INDIGENOUS PEST AND DISEASE CONTROL METHODS USED IN CROP & LIVESTOCK PRODUCTION IN THE SEKHUKHUNE DISTRICT

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ABSTRACT

The report is a product of the research conducted with the communities in Diphagane, Ga-Mashabela and Ga-Phaahla in Sekhukhune District of Limpopo, South Africa, to investigate Indigenous Knowledge Systems (IKS) for the control of pests and diseases. The fundamental issue is that the current use of indigenous plants for indigenous technologies in the villages studied is promising but underexploited or underutilized in research and eventually by the communities themselves.

The study reported on was conducted against the backdrop of international, regional and national discussions over the decline of biological diversity. Biological diversity, encompass all species of plants, animals, and microorganisms; variability within these and the ecological processes that form and sustain them. Agriculture has been identified as one of the three pillars of economic development strategy for the Limpopo Province. According to Oni *et al* (2004), there is a need to identify strategic interventions required from government in areas of competitive advantage to stimulate the agricultural and rural economy, especially to commercialize the smallholder agriculture. The study used Agricultural Research for Development (ARD), a multi-stakeholder approach to solving complex agricultural problems. Conducting strategic development in an ARD context helps one to consider options most likely to result in a desirable future situation. In this study, strategies were determined by what was learnt through engaging with stakeholders during the data gathering process.

The Diphagane project was used as the main focus of the study, with the two other villages serving comparative analysis purposes. The project's mission is to provide an attractive range of bio- products for diverse pests and diseases, conservation of indigenous plants used and minimizing the use of chemicals in production.

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EXECUTIVE SUMMARY

The study took place in the mountainous areas of Kgosi Sekhukhune in the Greater Sekhukhune District of Limpopo province where the Indigenous Knowledge System (IKS) team consisting of seven members of varying expertise, researched the management of pests and diseases using indigenous knowledge technologies. For these indigenous technologies (ITs) to be used in pest management they had to be identified and documented. The process of identification and documentation was done with three different communities; Ga-Mashabela, Ga-Phaahla and Diphagane. The Diphagane project isolated an indigenous technology, a biological pesticide synthesized to control pests and diseases of vegetable and livestock. Verification of the information about this IT, assisted in identifying the originality of this IK technology and others used for the purpose of benefit sharing and transparency. The project is driven by two main themes, synthesis and production of the biological pesticide and the sustainable harvesting of indigenous plants. The project services and products include: a) promotion of indigenous technologies, b) synthesis of biological pesticides using indigenous plant materials, c) sustainable harvesting of indigenous plants and, d) vegetable production using organic methods.

The IKS developed and maintained by South Africa's indigenous peoples pervades the lives and the belief systems of a large proportion of the country's population. Such indigenous knowledge manifests itself in areas ranging from cultural and religious ceremonies to agricultural practices and health interventions. The value of indigenous knowledge has gained significant ground in SA over the past few years, yet the capacity of available resources and technologies to satisfy the demands of the growing population for food and other agricultural commodities remains uncertain. Agriculture has to meet this challenge, mainly by increasing production on land already in use and by avoiding further encroachment on land that is only marginally suitable for cultivation. For sustainable development to prosper, ecosystems need to be maintained, enabling resources to provide communities with economic returns and making the IKS field more attractive, rewarding efforts of managing natural resources well. There is also an apparent lack of interest by the communities in the study areas, regarding the use of indigenous technologies for managing disease and pests outbreaks in crops and livestock.

The study used Agricultural Research for Development (ARD), a multi-stakeholder approach to solving complex agricultural problems. The approach guided the team in the exploration of ideas on how best to approach this challenge in Sekhukhune district. It should be noted that the ARD approach is not a panacea for all development problems, but it can be used to address specific problems that are complex in nature and as such cannot be solved by a single line function or stakeholder alone. The research process entailed joint analysis with all stakeholders concerned, including the communities, to the identification of strategies required to improve the situation. Conducting strategy development in the ARD context facilitates the evaluation of options most likely to result in a desirable future situation. In this study, the strategies were influenced by engagement with stakeholders during the data gathering process. Planning was done prior to the field research where the research team practically engaged the communities on issues and concepts which concern them. Community visits were undertaken to explore the importance of IKS in agriculture and the possible economic returns.

Informal discussions and semi-structured interviews were conducted with the communities to exchange information on ITs used in IKS. Communities were visited to verify the technologies identified so that ownership is known and acknowledged by other community members. When communities have common understanding about identification of indigenous technologies and what they stand for, further development and processing of these technologies can then be done. For such development to succeed communities needed to take into cognizance other factors, which might hinder development such as the role and importance of biodiversity, diverse stakeholders and school of thought within the IKS and the usage of indigenous medicinal plants for producing indigenous technologies which are used in agriculture. The driving forces dictate

the occurrence of the development and whether there are mitigating factors towards challenges. A common understanding of what are the issues and how then can be addressed is needed amongst different stakeholders. The availability of natural resources such as plants, water and land for cultivation, conserving and harvesting, is of critical importance. A separate cultivation site (gene bank) was proposed for mass production of identified plants. This site should be suitable for the development of the plants before a project could be started.

The investigation into IKS in the three villages helped identify what needs to be done in order for the communities concerned to, effectively benefit from the richness of ITs. The strategies proposed to improve utilization of ITs are; commercialization of the Diphagane bio-pesticide, creating awareness of the value of indigenous technologies, improved understanding of policies and regulations governing IKS, developing a database of IKS, improved use of indigenous methods and systems by concerned communities, mainstreaming and institutionalizing IKS,. Since the communities are aware of the technologies and innovations, existing knowledge should be shared amongst all and protected.

Recommendations made include conserving indigenous plants in the wild, where collectors and users need to harvest plants sustainably and have *in-situ* conservation site and gene bank for these plants. Further research on the plants used for producing biological pesticides is needed for commercialization purpose.

CHAPTER 1 INTRODUCTION

1.1 Background

A study was undertaken at three villages in the Greater Sekhukhune District (Diphagane, Ga-Phahla and Ga-Mashabela) to investigate Indigenous Knowledge Systems (IKS) for the control of pest and diseases. Indigenous knowledge also refers to the knowledge base acquired by indigenous peoples over many centuries through direct contact with the environment. It includes an in-depth and detailed knowledge of plants, animals, and natural phenomena, the development and use of appropriate technologies for hunting, fishing and farming, and a holistic knowledge, or "world view" which parallels the scientific discipline of ecology (Bourque *et al*., 1993).

In many communities women are the primary natural resource managers, and they possess profound knowledge of the environment. Women also play a crucial role in maintaining livelihoods, cultural continuity and community cohesion. Much of their activities are conducted in a manner that utilizes indigenous means.

Creation of incentive mechanisms needs to be a cornerstone of a South African IKS policy. Such a policy should highlight protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio-prospecting involving indigenous biological resources. For sustainable development to prosper, ecosystems need to be maintained for continued function over the long term, enabling resources to provide communities with economic returns and making the IKS field more attractive, rewarding efforts of managing natural resources well. Communities residing in areas well endowed with indigenous resources should be involved in planning and implementation of potentially beneficial activities, for these interventions to succeed. Community involvement ensures and promotes the integration of local interest and the development of project goals, stimulates greater acceptance of control mechanism through increased ownership.

1.2 Study Context

The study was conducted against the backdrop of international, regional and national concerns over the decline of biological diversity. Biological diversity, encompass all species of plants, animals, and microorganisms; the genetic variability within these species, and the ecosystems and ecological processes that form and sustain them (Pagiola *et al.,* 1998). Agricultural biodiversity is a term which has come into wide use in recent years. It described the genetics variety in the ecosystem and cultural diversity used by people in agricultural production of food, fodder, fiber, fuel and pharmaceuticals. Wild biodiversity is considered to be a component of agricultural biodiversity and consists of non-domesticated resources within systems, such as grazing lands. The importance of maintaining agricultural and wild biodiversity lies in the preservation of genetic diversity, which becomes eroded in the mass-scale production of genetically uniform crops for commercial use (Fox, W and Van Rooyen, E. 2004).

The Sekhukhune land region is rich in *ultramafic*-induced endemic plant species (Siebert, 1998), which makes it a treasure house for biodiversity. Unfortunately, the substrate to which these plants are restricted is being used for mining. At present mining activities occupies approximately 15% of Sekhukhune land, causing some endemic species to be threatened with extinction. There is the risk of over-utilizing (whether through overgrazing, mismanagement, increased cropping, mining etc.) these systems to the extent that the provision of these natural products and services becomes compromised (Victor. J *et.al.,* 2005).

Rajasekaran (1993) indicates that to incorporate IKS into development R&D ought to build on local people's knowledge, introduce interdisciplinary research teams, and offer technological

options and not technical packages. Scenario planning was used in this study to involve local people to determine future plans, as a tool for planning creatively for the future.

1.2.1 Rationale of the Study

Some small scale farmers are relying on Indigenous Pest Management practices, even though many government extension programs encourage the use of pesticides, synthetic herbicides and other chemical means. Whilst this is commendable, there is a general lack of biological and ecological information (Abete, Huis, and Ampofu, 2000). According to the LDA, (verbal communication, 2007) communities in the three villages do not realize the value of their knowledge and the extent to which this information can benefit them, for example by generating income from it and by using policies to gain benefit from knowledge sharing. However, increasing demands for indigenous plants by users such as traditional healers results in over-harvesting and the risk of extinction or endangerment.

The community members of the study villages are used to government and other agencies telling them how to do things (technical packages) instead of being actively involved in the processes which affect them. This study used a different approach.

An important constraint identified during this study is that indigenous knowledge systems are not recorded and are communicated orally. Most communities pass on all knowledge, history and cultural aspects of their lives through oral means (Rajasekaran, 1993), and it was not until recently that these phenomena were recorded. There is no database, detailing the origin of each technology or innovation available. There also appears to be a limited knowledge witin the community in terms of crop and disease management through the use of indigenous means.

The study also identified the kind of linkages and partnerships needed in the province to advance agriculture (Oni *et. al.* 2004). In achieving this, the LDA embraces collaborative relations with other stakeholders. This led to the formation of the ARD Limpopo Hub, an inter-institutional body of stakeholders collaborating in agricultural research for development. The hub consists of the Agricultural Research Council's Technology Transfer Academy (ATTA) and ARC institutes, the Universities of Venda and Limpopo and the Limpopo Department of Agriculture (LDA). The major focus of the ARD-hub was to address research and development issues and priorities.

The development of the Terms of Reference (ToR) by a hub theme group for Indigenous Knowledge System (IKS) was key in guiding the study on Indigenous Pest and Disease Management using Indigenous Technologies in livestock and crop production. This study also aligns with the international call to reduce chemical use harmful to the environment. Pollution and global environmental change also threaten the world's biodiversity. The use of natural and alternative means for pest and disease control is therefore clearly a priority R&D issue.

1.2.2 Study Objectives

- To identify and document indigenous technologies currently in use
- To share the collected information with the communities for increased awareness
- To identify research and development options required to resolve the problems identified
- To design business plans for chosen options

1.2.3 Hypothesis

The indigenous technologies currently used in small scale farming could be used more widely and effectively for greater benefit of all surrounding communities and could be commercialized to provide an income source for these local communities.

1.2.4 Provincial Management and Mandate for IKS

The study was managed by the LDA-IKS division, whose responsibilities are outlined below. The LDA has established a special division to take responsibilities of Indigenous Knowledge Research and Innovation. The division is responsible for the development of research policies, strategies and systems for Indigenous Knowledge mitigation in all agricultural commodities in the province. As per mandate of the National Department of Agriculture the division seeks to achieve the following:

- Plan and support competency development of technical extension agents and scientists in Indigenous Knowledge research and innovation.

- Manage partnerships with industry, research organizations and academic institutions on Indigenous knowledge related research matters.

- Provide institutional capacity building support for emerging/commercial farmer formations throughout the value chain in Indigenous knowledge.

- Manage the publications and dissemination of research results in Indigenous knowledge related research.

