	Taft (Pob.), Surigao City, Surigao Del Norte	DTI-Registered	Barangay
Impress Tarpaulin Printing	Poblacion, Calumpit, Bulacan	DTI-Registered	Barangay
Inkpression Tarpaulin Printing	General Santos City, South Cotabato	DTI-Registered	CityProv
Isurf Graphics Design And Tarpaulin Printing	Iligan City, Lanao Del Norte	DTI-Registered	CityProv
J.Ybitte Tarpaulin Printing	Barangay 21-C (Pob.), Davao City, Davao Del Sur	DTI-Registered	Barangay
Jaybeez Tarpaulin Printing And Copy Center	General Santos City, South Cotabato	DTI-Registered	CityProv
Jedd's Business Center And Tarpaulin Printing	Barangay 5 (Pob.), Balingasag, Misamis Oriental	DTI-Registered	Barangay
Jian C Photography Tarp. & Framing Services	Kansi, Tuburan, Cebu	DTI-Registered	Barangay
Jj Jassy-Jash Tarpaulin Printing	Bago Gallera, Davao City, Davao Del Sur	DTI-Registered	Barangay
Jm Marketing Tarpaulin & Upholstery Supply	Poblacion, Valencia City, Bukidnon	DTI-Registered	Barangay
Jmg Tarpaulin Shop	Muzon, San Jose Del Monte City, Bulacan	DTI-Registered	Barangay
Jobdone Photo, Tarpaulin & T-Shirt Design Services	Caloocan City, NCR, Third District	DTI-Registered	CityProv
Joel Tarpaulin	San Jose Del Monte City, Bulacan	DTI-Registered	CityProv
Jps Tarpaulin Printing	Almendras (Pob.), Padada, Davao Del Sur	DTI-Registered	Barangay
Jtps Tarpaulin Printing Hauz	Jones, Isabela	DTI-Registered	CityProv
Junrose Tarps & Stickers Trading	Cebu City, Cebu	DTI-Registered	CityProv

Business Name	Business Address	Status	Business Scope
Kaydian Tarpaulin Printing	Project 6, Quezon City, NCR, Second District	DTI-Registered	Barangay
Keijay Tarpaulin Printing	642 Pag-Asa Street, Gagalangin,, N/A, Tondo I/li, NCR, City Of Manila, First District	DTI-Registered	
Kim Micah's Tarpaulin Printing, Party Needs And Souvenirs	General Tinio (Papaya), Nueva Ecija	DTI-Registered	CityProv
Kleir Tarpaulin Printing		DTI-Registered	National
KnI Tarpaulin Printing	Puerto Galera, Oriental Mindoro	DTI-Registered	CityProv
KnI Tarpaulin Printing	Puerto Galera, Oriental Mindoro	DTI-Registered	CityProv
Krs Tarpaulin Printing	Porac, Pampanga	DTI-Registered	CityProv
Kukuy's Balloons And Tarpaulin Printing		DTI-Registered	Regional
Kyle Tarpaulin Printing	North Bay Blvd., South, Navotas City, Ncr, Third District	DTI-Registered	Barangay
Kyle's Digital Photo & Tarpaulin Printing	Taguig City, NCR, Fourth District	DTI-Registered	CityProv
L And B Tarpaulin Printing	Santo Niño (Pob.), Guagua, Pampanga	DTI-Registered	Barangay
L' Angel Tarpaulin Printing And Internet Cafe	Batac City, Ilocos Norte	DTI-Registered	CityProv
Lady Dianne Tarpaulin And Digital Printing	Pahinga Norte, Candelaria, Quezon	DTI-Registered	Barangay
Lady Dianne Tarpaulin Printing Center And Photo Imaging	Candelaria, Quezon	DTI-Registered	CityProv
Leni's Tarp Zone	Sindangan, Zamboanga Del Norte	DTI-Registered	CityProv
Leo Paulo Mimeographing Tarpaulin And Printing Services	Davao City, Davao Del Sur	DTI-Registered	CityProv
Lipeño Tarpaulin Printing	Lipa City, Batangas	DTI-Registered	CityProv
Lm Tarpaulin Printing	Poblacion (Sambulawan), President Quirino,	DTI-Registered	Barangay