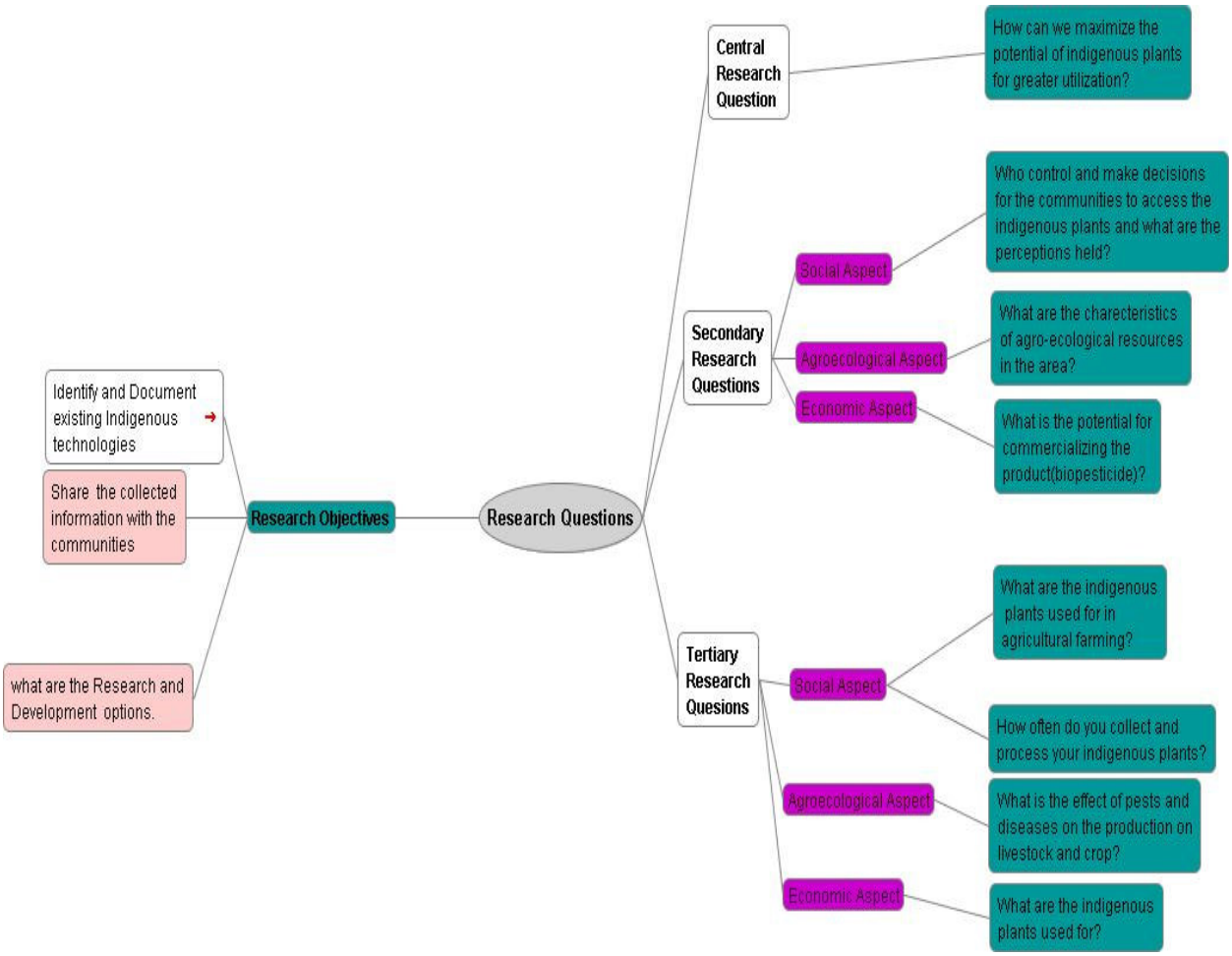
1.2.5 Expected Output of the Study

With the brief background given and the objectives clarified, the expected outputs of the study were to:

- Identify the Indigenous Technologies,
- Establish relevant links with stakeholders for the communities,
- Develop a model to market Indigenous Technologies identified in an economically, ethically, viable and acceptable manner
- Identify measures required to improve the current status of IT use

1.3 Research question

The formulated research question provided the team with a focus point on which to base the study:



1.4 Research Methodology

The study used Agricultural Research for Development (ARD), a multi-stakeholder approach to solving complex agricultural problems. The approach guided the team in the exploration of ideas on how best to approach the challenge in Sekhukhune. In order to enhance the understanding of the problem by all team members, ARD facilitated learning, based on each team member's capabilities. The approach enabled the team to facilitate joint analyses by all stakeholders interested and or affected by the IT issue. When there was common understanding amongst all the stakeholders, after a thorough problem analysis, the team identified the strategies that will help in solving the problem.

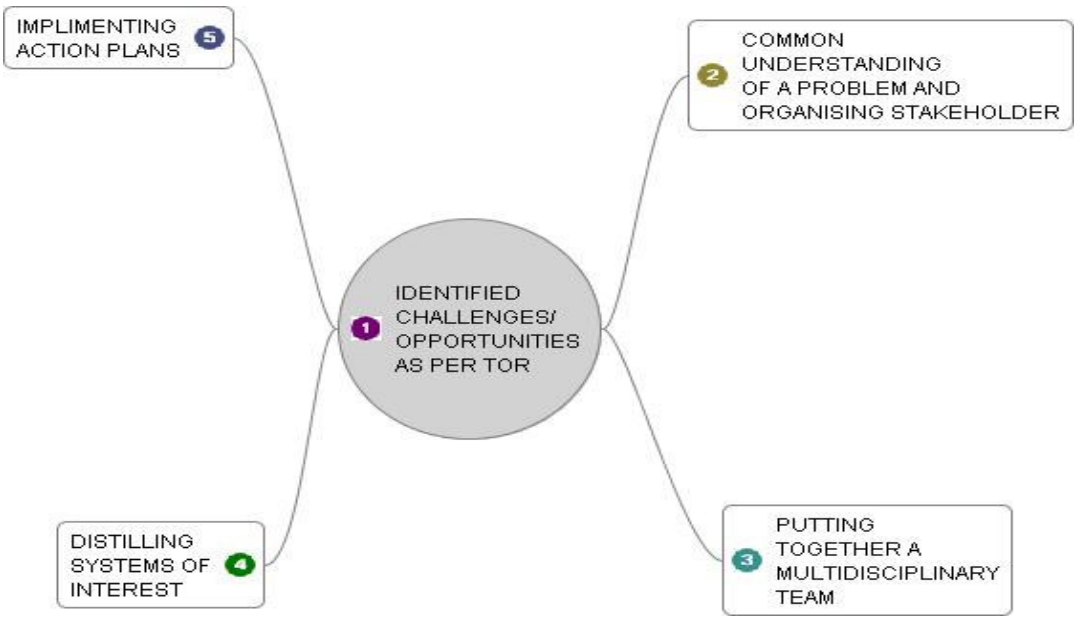


Figure 1: The ARD Procedure and learning cycle

The methodology used in the study, guided the research process; from identifying of issues to drafting an action plan. ARD is not a set of guidelines to be followed in getting certain information, but helps gain knowledge of the underlying concepts. It requires a change in mentality, way of thinking, analyzing situations and interacting with people. A shift from thinking of participation as just a question of consulting beneficiaries, to one of facilitating stakeholder interaction that results in joint analysis and planning, and hence collective action. In this manner, innovation results from action, where a variety of individuals and organizations interact in a complex relationship and according to their interests and opportunities. ARD has evolved from, and continues to be influenced by many other approaches; including Farming Systems Research (FSR), Farmer Participatory Research (FPR), Rapid Appraisal of Agricultural Knowledge Systems (RAAKS), Participatory Rural Appraisal (PRA), Participatory Learning & Action (PLA) and the Sustainable Livelihoods Approach (SLA), (ICRA learning material, 2007). At the end of an ARD research project, a joint action plan where each stakeholders commit themselves to tackle certain portions related to work activities, is developed.

1.4.1 Methods Used in the Research

A number of PRA tools were used to gather the required primary data, guiding dialogue between the team and the stakeholders, including the community. According to Hansen and Sthapit, (2000) development projects are thought to be more successful if the beneficiaries are actively involved, from identification of what the problems are, to joint analysis and to planning. Participation of beneficiaries is thought to enhance the ability of projects to exploit the potentials of indigenous technologies. In the case of research, increased participation of farmers is thought to increase the efficiency of agricultural research activities, in particular reaching poor farmers in marginal areas. The rationale in this context is that science can make its most effective contribution to research and development for the poor when it takes account of and utilizes indigenous knowledge based systems (Hansen and Sthapit, 2000).

1.4.2 Cooperation with Community Institutions

There is a need to understand local norms and processes of decision-making and how changes are negotiated and in particular, how some people may influence outcomes with direct participation. In this manner, local institutions received due consideration. If this is not done, these institutions and systems formalized through external interventions risk becoming empty shells, with important decisions and collective actions taking place elsewhere.

1.4.3 Field Preparatory Phase

Thorough preparation was required before the field study could start. This process took place during the last week of the ARD knowledge acquisition phase on key concepts and skills to conduct such investigations. During the preparatory phase the ARD research team reviewed the original TOR, to reach common understanding amongst all of what the real problem was and what was required of them by the IKS theme group of the ARD Hub. The research and work plans were also developed in this phase illustrating the purpose and expected outputs of the study as well as weekly activity plans.

1.4.4 Reconnaissance Survey

These surveys were conducted in all three communities on different dates to familiarize the team with the study area, to gather first impressions of the agro-ecological features and the farming activities, the type of farmers and livelihoods. The survey was also undertaken to identify challenges faced by the communities, measures to be taken to effect change and mitigate the challenges in these communities. The survey revealed that the three communities are not very different, all having arable land, are close to perennial rivers and lie in a mountainous area. The infrastructure in these communities includes shopping areas, clinics, churches, schools and residential sites.

1.4.5 Introductory Meetings

These meetings helped to gain familiarity and to create a rapport with the communities, with introductions made to the tribal authority (TA). The TA constitutes the highest decision making body in the community. It was therefore prudent to obtain the blessing from these authorities at the outset of this study. It is important to observe this protocol since TA has influence over the communities and the decisions taken by these communities. During the introductions, emphasis was placed on the reasons for the team being in the area, outlining the topic of the study, specifically the study objective and expected outputs.

1.4.6 Feedback Workshop

Two workshops were held during the ARD capacity building programme, on the 18 of June and 03 September 2007. At these events, stakeholders were engaged for their input in the process, sharing views and challenges experienced by the team. The workshops also focused on the way forward in terms of what needs to be done and how it should take shape.

1.4.7 Interviews with Key Informants

Interviews were held at all communities, with knowledgeable people who could refer the team to relevant people who are actively using indigenous technologies, practicing them in agriculture.

This activity also enhanced the knowledge gathered during the survey and gave in-depth understanding of when to target general community members for meetings, to ensure the research activities do not coincide with other engagements.

1.4.8 Meetings with Farmers

Meetings were held in the three villages with farmers. A guideline with questions had been prepared and helped direct the dialogue on the natural resources, access to genetic resources, the reasons for decreasing agricultural activities, and the possible solutions to the problems. The initial responses leaned towards unsustainable harvesting of indigenous plants being a problem.

1.4.9 Focus Group Discussions

Specific meetings were held with interest groups such as livestock farmers or traditional healers to analyze their understanding of indigenous plants used to manage diseases and pest outbreaks in crops and livestock production. A typology of farmers was established at these meetings, where farmers classified themselves and other community members, which ratified the hypothesis and the variables measured during the study.

1.4.10 Stakeholder Workshop

This workshop brought different stakeholders together for formulation of an operational plan with activities for taking IKS issues forward. Key role players were identified to facilitate appropriate follow up. Other important stakeholders were also identified and their interest was mapped compared with others, to provide direction to the study in terms of how the intervention will need to be implemented and who will need to be involved.

1.4.11 Video Recording

A video was taken to show case how the bio-pesticide is produced. The ingredients added and the preparation methods were fully described. Questions of clarity were asked by the team during the discussion, which also described the insect pests and diseases for which the mixture is used**.**

1.4.12 Final Workshop

The aim of the workshop was to give feedback to the LDA and other important stakeholders, e.g. farmers, NGOs, ARC etc. The workshop assisted in finalizing developmental strategies, scenarios, and discussed the institutionalization of IKS and what this would entail.

CHAPTER 2 CONCEPTUALIZING INDIGENOUS KNOWLEDGE SYSTEMS

2.1 Introduction

The three villages, Diphagane, Ga-Phahla and Ga-Mashabela in which the study was undertaken are located north east of Marble Hall in the Makhuduthamaga Local Municipality, of the Sekhukhune District, Limpopo.

2.2 Zonation

Figure 2: Map of municipalities in Sekhukhune District

The population of Sekhukhuneland is mostly rural and is highly reliant on wild plant biodiversity. The grasslands are mostly managed as extensive grazing in a low external input production system. There are four main vegetation types: Sekhukhune Plains Bushveld (Mixed Bushveld), Sekhukhune Mountain Bushveld (Sourish Mixed Bushveld), Sekhukhune Montane Grassland (Bankenveld) and Leolo Summit Sourveld (North-eastern Sandy Highveld) (Acocks 1953). The first two are semi-open woodland with a strong grass component, whereas the latter two are pure grassland. The vegetation is mainly used for grazing and browsing by domestic livestock, primarily cattle and goats, although crops (mainly sorghum) play a very important role in subsistence agricultural production in some areas (Figure 4). The long-term ecological sustainability of these natural ecosystems is therefore critical to the maintenance of livelihoods and for sustaining rural development.

2.2.1 The Importance of Vegetable and Livestock Production

South Africa covers an area of 122.3 million ha of which 14 million ha are under cultivation. Whilst approximately 80% of agricultural land in South Africa is mainly suitable for extensive livestock farming, most cattle are found in the Northern provinces, including Limpopo (ISHS 2007: 2). South Africa is self-sufficient with regard to vegetable production and also exports both fresh and processed vegetables. Cropping practices change continually, incorporating innovations by growers and new technology supplied, but pests and diseases often disrupt successional cropping programmes, reducing yields or decimating crops (Howick, 1984). The province in which this study took place, Limpopo, is divided into four regions and produces 75% of SA's mangos, two thirds of its tomatoes and 285,000 tons of potatoes (SEHD 2007:2).

The establishment of productive enterprises on land reform farms by the Limpopo Department of Agriculture is seen as a viable intervention, benefiting small-scale farmers and semi-commercial (Repot on Limpopo Agricultural Development Programme (LADEP 2002:22). Although, men do control the productive resources in most cases, the results of the LADEP study shows that both men and women have equal access to resources. The food insecurity and vulnerability information management system (FIVIMS) study in Sekhukhune district shows that 22.4% households have access to small plots for cultivating vegetables (FIVIMS 2005: 55). Vegetable production in Sekhukhune district has a long tradition of using local resources and innovative way of controlling pests and diseases (Reijntjes 1994: 195). Reijntjes further state that improving the capacity of farmers to control pests and disease in an ecologically sound way demands a participatory process in which the whole community is involved.

In Sekhukhune only 3 months of real winter weather occurs, with July being the coldest month when temperatures can drop to 7ºC. January is the warmest month during summer and temperatures go as high as 38ºC. Average annual rainfall is around 559mm. Farming is the mainstay of the local economy with virtually all smallholder farmers engaged in subsistence farming that constitutes 70% of the district's farming activities. Commercial farming contributes 30% of the farming activities.

2.2.2 Study villages

Diphagane is a case study area chosen by the Limpopo Department of Agriculture, whilst the other two mentioned areas were chosen to verify the information gathered from Diphagane and to collect additional information on indigenous knowledge technologies which are known to be used. The villages are characterized by climate which is fairly typical of the Savanna Biome, with mean annual rainfall range of 400-600mm and mean annual temperature of 7-38 ℃ (Erasmus 1985). At the Diphagane village, a group of nine women are producing a biological pesticide for the control of pest and diseases in crop and livestock production.

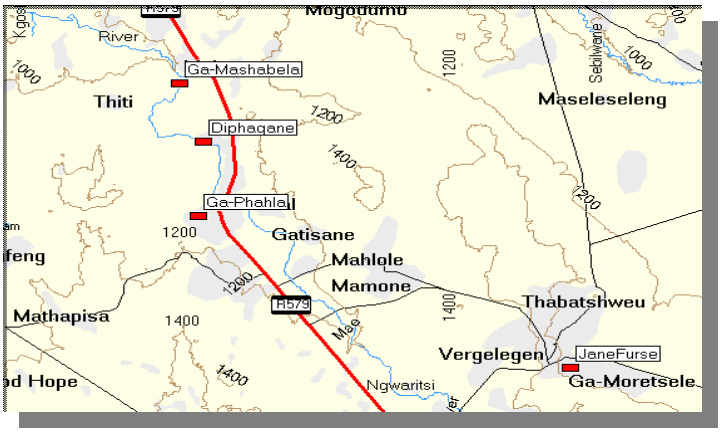


Figure 3: Map of the study sites, Diphagane, Ga- Mashabela, and Ga-Phaahla

2.3 Description of the Diphagane Project

The Diphagane project started in 1993 and is currently composed of nine members producing organically. The group is growing tomatoes, onions, spinach, butternuts, carrots, green beans, and green peppers. Marketing of these vegetables is done locally at pension pay-points. The group won the best female farmer award three times (twice at the district level and once at the Provincial level). The group grows their vegetables organically applying compost, kraal and chicken manure for fertilizing the garden. The group describes their practice as being premised on Indigenous

Knowledge Technologies (IKT) used by local people to solve farming problems related to pests and diseases. The project was established to counter the loss of indigenous knowledge by for instance the demand for food, changing climatic conditions and the loss of production due to pests and disease.

These factors prompted community members to search for alternative products, towards a more sustainable production system by reducing the use of chemicals which are damaging the environment and using indigenous plants in product development.

The bio-pesticide developed by the group is used as a broad spectrum pesticide, and is marketed locally through the umbrella body called Phadima Farmers Association (PFA) to other vegetable producer's in the area. The product is currently being sold at R5.00 per 2 liters.

They link with other farmers through the PFA, comprising of institutions that produce organically and are involved in indigenous seed preservation through a seed bank. The seed bank is for indigenous vegetables and other plants such as sorghum and millet. The project is assisted amongst other by Eco-hope, an NGO providing training, and also by the LDA.

Box1: mixing method of the bio-pesticide
Harvesting of plant material is done sustainable by cutting pieces/parts of the plants and following quadrants method. The plants are grinded whilst still fresh with pistil and mortar to make an extract. They are then placed in 20 litre containers containing hot water. The product is left to brew and used after twenty four hours where there is pest or disease infestation.

2.3.1 The efficacy of the Biological pesticide

The bio- pesticide has been used by other farmers for the control of pests and diseases and they confirm that the product controlled pests and diseases. The plant extracts which are used are safe to the environment, as they are found in their natural state. The product is even safe for human consumption as it is free from toxic chemicals.

2.3.2 Community development

The project takes place at community level; members identified themselves through sharing the same concern. To this end the group is committed to contribute to their community by using the project to educate others. They do this by creating awareness and conservation of the indigenous plants, which can then be used for mass production.

2.3 Typology of Farmers

Definition of Typology

The classification of objects, structures, or specimens by subdividing observed populations into a theoretical sequence or series of groups (types) and subgroups (subtypes) according to consideration of their qualitative, quantitative, morphological, formal, technological, and functional attributes is called a typology. Once established, typological sequences are often used as a surrogate chronology or culture history.

Indigenous technologies for pests and diseases are being used by different community members in agriculture. Using this phenomenon as a base; vegetable farmers (1) use Indigenous technologies to control pests and diseases. Others do not use (2) these technologies at all but, are aware of such technologies especially those that were used in the past. Livestock farmers (3) were categorized as users (3a) and non-users (3b). Traditional health practitioners (THP) (4) also feature in the typology because of their ability to control pests and diseases. The common denominator in all these categories of farmers is that they use or know of indigenous plants in their daily activities for business and medicinal purposes.

Apart from the crop fields that are tilled during summer, people are also engaged in vegetable gardening on smaller pieces of land averaging 3 hectares. They work on the food garden projects all year round and more so during the off-peak farming season when they can cope with the labor demands outside their household fields.

2.5 Elements of the System

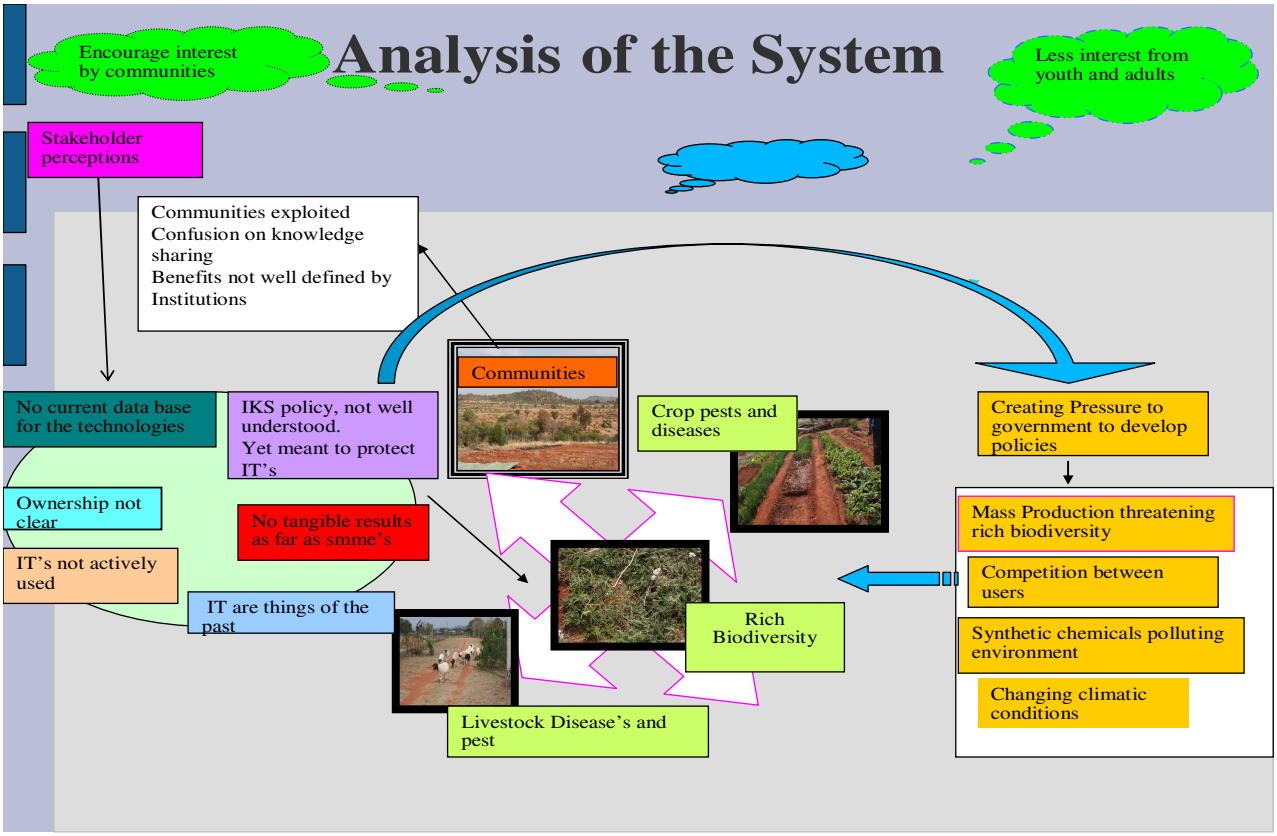


Figure 4: Rich Picture depicting elements of the IKS system

Although the Sekhukhune district is rich in indigenous plants, it is up to each of the stakeholders with interest to ensure that the biodiversity is protected. For communities to benefit from indigenous technologies, they need to protect both the custodians of the indigenous knowledge and the plants themselves. An accommodative stakeholder platform needs to be established in order for all stakeholders' views and concerns to be addressed.

2.6 Literature Review of Indigenous Knowledge

Indigenous knowledge is a critical and substantial aspect of the culture and technology of any society. It is sometimes referred to as folk knowledge, ethno-science or traditional knowledge. Adedipe, Okuneye and Ayinde (2004) and Rajasekaran (1993) defined IK as the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and the development of an intimate understanding of the environment of a given culture. Farmers in all parts of Africa have experience and ingenuity which evolved through many indigenous farming techniques. Farmers have consequently developed the ability to select good agricultural land at sight, devised and adopted ingenious farming methods and strategies for pest control and soil regeneration with a view to boosting agricultural productivity. These indigenous practices have been passed down over countless generations and have stood the

test of time. Modern approaches to agricultural development will continue to fail unless it takes into consideration a society's indigenous skills and knowledge systems. Incorporating indigenous knowledge is promoted as it takes into consideration maintenance of biodiversity concerns.

Many rural people, whether predominantly pastoral or crop-based, deliberately incorporate natural resources into their livelihood strategies (FAO, 1999). Other than the provision of resources, biodiversity may contribute to key ecosystem functions, such as breakdown of organic matter, recycling of nutrients, breakdown of pollutants, maintenance of productive animal populations and the protection of soil and water resources. Ecosystem integrity (i.e. resilience and inertia) is linked to the level of biodiversity (FAO, 1999).