Business Name	Business Address	Status	Business Scope
	SULTAN KUDARAT		
Louarc Tarpaulin Printing	Zaragoza, Nueva Ecija	DTI-Registered	CityProv
M. B. A. Solution Tarpaulin Printing	Malolos City, Bulacan	DTI-Registered	CityProv
M.E.C.T. Tarps R Us Printing Services	Barangay 1 (Pob.), Calamba City, Laguna	DTI-Registered	Barangay
Magictools Tarpaulin Printing	Tondo I/li, NCR, City Of Manila, First District	DTI-Registered	CityProv
Mam Tarpaulin Printing, Advertizing And Merchandizing	Paciano Rizal, Calamba City, Laguna	DTI-Registered	Barangay
Marian & Ian Tarpaulin Shop	San Juan, Cainta, Rizal	DTI-Registered	Barangay
Max Tarpaulin Printing	Digos City, Davao Del Sur	DTI-Registered	CityProv
Maya Tarpaulin Printing	Malabang, Lanao Del Sur	DTI-Registered	CityProv
Mc Tarpugraphics And General Merchandise	Poblacion, Alaminos City, Pangasinan	DTI-Registered	Barangay
Mcav Tarpaulin Printing Services	Mandaue City, Cebu	DTI-Registered	CityProv
Mci-Zaki's Tarpaulin Printing	Bangon, Marawi City, Lanao Del Sur	DTI-Registered	Barangay
Mega Tarp Co. Inc.		SEC-Registered	
Meganz Box Tarpaulin Printing Services	Pinagbuhatan, Pasig City, NCR, Second District	DTI-Registered	Barangay
Mf Tarp Ads		DTI-Registered	Regional
Mogar Tarpaulin And Upholstery Supply	# 676 Gandara Street, N/A, Binondo, NCR, City Of Manila, First District	DTI-Registered	
Mommy J Tarpaulin Printing	Poblacion, Malita, Davao Del Sur	DTI-Registered	Barangay
Mr. Tarp Computer Services	Poblacion Barangay 3, Lipa City, Batangas	DTI-Registered	Barangay
Mrc Tarpaulin Printing Services	Antipolo City, Rizal	DTI-Registered	CityProv
Multimediatarps Technologies Inc.		SEC-Registered	

Business Name	Business Address	Status	Business Scope
My Awesome Tarpaulin & Billboard Advertising	National Highway,, Barangay Poblacion 8, Midsayap, North Cotabato	DTI-Registered	
Naflor Tarpaulin Printing	Longos, Malabon City, NCR, Third District	DTI-Registered	Barangay
Natural Image Tarpaulin Graphic And Signs		DTI-Registered	Regional
Nelyn's Tarpaulin Printing	Sampaloc, Apalit, Pampanga	DTI-Registered	Barangay
New Amazing U Tarpauline Printing	Lipa City, Batangas	DTI-Registered	CityProv
New Generation B-Art Tarpaulin Printing Services	Iloilo City, Iloilo	DTI-Registered	CityProv
Okey Tarpaulin Solutions And Gen. Mdse.		DTI-Registered	Regional
P-F Internet Cafe And Tarpaulin Printing	Poblacion, Lingayen (Capital), Pangasinan	DTI-Registered	Barangay
Passover Computer Shop And Tarpaulin Printing	Lucena City, Quezon	DTI-Registered	CityProv
Pgv Tarpaulin Printing	Magsaysay, San Pedro, Laguna	DTI-Registered	Barangay
Philtarp Corporation		SEC-Registered	
Pixels Tarpaulin Printing	Lipa City, Batangas	DTI-Registered	CityProv
Pluto Tarpaulin Printing Services	Coron, Palawan	DTI-Registered	CityProv
Power Ink Tarpaulin Printing	Cabanatuan City, Nueva Ecija	DTI-Registered	CityProv
Powertarps Printing Services	Dasmariñas, Cavite	DTI-Registered	CityProv
Print Master Printing Solutions Tarpaulin Printing & Copy Center Co.		SEC-Registered	