2.6.1 The role of IKS Policies in South Africa

To provide for the management and conservation of South Africa's biodiversity within the legal framework, a number of policies are in place. One of these is the National Environmental Management Act-NEMA, (1998). These policies deal with the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio-prospecting involving indigenous biological resources; and the establishment and functions of a South African National Biodiversity Institute. In South Africa, IKS are owned by and provide services to people who are prone to unemployment.

2.6.2 Interfacing with Other Knowledge Systems

It has been estimated that by consulting indigenous people, bio prospectors can increase the success ratio in trials from one in 10,000 samples to one in two, and that 'traditional' knowledge increases the efficiency of screening plants for medicinal properties by more than 400 percent. Without the input of indigenous knowledge, many valuable medical products used extensively today, would not exist. The individualistic nature of intellectual property regimes creates several complications, when applied to local communities. They fail to take into account the fact that these communities have a holistic approach to their environment and do not separate the resources from which their livelihood stems into distinct economic and social assets.

CHAPTER 3 RESULTS AND DISCUSSION

3.1 Conflicts over Usage

The meeting held at Ga-Mashabela with the Tribal Authority suggested that livestock farmers are not organized as there is no committee in place to effectively manage livestock issues. Livestock farmers believed that livestock health management and production training would help to improve their situation. There was also worry about crime in the area and livestock farmers fearing for their lives.

There was also confusion with the Traditional Health Practitioners (THPs) requiring incentives in order to share their knowledge on pest and disease management. Clarification was given, emphasizing that no one is compelled and the study just aimed to highlight the importance of identifying indigenous technologies. It was understood that the purpose is to ensure that local knowledge is preserved and incentives accrued go to the right people and the communities receive due recognition. The issue of complying with trade secrets should be discussed as one of the institutional requirement for future intervention; otherwise IK holders will not want to open up, fearing that their knowledge may be compromised.

3.2 State of Natural Resources

Diphagane is rich in natural resources. The area is characterized by mountains and a rich biodiversity of indigenous medicinal plants as described in chapter 2. The transect walk revealed that the area below the mountain is comprised of light forest with shrubs and trees. This is immediately bordered by a grazing area, recently been targeted for residential purposes. The arable land below has red sandy loam, which actually runs from up the slope, with clay in the bottom of the valley. A grazing area is allocated to small stock (about 200 goats) and sheep and the rest to large stock.

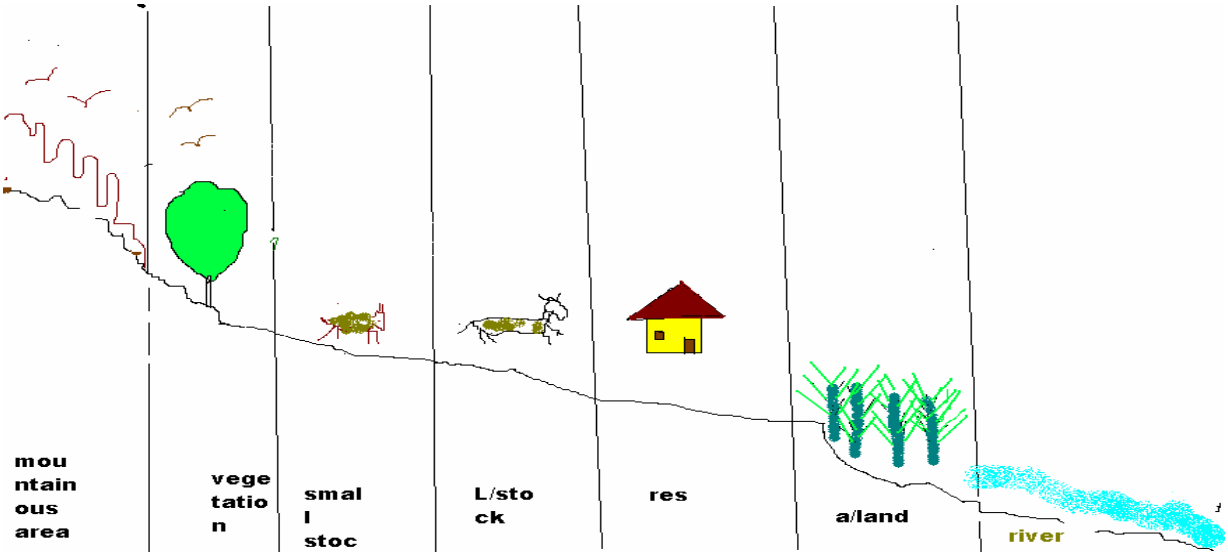


Figure 5: Transect map

In order to commercialize the biological pesticide, the area must have sufficient stock of the relevant indigenous plants, which could be realized through establishment of a gene bank, accessible to the users to sustain the product to harvest.

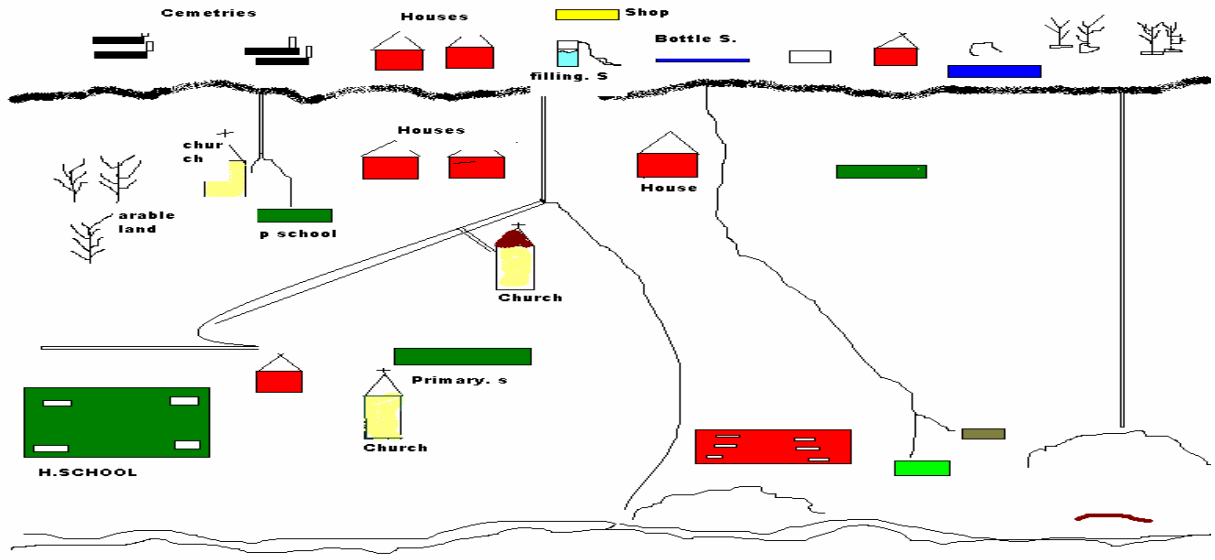


Figure 6: Natural Resource Map

Challenges that are currently faced include population growth demanding residential and business sites, instead of agricultural land. Other resources such as infrastructure are required for the type of project that the Diphagane group is establishing. Currently the tarred road is the one that connects Polokwane and Jane Furse, whilst secondary roads are gravel. The project lacks storage facilities and a transportation system. In Diphagane small livestock is prevalent as it is easily manageable unlike large livestock (cattle) which is regularly stolen. The degrading environment also contributes to a reduction of large livestock, as is drought and changing rain patterns. Farmers are struggling with animal husbandry management, e.g. none of them had branding skills. Currently most livestock was under female control.

Table 1: Livestock Seasonal Calendar for Ga-Mashabela

Month Event	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Vaccination		X							X			
Branding					***	***						
Dipping	^^^	^^^	^^^	^^^	^^^	^^^	^^^	^^^	^^^	^^^	^^^	^^^

3.3 Crop and Livestock Management

Crop and livestock farmers engage in different activities during the year. Commonality arises when these farmers attend their arable land where they have planted millet and sorghum because these are staple food in these communities. It was learnt that these crops requires considerable time for production, even though grown for household consumption (subsistently). It was also established that sorghum and millet are interchanged, with vegetables grown in between the crops. Farmers with high numbers of livestock will hire extra hand to assist when necessary.

3.4 Diphagane Farming Practices

Apart from the cropping fields which are tilled during summer, the members of the Diphagane project are also engaged in vegetable gardening on smaller pieces of land averaging 3 hectares. The women work on the food plots all year round, although more intensively out of season, when labor demands at the cropping fields decrease. The garden plots are located within the community and are donated by the local chief. The vegetables are mainly grown for the local market and for household consumption. The farmers grow different varieties of tomatoes, onion, beetroot, cabbage and Swiss chard, which produces three harvests per year. Many of the plots are fenced, have generator-powered water pumps and irrigation systems and structures to store equipment. With the exception of a few, the plots are the exclusive domain of women who actively manage the projects and provide for their families from it.

CHAPTER 4 BIODIVERSITY ANALYSIS

4.1 Introduction

Expansion and intensification of agriculture contributes to the loss of biodiversity worldwide. As agricultural production continues to rise to meet the growing demands of the world's population it is critical to find ways to minimize conflict and enhance complementarities between agriculture and biodiversity (Pagiola *et al*., 1998). Pollution and global environmental change also threaten the world's biodiversity. Lesser known causes are due to "knock-on" effects. Species that are co-evolved with another, such as plants with specialized insect pollinators, will become extinct if one is lost. Over-harvesting by (illegal) collection, and the systematic cutting of wood for heating purposes, or charcoal production, is another reasons for biodiversity loss. The use of medicinal plants might illustrate this point as some plants face extinction when they are in high demand for medicinal purposes.

4.2 Risks to the Plant Diversity in the Sekhukhune Land Region

The role of biodiversity in agricultural and natural ecosystems is to ensure food security and sustainable agricultural production through direct or indirect provision of food for humans and their livestock, provision of raw materials and services, such as fibre, fuel and pharmaceuticals and the maintenance of ecosystem function. However, there is the risk in over-utilized (whether through overgrazing, mismanagement, increased cropping, mining etc.) systems, compromising provision of these natural products due to unsustainable harvesting (Victor *et.al* 2005)

4.3 Changes in Biodiversity in the Three Villages

To identify specific practices that might have impacted on the status of biodiversity today, the communities were engaged in historical analysis through developing a time line. Historical analyses include detailed accounts of the past, of how things have changed; particularly focussing on relationships and trends in natural resource management, social mobility, health and education etc. In this case, biodiversity was analysed (Woodhill, 2004).

Table 2a: Time Line Diphagane

Year	Events relevant to Biodiversity	Reasons/Causes for Events
1954	High abundance of trees	Virgin land was bushy, many plant species dominated the area, mohlakolane, motaposane mohwelere, morapori, and monare
1964	Inclusion of new plant type	Same species occurred in abundance, with the introduction of sisal
1974	Increase in demand for residential sites	Many indigenous plant species became scare as they were being cut
1984	Increase in demand for residential sites	Plants were still visible, but now occurred at homesteads, being planted
1994	High demand for fire wood	Plants were cut down heavily for firewood and only stems were remaining
2004	Increase in both demand for residential sites and fire wood	Many plants which were present in the 70s had now disappeared i.e. Mohwelere, and motapori are only present in home stead's
2007	Biodiversity completely lost within 5km radius of the residential area, plants available are kept by households	Plants are very far and they are not easily accessible

Table 2b: Historical Time Line for Ga-Mashabela

Year	Historic Events	Reasons and Causes for Events
1970	Drought	Lack of rain and some plants disappeared thereafter
1976	Soweto uprising; riots and Violence	
1980	Mamone war	Neighboring residents migrated to Ga-Mashabela
1986	Nationwide Riots against apartheid	Residents were sleeping in mountains
1990	Drought	Lack of rain, opportunistic diseases and pests attacked what was remaining in the fields
1996	Floods	Too much rain and storms which destroyed resources such as bridges and houses, while arable land was flooded and livestock and plants died and so did people.
2000	Floods	Same devastation mentioned above in 1996
2005	Drought	High mortality rate of livestock
2006	High yield in crop production	Good rains

Table 2c: Historical Time Line Ga-Phaahla

Year	Historic Events	Reasons/Causes for Events
1971	Hunger due to droughts	Led to community using red sorghum as staple meal
1976	Heavy thunderstorms	Destruction (degradation) in arable land
2000	Floods	Too much rain and storms which destroyed resources such as bridges and houses were damaged while arable land was flooded and livestock died and many lives were lost.
2001	Heavy Hail storms	Good rain
2004	High yield of field crops	Resulted into high mosquitoes infestation
2006	Heavy rainfall	

Throughout all the three tables it is evident that the loss of biodiversity is not due to human pressure alone, but that natural disasters also contributed. It is evident that the area had high biodiversity back in the 1950's as compared to decreasing plant species in the 80's and completely decreased in the 90s. However, the availability of plants in less disturbed ecosystems shows that people have a huge impact. Where people reside close to indigenous resources; these plants are scarce due to unsustainable harvesting. Plants are now found far in the wild as compared to early years where they were found in close proximity to homesteads. Climatic changes also contribute towards loss of biodiversity and production from farming arable lands as they lead to communities having to seek alternative sources of food from indigenous plants. This led to people changing to resources they had not used for food before, whilst the reliance on these plant species slowly grew, hugely depleting these plants in their natural state.

Surprisingly, whilst some of these species are identified on the list of major historic events, communities are not taking special measures to conserve these, or promote them as source for food. The history shared during this exercise was not commonly known, and the younger generation appreciated getting this new knowledge.

The benefits of conserving biodiversity often do not accrue to the decision makers on communal resources management. Resources use such as fire wood collection is done primarily by females, whilst male farmers and traditional healers also use the same resources. Communities might be cutting plant species which are valuable to other users without even realizing that their actions are detrimental. It would seem all local land users tend to systematically undervalue the services provided by biodiversity and consequently, practices that reduce biodiversity are common.

4.3 Communal Resource Use

Table 3: Perceptions on Access and Control Profile in Diphagane Village

Resources	Man			Women			Girls			Boys		
Profile	A/C	A	C	A/C	A	C	A/C	A	C	A/C	A	C
Land	♣	♣		♣	♣			♣			♣	
House		♣	♣	♣	♣	♣		♣			♣	
Cash		♣	♣	♣	♣	♣		♣			♣	
Cattle	♣				♣	♣		♣			♣	
Goats	♣		♣	♣	♣			♣			♣	
Sheep	♣				♣						♣	
Poultry		♣		♣		♣	♣	♣	♣		♣	
Pigs				♣		♣	♣		♣			
Vegetables		♣		♣				♣	♣			
Fruit trees		♣		♣			♣					
Wood		♣		♣			♣				♣	
Water		♣		♣			♣				♣	
Education for children		♣		♣				♣			♣	
Agricultural produce for sale		♣		♣								

In Diphagane village each member of the household has responsibilities over different types of resources. Men have both access and control over land and livestock resources, deciding what land can be used for what and which animal to be culled, sold or otherwise. Interestingly, for resources that women has both access and control of, men have only access. An example of this is fruit trees, fire wood, water, and vegetables. Men can use these whenever they require them, whilst women cannot slaughter animals without authorization from men. The roles that are performed by girls are related to those of women. Boys in Diphagane only have access to resources but have no controlling powers over them, as compared to girls who have control over some of the domestic resources.

Table 4: Perceptions on Decision Making Diphagane Project

Activities	Father	Mother	Daughter	Son	Grand Parents
Livestock activities	♣	♣		♣	
Crop related issues		♣			
Cutting fuel wood		♣			
Carrying and collecting fire wood		♣			
Fetching water for the house		♣	♣		
Cleaning the house		♣	♣		
Cooking		♣	♣		
House maintenance	♣	♣		♣	
Shopping	♣	♣			
Education	♣	♣	♣	♣	
Social grant.	♣	♣	♣		♣
Salary	♣	♣			
Other sources of income	♣	♣			

Women are making most of the decisions in the households in Diphagane because most men work in the cities and only come home once or twice a month. Men make decisions on livestock, house maintenance and education of the children. Girls on the other hand are responsible for fetching water, cooking and cleaning the household. Girls are also entitled to decide on their own education, e.g. where they want to study after completing matric. Boys have a say when it comes to livestock related issues and the maintenance of household goods.

CHAPTER 5 IDENTIFICATION OF INDIGENOUS PEST & DISEASE CONTROL METHODS IN CROP AND LIVESTOCK PRODUCTION

5.1 Introduction

Agriculture in the study area is largely traditional-characterized by a large number of smallholdings of no more than one hector per household. Crop production takes place under extremely variable agro-ecological conditions, as a result farmers often select well-adapted, stable crop varieties and cropping systems are such that two or more crops are grown in the same field at the same time. The majority of African farmers still rely on indigenous pest management approaches to manage pest problems, although many government extension programs encourage the use of pesticides. Indigenous pest management knowledge is site-specific and should be the basis for development of integrated pest management (IPM) techniques. Chemical inputs and factory farming became popular in the middle of the last century as a way to maximize crop yields, under the Green Revolution. Today conventional farmers and the world at large, pay the price for these practices, which result in environmental and economic imbalances. While synthetic pesticides may initially hit their targets, over time the substances become less effective and pest populations tend to develop resistance. Pest problems and subsequent losses are expected to increase during the next decades as more intensive production techniques will be employed to meet the extra food demand by a growing population (Abete, Huis, and Ampofo, 2000).

There is a shift towards doing research with rural communities, instead of for them in order to enhance participation and thus the adoption of Farmer Participatory Research (FPR) methodologies. Such shifts assists in boosting the economy of these communities eventually lifting them from 2nd economy farmer status. This contributes to improving livelihoods by enhancing the capacity to innovate and enabling the generation of income.

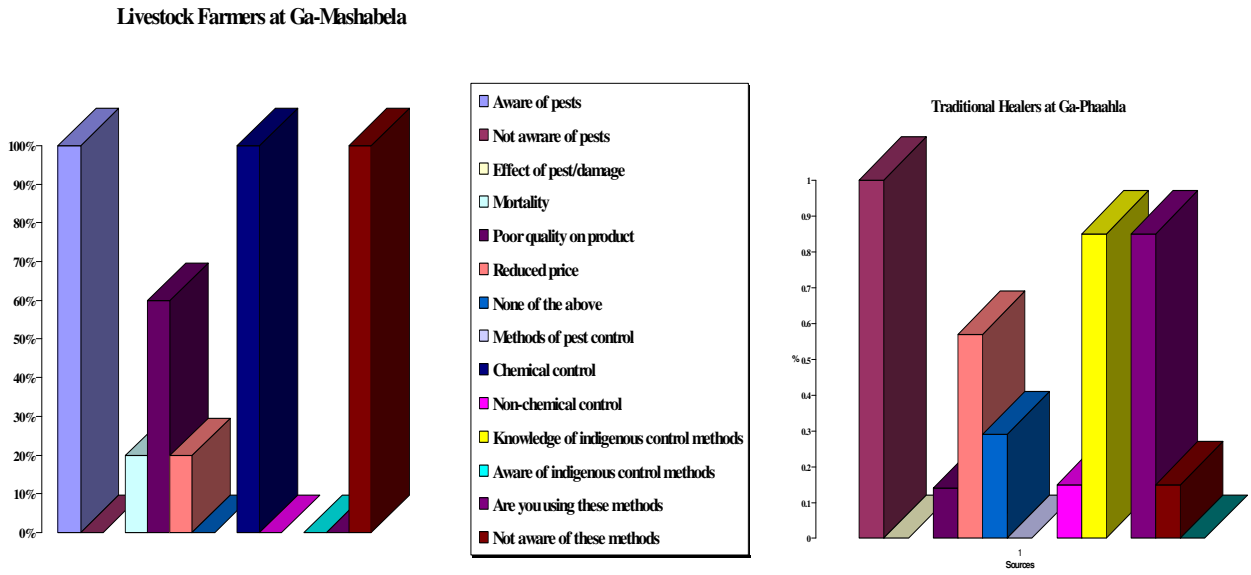
5.2 Identified Indigenous Technologies

Indigenous plants materials are used as innovations to manage pests and diseases. Indigenous pest and disease control methods are employed by communities synthesizing these materials into a bio-pesticide, to control pest and disease outbreaks in all cultivated crops. It is also practiced by livestock farmers with disease problems.

5.2.1 Perceptions held

Graph 1 below illustrates the knowledge of stakeholders on pest and disease control methods. All farmers are aware of the occurrence of pests and diseases and the effect they have on crops and livestock, and the extent of damage caused, whether it be reduced price or poor quality. The livestock farmers at Ga-Mashabela use only the conventional methods of control, with products sourced from chemical companies in Polokwane city, approximately 120 km from the study area. The livestock farmers were not knowledgeable of any indigenous technologies used in pest and disease control but acknowledged the presence of traditional healers in the area, who are more aware of these methods and materials. The Ga-Phaahla Traditional healers are viewed as custodian of the natural heritage, which includes medicinal plants. These healers were reluctant to reveals information and knowledge. The Diphagane group (illustrated in graph 5.1) was the only one aware of ITs, using these in their vegetable garden to control pest and disease infestation.

Graph 1: Knowledge of different Indigenous technologies in farming:



5.2.2 Knowledge of pests and disease control methods

The graph below (graph 2) suggests that it is expensive to consult with people holding this knowledge. Another reason cited was lack of interest of the IK owner to involve others and reluctance to share their knowledge with others. There is fear that such knowledge will be stolen or used by the wider public without acknowledging the owner. It was also suggested that researchers contribute to culture as they often exploit communities.

Graph 2: Knowledge of pests and disease control methods:

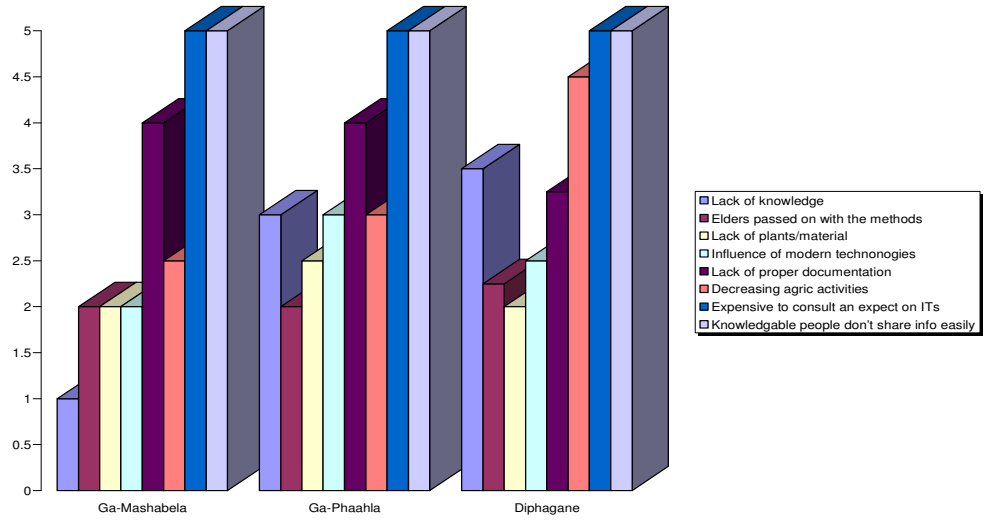


Table 5: Plants used the control of insect pest and disease in crops and livestock.

Common Name	Function	Method of Preparation
Sebalo,Moologa, Moshikidipela, Sekgopa se sehla,, Pharoge	Broad spectrum pesticide	Dried, grind, boiled and applied to vegetables
Moologa	Controls cut worm	Mixture applied to the vegetables
Moshikidipela	Controls cut worm	Mixture applied to the vegetables
Sebale	Kill termites	Plant one stalk next to the crop, it can also be use for human purpose to treat pimples
Moologa	To control cutworms and flies (Arguspiscus) in poultry	Break the plants parts in small pieces and put inside the poultry house It can be also be mixed with mosikidipela and kgopa (sisal) to make a mixture and spray on tomatoes and cabbage The mixture is prepared with cold water
Tepane	Use for poultry disease such as mokokorwane	
African potato IK technology from Ga-Mashabela by Mr Diketane	Well being of goat	Extract administered to goats added in water for their well being.