Business Name	Business Address	Status	Business Scope
Print Space Tarpaulin Printing	Poblacion, San Antonio, Nueva Ecija	DTI-Registered	Barangay
Printek Tarpaulin Printing	Poblacion, Lingayen (Capital), Pangasinan	DTI-Registered	Barangay
Printing Frenzy Tarpaulin Printing	Tugatog, Orani, Bataan	DTI-Registered	Barangay
Prints Scheme Tarpaulin Shop	Cainta, Rizal	DTI-Registered	CityProv
Printwerkz Tarpaulin & Stickers	Tagum City, Davao Del Norte	DTI-Registered	CityProv
Q8 Tarpaulin Printing Center	Angeles City, Pampanga	DTI-Registered	CityProv
Q8 Tarpuline Printing Center	Angeles City, Pampanga	DTI-Registered	CityProv
Quantum Graphics Tarpaulin Printing	Poblacion Barangay 6, Tanauan City, Batangas	DTI-Registered	Barangay
R. Molina's Tarpaulin Printing	Bugallon-Posadas Street (Pob.), San Carlos City, Pangasinan	DTI-Registered	Barangay
R.D.M. Tarpaulin Installation & Marketing Services	Turac, San Carlos City, Pangasinan	DTI-Registered	Barangay
R.G. Sanchez		DTI-Registered	Regional
Tarpaulin Printing And General Merchandise			
R.N. Grafix Ads Tarpaulin Shop	North Poblacion, Masinloc, Zambales	DTI-Registered	Barangay
Rancho Tarpaulin Printing	Malabang, Lanao Del Sur	DTI-Registered	CityProv
Reans-Yllers Tarpaulin, Photocopying & T-Shirt Printing	San Jose (Pob.), Concepcion, Tarlac	DTI-Registered	Barangay
Reinier's Tarpaulin Printing	Marikina City, NCR, Second District	DTI-Registered	CityProv
Rkb Tarpaulin Printing Services	Liloy, Zamboanga Del Norte	DTI-Registered	CityProv
Rolet's Photo Studio	Libertad (Pob.), Surallah, South Cotabato	DTI-Registered	Barangay

Business Name	Business Address	Status	Business Scope
& Tarpaulin Printing			
Rolet'z Digital Studio & Tarpaulin Printing	Surallah, South Cotabato	DTI-Registered	CityProv
Roma Express Tarpaulin Printing		DTI-Registered	National
Rule Now Create Tarpaulin Printing		DTI-Registered	Regional
Sam Net Cafe & Tarpaulin Printing	North Fairview, Quezon City, NCR, Second District	DTI-Registered	Barangay
San Felipe Tarpaulin Printing And Services	Rosete (Pob.), San Felipe, Zambales	DTI-Registered	Barangay
Sign Up Tarpaulin Express	Cagayan De Oro City, Misamis Oriental	DTI-Registered	CityProv
Skyprint Tarpauline Printing	Bulaon, San Fernando City (Capital), Pampanga	DTI-Registered	Barangay
Starlyn Tarpaulin Shop	Nabua, Camarines Sur	DTI-Registered	CityProv
Starp Entertainment Club & Restaurant	22 Avenue Bonifacio Global City, N/A, Taguig City, NCR, Fourth District	DTI-Registered	National
Starp Trading & Dev. Corp.		SEC-Registered	
Starpape General Merchandise		DTI-Registered	National
Starpape Internet Cafe	Guinobatan, Albay	DTI-Registered	CityProv
Starpaholic Enterprises Inc.		SEC-Registered	
Starpath Trading Corporation		SEC-Registered	
Starpayt's Coffee Shop And Catering Services	Sagñay, Camarines Sur	DTI-Registered	CityProv
Starpeak Boutique	Dalaguete, Cebu	DTI-Registered	CityProv
Starpeak Gas Corporation		SEC-Registered	
Starpeak Ticketing And Allied Services	Argao, Cebu	DTI-Registered	CityProv
Starpel Inc.		SEC-Registered	