(Adapted from Odeyemi, Masika, and Afolayan, 2006)

CHAPTER 6 STAKEHOLDER ANALYSIS

6.1 Introduction

Stakeholders are individuals, institutions and organizations directly involved in an issue, engaging with it. Stakeholders differ on their intentions, views, and the degree of influence and importance to the problem and resultant developments. Agricultural development often fails because stakeholders are not given enough consideration. Analyzing the perceptions, views and issues of relevant stakeholders is an important starting point towards envisaged improvements. Stakeholder analysis attempts to deal with stakeholders' multiple and often conflicting views, interests and objectives. The term stakeholder analysis was first used in management science for identifying and addressing the interest of different business stakeholders. Nowadays, stakeholder analysis is frequently used for policy and project formulation, implementation and evaluation and for understanding and analyzing complex situations in natural resource management (ICRA, 2007). Stakeholder analysis is therefore a way of understanding a system through its stakeholders, by looking at their interest, objectives, power and relationships. Stakeholder analysis will also show existing patterns of interaction between stakeholders. By understanding the system, it is possible to facilitate change. In a project setting, such as the Diphagane context, stakeholder analysis can help to improve performance of the system; by helping to identify trade-offs between different stakeholders' objectives, and conflicts between them. As a result, project efficiency and effectiveness can be improved. Stakeholder analysis can also help in evaluating policy and project impacts, e.g. the distributional, social and political impacts of policies and projects. It can also highlight the needs and interest of powerless people.

A number of participatory tools and techniques were used to conduct a stakeholder analysis; from a Venn diagram to explore relations and significance of stakeholders to the problem, to matrices for identifying interests, perceptions and power distribution.

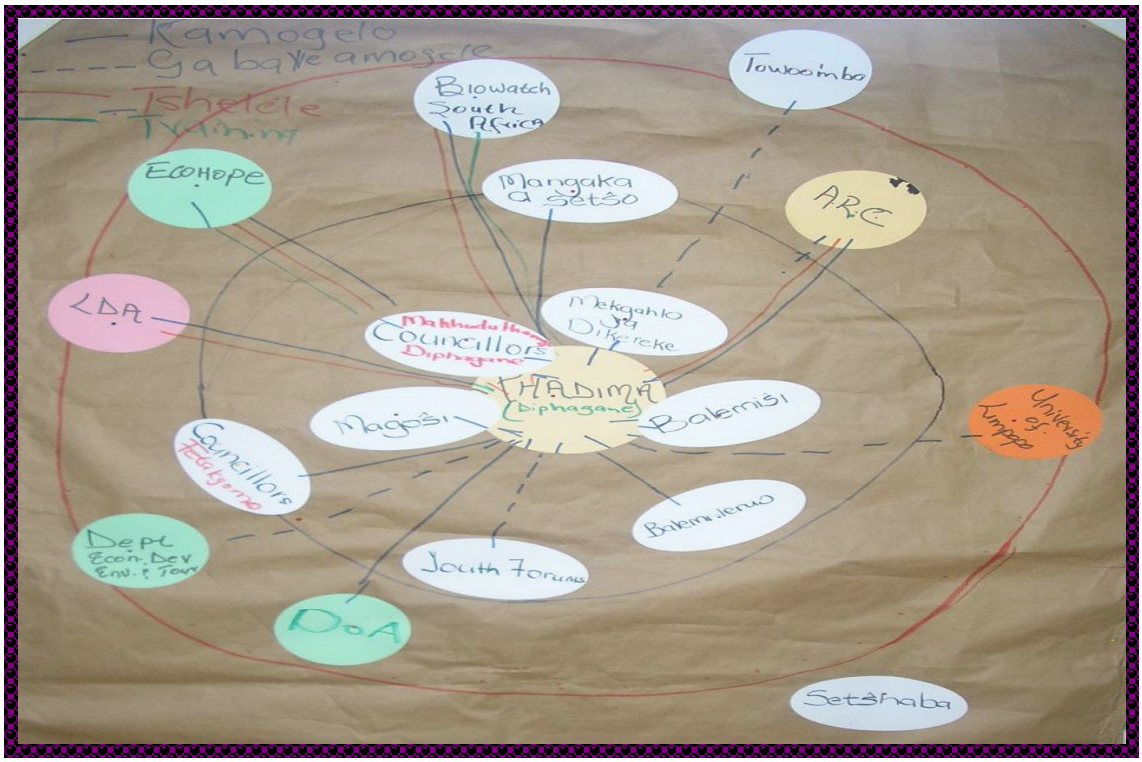


Figure 7: Venn diagram depicting Stakeholder linkages

The information in the Venn diagram above (figure 7) was obtained at a stakeholder workshop held by LDA IKS-division together with the ARD-IKS Team. The diagram has three spheres; wherein the first two spheres represent the organizations, and individuals situated directly in the village or in the community and the outer sphere represent the institutions which work in the area. Phadima farmers were interviewed through semi structured interviews on their perception of the relationship with different stakeholders, the nature of the support received, be it training and/or funding for the work the stakeholders provide in the projects. The dotted line indicates that the bond and the working relationship between the youth forums, traditional health practitioners, and livestock farmers is not as strong and efficient as the farmers would have wished. Farmers wish the youth were directly involved in farming activities as they are currently not interested. This also includes Bio-watch which also works with the farmers in the same manner, not very closely. The National Department of Agriculture (DoA) is currently well known to the farmer through their seed bank project where farmers either receive seeds or sell to National Department of Agriculture (DoA) and thus use resources to source seed from other provinces. The Limpopo Economic Development Environment and Tourism (LEDET) and Limpopo University Centre for Rural Community Empowerment (CRCE) were not known to the farmers. Diphagane farmers specifically highlighted excellent working relations with the Tribal Authority, the councilor and the extension workers, whilst farmers from other areas had differing views on the relation with ward councilors. Eco-hope, an NGO with long standing relationship with the Phadima farmers, were viewed positively and recognized in their function to provide training and funding.

The workshop identified the need for a broader stakeholder platform and that government and private companies should explore the benefits of working together to achieve development.

6. 2 Stakeholders Identification

The stakeholders mentioned in table 6 were selected on the bases of their involvement in organic farming and use indigenous plants either for farming or in their practice as THPs. The THPs were against setting boundaries on harvesting periods for indigenous plants as nature provides accordingly. The table shows dynamic relations exist amongst the stakeholder and highlights a need to reach consensus at the end of the day for the Diphagane Project to be successful in commercializing the bio-pesticide product. The potential competition from suppliers of the synthetic products (fertilizers, herbicides and pesticides) should be regarded as a threat, motivating the groups to engage in aggressive marketing. In the same token, there should be facilitated discussions between the group and institutions identified as potential donors of projects relating to IKS.

Table 6: Stakeholder identification matrix in Diphagane community

Stakeholder	Key stakeholder	Why (or why not?)
Traditional leaders	Yes	Custodians of communal land, deciding on access & control over land resources
Traditional healers	Yes	Harvest and manages the indigenous resources for their livelihoods
Extension Workers	Yes	Provide advice & technical expertise in identification and implementation
Livestock farmers	Yes	Provide relevant knowledge pertaining to livestock disease and pests and have good organisational skills
Crop farmers	Yes	Use bio-pesticide for disease & pest control & have access to & benefit from land
Local Govt	Yes	Holds authority and take responsibility for development in the wards
Youth Forums	No	Currently not involved but have access to resources and some knowledge of IKS
LIBSA	No	Provide expertise and skills in developing Business Plans
Bio-watch	Yes	Responsible for development of gene banks & potential funders for IKS projects
PROLLINOVA	Yes	Promoters of local innovations and products
LDA (IKS Division)	Yes	Manage IKS programmes & assist IK holder to implement, providing resources
ARC Institutes	Yes	Conducts research and inform on new knowledge
Universities (Univen & UL)	Yes	Conducts research and use findings to advice and promote local knowledge
Ministry of Agriculture	Yes	Provide policy framework and guidelines on IKS
Agricultural municipalities(Makhuduthamaga)	Yes	Facilitate the linkages between various stakeholders coming to the District
Environmentalist(DWAF) NGOs	Yes	Oversee use of water and forestry resources, provide collection permits for farmers and traditional healers, source seeds of extinct plant
Community		Beneficiaries of IKS, undertaking farming & have the knowledge of plant resources
Project Members		Producing & selling bio-pesticide, want to accomplish project goals and objective
Eco Hope		Promote safe environment and encourage healthy communities

Table 7: Stakeholder Perception Matrix

Stakeholder	Perception on problem causes	Perception on solutions
Traditional leaders	Greediness of other collectors without thinking of the future and others	Conservation of the plants and setting strict laws that punishes those who offend the laws
Traditional healers	High demand of traditional medicines in towns, vs. low supply from nature	Conservation, regulations
Crop farmers	Increasing demand for residential land	Conservation site should be developed within the communities to conserve these plants

Local Govt, LIBSA, LDA-IKS division, Eco Hope	Poor rainfall and climate change	Regulations should be strengthened for plants, which are endangered
Youth Forums, local government, ARC	Endangered plants are cut down for other uses	Youth to participate in forums that will conserve and save natural resources for future usage
Bio-watch	Poor seed storage, loss of genetic material	Indigenous plants gene banks can be developed
LDA (IKS Division)		Cultivation of plants on plots when scaling up
ARC Institutes	Unsustainable harvesting	Technology transfer of cultivation & propagation methods
Ministry of Agriculture	No community involvement in the conservation of the plant resources	Have a knowledge sharing strategy that will make communities realize the importance of IKS
Agricultural municipalities (Makhuduthamaga)	Climatic changes, high demand for residential site and high demand for cultivating exotic plants	Municipalities should be seen championing the action of conservation of indigenous plants and renouncing their economic benefit s in this day and era
Community at large	No real problem, plants are local and still available for small scale usage	Conservation methods and the importance should be highlighted to the communities
Diphagane Project Members	No collaboration amongst the communities on accessing and best use of the plants	Communities aware & conserving plants in demand
Eco Hope	Over-exploitation	Create awareness on sustainable harvesting

Table 7 illustrates stakeholders' perception on causes and solutions of the problem of irresponsible harvesting of indigenous plants. Some stakeholders thought there is high demand of these products by the broader community for other uses other than medicinal. These stakeholders further suggested that some individuals want to generate profit from plant sales, with no strategy for conserving the stock. The perception is that better profits are achieved by selling in bulk, tempting people to harvest with no consideration for sustainability. Encouraging conservation methods is necessary, for communities to accept the stewardship of their own resources. Government needs to interact with communities more effectively, to solve this challenge. Though collaborative engagement, knowledge can be transferred from communities to service providers and vice versa.

Box 2: Definition of irresponsible harvesting: One that involves pulling plants out by root, causing plants to regenerate very slowly or not at all, especially under unfavourable climatic conditions.

Table 8: Stakeholders Perception on Causes and Solutions of Unemployment at Diphagane

Stakeholder	Perception on causes	Perception on solutions for the problem situation
Traditional leaders	Illiteracy	Bring more skills to the people
Crop farmers	Lack of interest from the youth	Awareness on agricultural possibilities
Local Govt	Lack of economic activities in rural area,	Create awareness on municipal activities, bursaries etc, targeting matrix
Youth Forums	Lack of business knowledge	

Community	Unemployment, distance from economic centres	Local councillor and tribal authority to fully participate and get necessary resources
Project Members	Lack of funds, water and prevalent drought	Learn water harvesting techniques and be able to draw their own business proposals

Sekhukhune District is one of the poverty nodal areas targeted for the Presidential Imperatives Programme. One of the interventions identified is agriculture. However, the youth in these areas are not interested in farming. Farmers suggested that the young people do not realize the importance of agriculture and the benefits of using indigenous technologies to enhance and improve their livelihoods by actively using the rich biodiversity the area has. Youth see indigenous technologies as just things of the past not benefiting them in any way. Although drought is a concern to those actively farming and using ITs, there are still resources available to succeed in farming. Awareness should be created and skills transferred to the youth as this may hamper development.

Table 9: Stakeholder perception on Diphagane Bio-Pesticide project and its impact

Stakeholder	Perception on the project	Possible changes/impact
Traditional leaders	Could assist youth to better value farming and the associated benefits	Realizing the benefits of our own indigenous plants
Traditional Health Practitioners	Encourages use of indigenous plants	Appreciation of the diverse uses of indigenous plants
Crop farmers	Inadequate info on funding & procedures for accessing funds	Increased income through producing quality produce, conservation of the plant materials
Local Govt	potential to increase activities in municipality	Increase the revenue of the municipality
Youth Forums	High value farming and associated benefits	Employment , healthy diet
Community	Usage of plants for developing farmers	Employment , income through bio-pesticide sales, awareness on indigenous pest and disease control
Project Members	Increase income	Livelihood enhancement, added value
Biowatch	Lack of support from local govt & traditional leaders, lack of capacity & technical skills	Involvement of all local stakeholders Organise capacity building and training workshops
DoA	Increased awareness of nutritional values, collective responsibility for heritage	local markets, shared heritage
Eco-hope	Encourage other groups to follow the same method and patterns of farming	Knowledge sharing days

The Diphagane project using a number of indigenous medicinal plants to produce a biological pesticide to control pests and diseases in crops and livestock. Table 9 explores the perception held by different stakeholder on the project and possible changes it might have on community development. It is anticipated that the success of the project will change the livelihoods of the project members and the community as a whole. This perception is enhanced by potential mass production and scaling up expected to result in job creation in the areas. This in turn will highlight the importance of conserving local and indigenous resources and the economic value of these plants.

The municipality is supporting the initiative, as it could increase local revenues and local economic development. There is also an expectation that youth participation could increase, as they begin to value the importance of these plants.

Lastly, improved understanding of controlling pests and diseases in crops and livestock could result, as people learn more about sustainable harvesting methods.

Table 10: Stakeholder Interest, Importance, & Influence Matrix

Stakeholder Groups	Interest(s) or stake	Effect of project on interest(s) + 0 _	Importance of Stakeholder for success *U= Unknown* *1=Little/None* *2=Somewhat* *3= Moderate* *4=Very Important* *5=Critical player*	Degree of stakeholder Influence *U =Unknown* *1=Little/No Influence* *3= Some Influence* *3= Moderate Influence* *4=Significant Influence* *5=Very Influential*
Project Members				
Tribal Authority	Yes	+	3	3
Extension Worker	Yes	+	5	5
Livestock farmers	Yes	+	4	2
Crop farmers	Yes	+	4	2
Local Goverment	Yes	+	3	3
Youth Forums	Yes	+	3	1
LIBSA	No	0	4	4
Biowatch	Yes	+	5	5
PROLLINOVA				
LDA (IKS Division)	Yes	+	5	5
ARC Institutes				
Universities (Univen and UL)	Yes	+	4	4
DoA, division of I-food crops	No	0	1	1
Agricultural municipalities (Makhuduthamaga)	Yes	+	5	5
Environmentalist (DWAF)	Yes	+	3	3
NGOs				
Community	Yes	+	3	Unknown
Project Members	Yes	+	5	5
Eco Hope	Yes	+	4	4
LEDET	Yes	0	4	5
Organic promoting Co.				

Table 11: Mapping Key stakeholders Relative Influence and Importance

Influence of stakeholder	Importance of activity to stakeholder Unknown	Little/No Importance	Some Importance	Moderate Importance	Very Important	Critical Importance
Unknown						
Little/ No Influence	DoA I-food crops				Diphagane Youth forum	Phadima Crop farmers
Some Influence						
Moderate Influence				Tribal Authority Diphagane	Local Govt & Youth Coop in Diphagane	
Significant Influence				LIBSA	Eco-hope UL-CRCE	M-Agric Municipality
Very influential					LEDET	Biowatch, LDA-IKS Extension Worker

Table 10 & 11 further explores the nature of the influence of some key stakeholder, for example Biowatch, LDA-IKS Division and the extension worker are regarded as being very influential and contributing to the success of the project. All three are responsible for service provision at local level in the Limpopo Province and have a long standing relationship with the Diphagane farmers,

work with them on daily basis. The Makhuduthamaga Agricultural municipality also plays a very critical role; have prioritized the project to demonstrate that they are taking indigenous knowledge innovation and technologies seriously. The municipality aim to integrate the project in their Integrated Development Plan (IDP) and have agreed with the LDA-IKS division to delegate one member of the municipality to deal specifically with the IKS related issues.

Table 12: Formulation of Stakeholder Participation Strategy in IPM

Stage in Project Process	TYPE OF PARTICIPATION			
	Info sharing (one-way flow)	Consultation (two-way flow)	Collaboration (Increasing control over decision making)	Empowerment (Transfer of control over decisions and resources)
Project Identification	LDA-IKS Division			LDA-IKS Division Biowatch Eco-hope
Preparation Appraisal		LDA-IKS Division and ARC-ITSC Medicinal plant Projects		LDA-IKS Division Biowatch Eco-hope ARC-ITSC (SRL projects
Implementation, Supervision, and Monitoring			LDA-IKS	LDA-IKS Division Bio-watch Eco-hope ITSC(SRL projects
Evaluation		LDA Biowatch		

Table 12 outlines the type of participation of stakeholders involved in the Diphagane Project and expected involvement for the future of the project. The LDA has the capacity to share, consult, collaborate and empower the participants, whist other departments should play a role in implementation with the community to achieve project goals and objectives.

CHAPTER 7 DRIVING FORCES AND SCENARIO BUILDING

7.1 Introduction

With the analysis of the problems undertaken, a process of consolidation and strategic thinking on potential improvement actions followed. This process took into consideration the views of the stakeholders as well as external factors likely to have bearing on envisaged improvement. This chapter identifies the external factors (driving forces) impacting on the project. It ensures that resultant plans do come to fruition in response to predictions of the future (scenario planning).

7.2 Driving Forces

The term driving forces, in ARD is used to describe *external* factors that are, or might cause, changes in livelihood systems and rural practices. These factors are *external* to the immediate area of concern for the stakeholders, in other words, they are considered to be beyond the project's control. Driving forces can include changes in social, technological, environmental, economic and political factors. Driving forces come in two forms according to their *predictability.* Firstly ***Trends*** are driving forces that are well established and will not change over the (planning) term, or are fairly certain to happen. These factors have implications for future scenarios. Examples of these are; population growth, consumption of a given commodity (staple food, source of energy), market liberalization (removal of subsidies, lowing of tariffs for agricultural goods). Secondly, ***Shocks or risks*** are unpredictable driving forces. However, they are crucial in the evolution of any problem situation. These uncertainties will determine the shape of particular scenarios. Example of these are; changes in public opinion, consumer choice between different commodities, risks such as floods, droughts, changes in commodity or input prices.

Some of the examples of the driving forces mentioned in the paragraph above were identified to have bearing on the study. Firstly, according to Alexandratos (1995), poverty-related environmental pressures, agricultural practices, consumption patterns and policies contribute to the actual problems of agriculture and food supply. Actual agricultural supply is characterized by low-input systems, production deficits and malnourishment in many developing countries. Production of food and feed is limited due to limitations in natural resources such as arable land water, soil fertility, inherent (genetic) productivity of crops, in the ability of man to maintain or replenish these resources, and the shortcomings of protecting crops against biotic and abiotic constraints (Oerke and Dehne, 1997). In order to promote crop growth and yield, farmers have to protect plants against pests and other organisms damaging crops grown for human consumption. The ultimate purpose of crop protection is not the elimination of pests but to minimize crop losses to an economically acceptable level (Oerke and Dehne 1997). The scenario described is clearly relevant for the project.

7.3 Visioning by Diphagane Project

In determining the way forward in terms of project improvement, the Diphagane project members developed a statement of the desired future through visioning. Visioning serves to elicit people's hopes and dreams and aims to help people articulate these**, b**uild awareness about these hopes and empower them to think that it is possible to achieve it. Visioning is a way of using a scenario which is usually a snapshot view of some point in the future.

Vision for Diphagane project

We aspire to be able to sell our bio-pesticide to other vegetable farmers outside the boarders of the Sekhukhune district municipality in the near future. Hoping to sustain the natural resources which we harvest from, by continuing to harvest sustainably and promote indigenous technologies to others so that there would be more investors in our district municipality.

7.4 Use of Scenarios for Planning Development Intervention

7.4.1 Description of Scenarios

Scenarios describe what the future might be and are a mechanism used to stimulate creative thinking. This is useful in planning where complexity and uncertainty are high and are thus better than projections. Scenarios can be useful to evoke and communicate people's ambitions, plans and perceptions of change, assiting people in deciding how to adapt to change and achieve their vision (ICRA, 2007). Scenario planning is increasingly regarded as most useful to formulate a common strategy and change attitudes. Tools used in scenario planning include pictures, photographs, videos, written stories, statements, poems, dramas and GIS maps and graphs.

7.5 Driving forces, Scenarios and Strategies

As discussed above, scenarios highlight different possible conditions that might exist in the future. Stakeholders can then make strategic decisions about which actions are likely to produce an optimal outcome. Different stakeholders will be affected in different ways by the situation/problem and would need to adopt different strategies to bring about the desired change, but resultant strategies must be robust enough to work under most scenarios. The best strategies are those that can adapt to all scenarios, or at least minimize the negative consequences of more pessimistic scenarios. The aim is to have a set of strategies that solves the problem, while having desirable environmental effects, social effects, and economic effects.

The Diphagane project uses an indigenous pest management program in vegetable production. The natural biodiversity being threatened and pest and disease outbreaks prevail. It is a complex system not suited to uniform application of knowledge, machines and agrochemicals. Diversity of practices is related to soils, climate, access to markets and technology, and cultural influences differing greatly between communities (Oerke and Dehne, 1997).

Table 13: Contrasting driving forces, scenarios and proposed strategies

Driving Forces	Prevailing Scenarios
Technologically intensive agricultural practices	High intensity of cultivation with synthetic substances
Changing consumption patterns	Increased demand for healthy food, grown organically
Policies governing harvesting of indigenous plants and IKS broadly, e.g. collection permits and research permits	Conflict over resource access and control
Environmental pressures and climate change	Epidemic pests and diseases
Limited land resources, due to degradation and heavy reliance on chemicals	Food demand in 2025 may exceed resource capacity
HIV and AIDS pandemic	Indigenous knowledge is being eroded Demand in indigenous medicinal plants Unsustainable harvesting by collectors
Increasing mining activities	Loss of biodiversity
Emphasis on Intellectual Property rights	Communities (IK holders) receiving due acknowledgement
Gender equity in agriculture	Changed population dynamics
Non-agricultural employment opportunities, especially attractive to the youth	

These trends suggest that the Diphagane project has significant potential. For example, the demand for alternative medicines and organically produced food is positive. The prevalence of HIV/AIDS and the demand for alternative (indigenous) medicines could therefore counter the efforts of the group to commercialize their product, as it might be perceived as in competition with the needs of Traditional Health Practitioners. However, if the plant material can be mass produced effectively, this potential constraint; conflict over access and control of limited resources, is dealt with. Discussion between land users regarding resource access is required.

CHAPTER 8 DEVELOPMENT STRATEGIES AND ACTION PLANNING

8.1 Introduction

The investigation into IKS in the three villages helped to identify what needs to be done in order for the communities concerned to effectively benefit from the richness of Indigenous Knowledge and technologies. In studies that include a social analysis, problems, stakeholder issues and views, potential merit, difficulties and risks associated with possible project interventions is evaluated (AusGuidelines, 2003). In ARD this is called strategy development and entails stakeholder engagement in determining options to effect change. The identified interventions are scrutinized to determine the likely scope of the project prior to conducting more detailed planning. This chapter describes this process of identifying what needs to be done by first outlining strategies and providing an action plan. Development is a systematic utilization of the knowledge or understanding gained from a particular investigation, towards production of useful materials, devices, systems or methods, including development of prototypes and process.

8.1.1 Identification of Strategies Required to Improve the Situation

Stakeholders need different research and development options due to their varying capabilities, resource endowments, livelihood strategies, interests and vulnerabilities. Strategies are products of scenario building, a process that takes cognizance of the emerging trends. Conducting strategy development in the ARD context helps to consider options most likely to result in a desirable future situation. In this study, the strategies were determined by what was learnt through engaging with stakeholders during the data gathering process. Strategies are developed to counteract the negative implications of the future scenarios. It is important to show why a certain strategy is relevant for the achievement of the desired change. A number of development strategies (options) were identified from the proposed solutions as well from the analysis of the most likely scenario.

8.2 Analysis of Alternative Strategies

8.2.1 Commercialization of products from indigenous technologies

As argued in chapter 1, efforts to add value through innovations in IKS could mean that knowledge is effectively utilized to produce economic growth. This could be achieved by providing mechanisms and incentives for sharing IKS knowledge. This is particularly needed for the lower income agricultural sector, wherein innovators are somewhat indifferent, in the absence of public incentive and protection, to making their knowledge public. The legislation on bio-prospecting provides for equity in access and benefit sharing. According to the NEM's Biodiversity Act (10 of 2004) "*bio-prospecting refers to research on or development or application of indigenous biological resources for commercial and or industrial exploitation"*. The Act further suggests that commercialization includes amongst other things, *clinical trials and product development including market search and multiplication of indigenous resources through cultivation, propagation, …"* There must be fair and equitable sharing of the benefits arising from bio-prospecting on indigenous biological resources. The Diphagane farmers are currently developing an indigenous plant mixture and sell it to neighboring farmers, a process that can be described as bio-prospecting. They are also looking to expand their current practice through mass cultivation. Assistance in terms of development of marketing strategies should therefore add significant value.