Business Name	Business Address	Status	Business Scope
Starpel Taxi	2315 Rubi 804 San Andres Bukid, Santa Ana, NCR, City of Manila, First District	DTI-Registered	CityProv
Starpharm, Inc.		SEC-Registered	
Starphil Mfg. Corp.		SEC-Registered	
Starphil Universal Trading Co., Inc.		SEC-Registered	
Starphone Cellphone Center	Quezon City, NCR, Second District	DTI-Registered	CityProv
Starphy Auto Service Center And General Merchandising	Daet (Capital), Camarines Norte	DTI-Registered	CityProv
Starpines Minimart	Baguio City, Benguet	DTI-Registered	CityProv
Starpioneer Industrial Supply	Quezon City, NCR, Second District	DTI-Registered	CityProv
Starplanet General Merchandise	Santolan, Pasig City, NCR, Second District	DTI-Registered	Barangay
Starplast Enterprises	San Nicolas, NCR, City Of Manila, First District	DTI-Registered	CityProv
Starplates Co.		SEC-Registered	
Starplus Arcade		DTI-Registered	Regional
Starplus Enterprise	Taguig City, NCR, Fourth District	DTI-Registered	CityProv
Starplus Land Progress Inc.		SEC-Registered	
Starplus Marketing	Davao City, Davao Del Sur	DTI-Registered	CityProv
Starplus Plastic Printing Services		DTI-Registered	National
Starplus Trading	Centro Norte (Pob.), Pandan, Antique	DTI-Registered	Barangay
Starpoint Advertising	General Santos City, South Cotabato	DTI-Registered	CityProv
Starpoint Agricultural Association Inc.		SEC-Registered	
Starpoint Assets & Resources Dev. Corp.		SEC-Registered	
Starpoint Glass And Aluminum Enterprise		DTI-Registered	Regional
Starpoint Ktv & Restaurant	G/F 5 Imperial St., Cubao, E. Rodriguez, Quezon City, NCR, Second District	DTI-Registered	National
Starpoint Marketing, Inc.		SEC-Registered	
Starpons Enterprises	Poblacion, Valencia City, Bukidnon	DTI-Registered	Barangay

Business Name	Business Address	Status	Business Scope
Starpop Pet Salon	Makati City, NCR, Fourth District	DTI-Registered	CityProv
Starport Shipping		SEC-Registered	
Crewing Inc.			
Starport Trading Corporation		SEC-Registered	
Starportal Entertainment Productions		DTI-Registered	Regional
Starpower Marketing & Services, Inc.		SEC-Registered	
Starpower Mrktg., Inc.		SEC-Registered	
Starprawns Suka At Toyo	Namuco, Rosario, Batangas	DTI-Registered	Barangay
Starpress Tarpaulin And Printing Press	Molino Iii, Bacoor, Cavite	DTI-Registered	Barangay
Starprint Publication Inc.		SEC-Registered	
Starprint Publishing House	Peñafrancia, Naga City, Camarines Sur	DTI-Registered	Barangay
Starpro Foods Inc.		SEC-Registered	
Starproperties (Spv-Amc) Philippines Inc.		SEC-Registered	
Startarps Kaptains Upholstery	Taytay, Rizal	DTI-Registered	CityProv
Summitville Tarpaulin Printing And Signage Maker	Muntinlupa City, NCR, Fourth District	DTI-Registered	CityProv
Super Tarpaulin Printing Services		DTI-Registered	Regional
Sure Print.Com Tarpaulin Co.		SEC-Registered	
Talisay Tarpaulin And Graphics Services	Tabunoc, Talisay City, Cebu	DTI-Registered	Barangay
Target Audience Rating Poll System (Tarps) Inc.		SEC-Registered	
Tarp Attack		DTI-Registered	CityProv

Business Name	Business Address	Status	Business Scope
Advertising			
Tarp Ink Enterprises		DTI-Registered	National
Tarp King Printing Shop	Poblacion, Alaminos City, Pangasinan	DTI-Registered	Barangay
Tarp Matters Ads And Services	Cagayan De Oro City, Misamis Oriental	DTI-Registered	CityProv
Tarp Mo Print Ko Atbp.	San Fernando City (Capital), La Union	DTI-Registered	CityProv
Tarp Pro Advertising	G/F Metz Arcade, Capt. V. Roa Ext.- J. Agudo STS.,, BARANGAY 24 (POB.), CAGAYAN DE ORO CITY, MISAMIS ORIENTAL	DTI-Registered	
Tarpan Concrete	San Antonio, Agoo, La Union	DTI-Registered	
Products			
Tarpauline Ni Paopao	4405 Old Sta. Mesa St., N/A, Sta. Mesa, Ncr, City OF MANILA, FIRST DISTRICT	DTI-Registered	
Tarpaulintech Printing Services And General Merchandise	Diversion, San Leonardo, Nueva Ecija	DTI-Registered	Barangay
Tarpaulintech Printng Services	Diversion, San Leonardo, Nueva Ecija	DTI-Registered	Barangay
Tarpulous Enterprise	Barangay 404, Sampaloc, NCR, City Of Manila, FIRST DISTRICT	DTI-Registered	Barangay
Tarhouse Marketing	Quezon City, Ncr, Second District	DTI-Registered	CityProv
Tarpin Cars Exchange	Bauan, Batangas	DTI-Registered	CityProv
Tarpman Enterprises	Pogo Grande, Dagupan City, Pangasinan	DTI-Registered	Barangay
Tarpman General Merchandise	Sampaloc, NCR, City Of Manila, First District	DTI-Registered	CityProv
Tarpmania Printing Services	Quezon City, NCR, Second District	DTI-Registered	CityProv
Tarpmate Printing Services	Maramag, Bukidnon	DTI-Registered	CityProv
Tarpograpix Limited Co.		SEC-Registered	
Tarpolinan Ni Bupin	Santa Rosa City, Laguna	DTI-Registered	CityProv
Tarpomart Sales	#672 Gandara St., Barangay 290, Binondo, NCR, City Ff Manila, First District	DTI-Registered	
Tarporter Printcut Services	San Bartolome, Quezon City, NCR, Second District	DTI-Registered	Barangay

Business Name	Business Address	Status	Business Scope
Tarppy's Enterprises	Barangay 175, Tondo I/li, NCR, City Of Manila, First District	DTI-Registered	Barangay
Tarprintas Printing Services	Pasay City, NCR, Fourth District	DTI-Registered	CityProv
Tarps Turfs Print Services	Antipolo City, Rizal	DTI-Registered	CityProv
Tarptec Print Services	Poblacion, Lingayen (Capital), Pangasinan	DTI-Registered	Barangay
Tarpy's Catering Services	Tondo I/li, NCR, City Of Manila, First District	DTI-Registered	CityProv
Tarpzone I Advertising		DTI-Registered	National
Tec Tarpauline Express Centre	Cordon, Isabela	DTI-Registered	CityProv
The Original Neighborhood Assn. Of Tarpoint (Tonat) Inc.		SEC-Registered	
Theanbel's Tarpaulin Printing	Cambaog, Bustos, Bulacan	DTI-Registered	Barangay
Three Printcess Tarpauline Printing	Taal, Batangas	DTI-Registered	CityProv
Three Printcesses	Taal, Batangas	DTI-Registered	CityProv
Tarpaulin Printing			
Tnt Tarpaulin Printing	Santa Ana, NCR, City Of Manila, First District	DTI-Registered	CityProv
Twinny Arts Tarpaulin Shop	Poblacion, Shariff Aguak (Maganoy) (Capital), Maguindanao	DTI-Registered	
Unitarp Enterprise		DTI-Registered	Regional
Ven And Iris Tarpaulin Printing	Marikina City, NCR, Second District	DTI-Registered	CityProv
Warpie Tarpie Ads & Signs	Kabankalan City, Negros Occidental	DTI-Registered	CityProv
Wellmade Graphics Copy Center Tarpaulin Printing Services	Fairview, Quezon City, NCR, Second District	DTI-Registered	Barangay
Wink Of An Ink Tarpaulin Printing	Parañaque City, NCR, Fourth District	DTI-Registered	CityProv
Yajd's Fotoshop And	Poblacion, Malita, Davao Del Sur	DTI-Registered	Barangay

Business Name	Business Address	Status	Business Scope
Tarpaulin Printing			
Zale Tarpaulin Printing	Makati City, NCR, Fourth District	DTI-Registered	CityProv
Zealous Starprint & Trading	Muntinlupa City, NCR, Fourth District	DTI-Registered	CityProv
Zen's Tarpaulin Digital Arts	Poblacion, Mangaldan, Pangasinan	DTI-Registered	Barangay
Zendnet Internet Cafe Tarpaulin And T Shirt Printing	Barangay Zone Iv (Pob.), Zamboanga City, Zamboanga Del Sur	DTI-Registered	Barangay