8.1.2 Conceptual framework for shift from problem analysis to strategies

For ease of understanding the diagram paves a way from analysis to strategy development. Each perceived problem is turned into clear objectives through a specific related strategy. The strategies identified and proposed by the research team are indicated in blue, whilst the problems are in light green. The strategies are discussed in detail under 8.2.

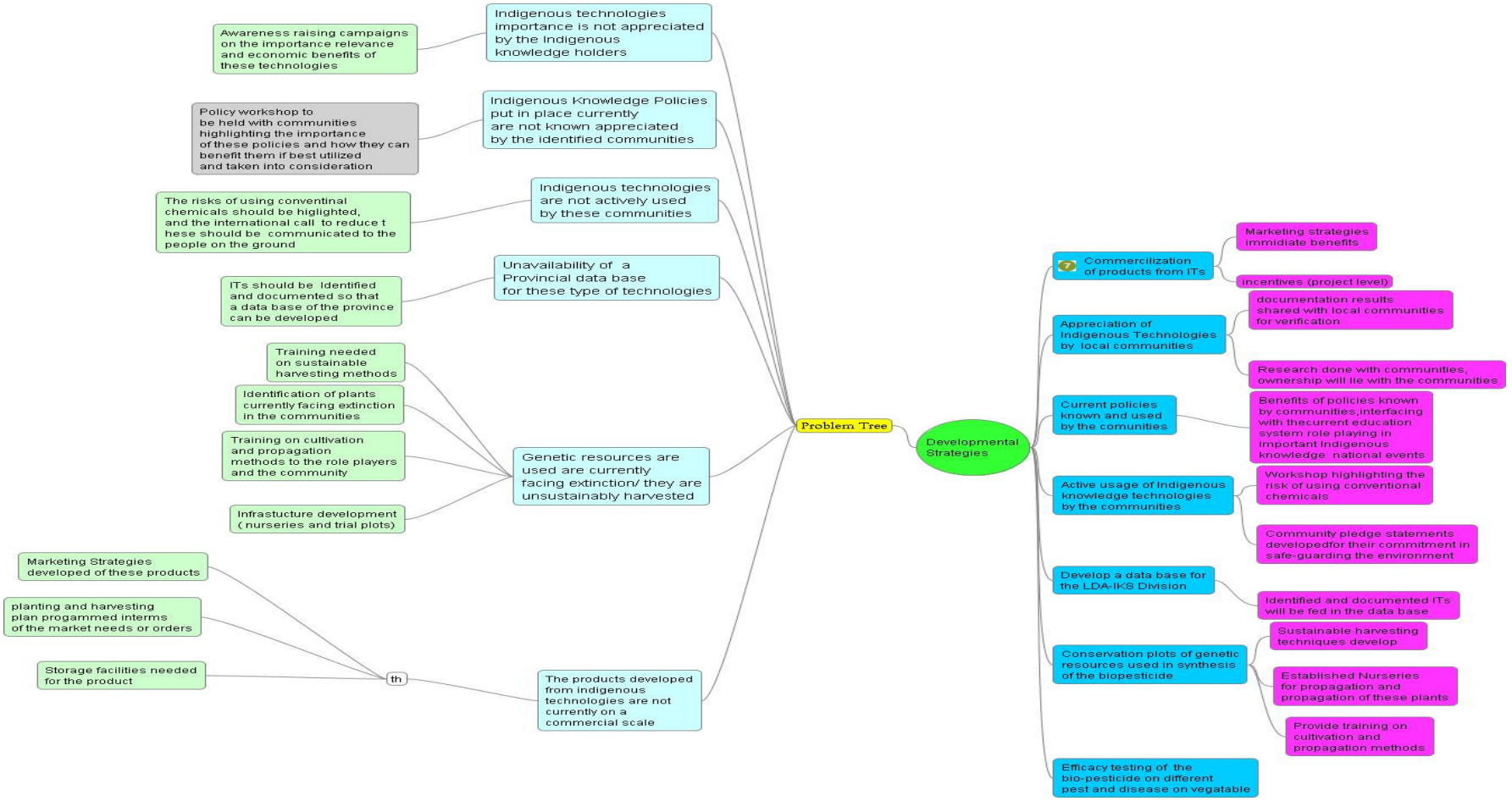


Figure 8: Problem and Objective/strategy Tree

8.2.2 Conscioutization on the value of indigenous technologies

The study allowed for cross sharing of skills, knowledge and practices on IKS between the three villages and the broader IKS practitioners belonging to the Phadima association. Strength in recognition of IKS lies in the creation of such dialogue platforms. An important outcome of the workshop held at Tompi and at Bela Bela during the study, was the creation of awareness on the benefits of IKS. The LDA (and partners) are currently developing a strategy for the promotion of IKs in the province. Activities under this strategy include the development of promotional materials in print and audio media. There should be appropriate documentation of these materials and of findings obtained from research on people's indigenous resources. Research being conducted should be participatory in nature; giving credence to local knowledge.

8.2.3 Improved understanding of policies and regulation governing IKS

The SA government through its many departments holds responsibility for control and management of indigenous resources. DST for example has established a national IKS office, which has developed an IKS policy, whilst the DEAT's policies seek to govern issues on bio-prospecting. Policies are as good as their application and it is therefore crucial for indigenous communities to understand what all relevant policies for adherence and application. There is therefore benefit in establishing relations between policy making bodies and communities using indigenous resources as this could result in collaboration rather than antagonistic engagements on control measures being instituted.

8.2.4 Develop database of IKS

There is presently a great need in South Africa for a database that describes identified practices, types of and other related information on IKS. In Limpopo the LDA should develop mechanisms for: 1) recording of IK by IK holders; 2) develop guidelines for minimum standards for benefit sharing; 3) facilitate development of agreements on public domain declaration of knowledge; and lastly 4) facilitate drafting of agreements on certification of IK holders and their IK rights. All this information could be contained in a database.

8.2.5 Improved use of indigenous methods and systems by concerned communities

The team proposes a workshop to create awareness and highlight risks associated with the use of indigenous products. This will help provide people with information essential to make informed choices. In the same token, there should be locally developed control and management system to safeguard the indigenous resources from over usage. Part of the solution could include communities drawing statements pledging to harvest wisely and protecting the environment.

8.2.6 Conservation pilots of genetic resources used in synthesis of the bio-pesticide

The communities with the help of all the stakeholders will need to establish nurseries for propagation of indigenous plant resources. Initiatives to implement this strategy will need to include training farmers on correct cultivation and propagation techniques, production management, sustainable harvesting techniques and on other technical aspects at all the villages and possibly at wider forums.

8.2.7 Research on efficacy of the bio-pesticide on pests and diseases

The study could only identify the types of plants used by the Diphagane project farmer, research to establish the scientific compounds of each plant will be of great benefit. Such a study could explore the active ingredients against the pests and diseases, currently being controlled.

8.2.8 Enhanced support provision to the Phadima Association

The investigation concluded that a platform of all stakeholder involved in IKS should be created to support the Diphagane project specifically as well as the broader association, Phadima. Such a body could better meet the needs of the farmers and enhance the knowledge of all role players. A stakeholder platform was created to utilize expertise of different stakeholders and outline the role that each can play in research and development of biological pesticides. The different stakeholders worked together and identified ways to support the Diphagane initiative; including the extent to which they have influence on the outcomes and the scaling up of initiatives established through the project. They also explored the effort required to develop the biological pesticide to be investigated, its mode of action, dosage, shelf life, marketing, etc. in order to draw beneficiaries into the mainstream economy.

8.2.9 Mainstreaming and institutionalized IKS

Institutionalization at municipal level is of paramount importance as that is where implementation happens. To have municipalities well informed on plans concerning IKS projects will assist in aligning efforts. Working together with researchers from LDA should enhance the quality of work. The institutionalization of an IKS strategy will also avoid duplication and ensure sound communication through correct platforms, resulting in a holistic approach towards a common vision

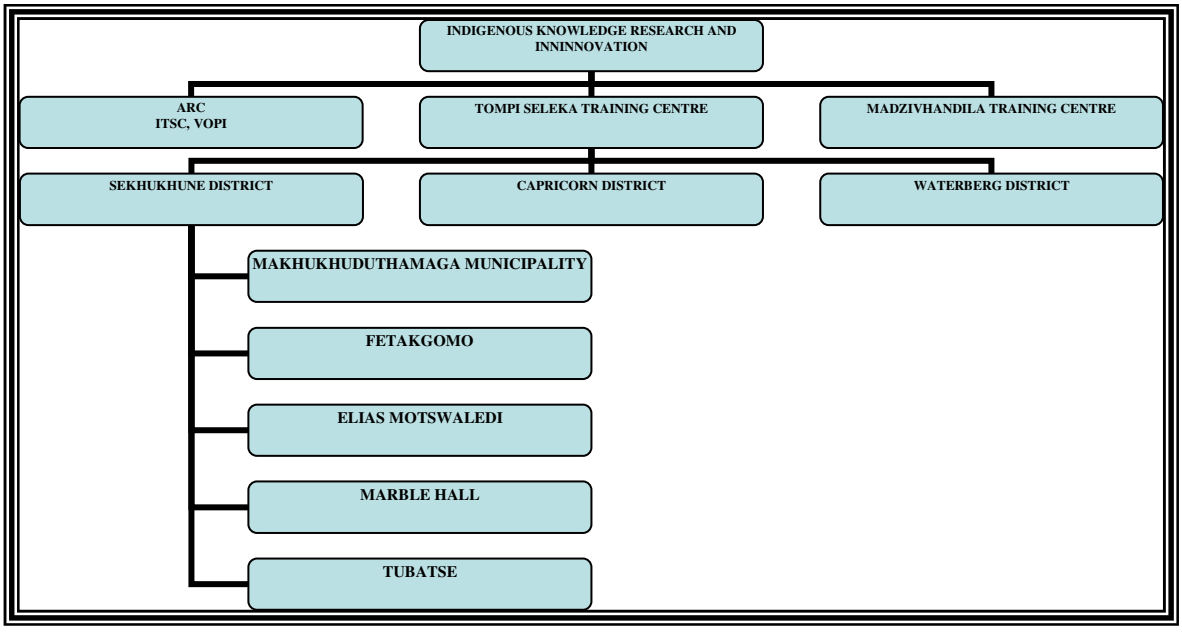


Figure 9: Institutionalization of Indigenous Knowledge Systems in LDA

8.3 Action Planning for Implementation of the Strategies

8.3.1 Documentation of Indigenous Technologies used in control of disease and pest

Indigenous technologies will be identified and documented and communities can be part of decision making on how to disseminate the information. Activities involved will include visits to local schools and community educating them during information days, where technologies will be exhibited. The theme of the exhibits could be conserving biodiversity and indigenous plants for use in controlling pests and diseases and other uses which might benefit rural communities. Extension and field workers need to be trained in order to know what to document and how to deal with challenges in the process. Communities are the custodians of local knowledge and in order for the strategies to be successful local knowledge must be incorporated in collaboration with local experts.

8.3.2 Awareness about value of existing IT among community members

Revaluing IKS - Indigenous knowledge based technologies is not a new concept amongst many rural communities, what is currently needed is to create awareness of the value of these technologies. Since communities are aware of the technologies and innovation what needs to be done is to facilitate sharing of knowledge amongst community members. Communities will be assisted to form forums wherein the youth, schools and general community members engage each other and develop promotional material which will target the importance of IKS with the help of the LDA IKS Division. Competitions, involving schools children are a positive way of enlisting their support and interest. Teachers could assist in the designing and running of the competitions.

8.3.3 Planning IT (Bio-pesticide) conservation strategy

For mass production of the indigenous plants for synthesizing the biological pesticide, the relevant plants need to be conserved and multiplied. An area for conservation will be required. This will ensure sustainable supply whilst releasing pressure from forest resources. Communities need to be educated about relevant policies and acts, to prevent exploitation.

8.3.4 Launching of IK-Technologies (Bio-pesticide) among communities

The bio pesticide as a product of the community needs to be launched officially, for market exposure highlighting the benefits of the technology.

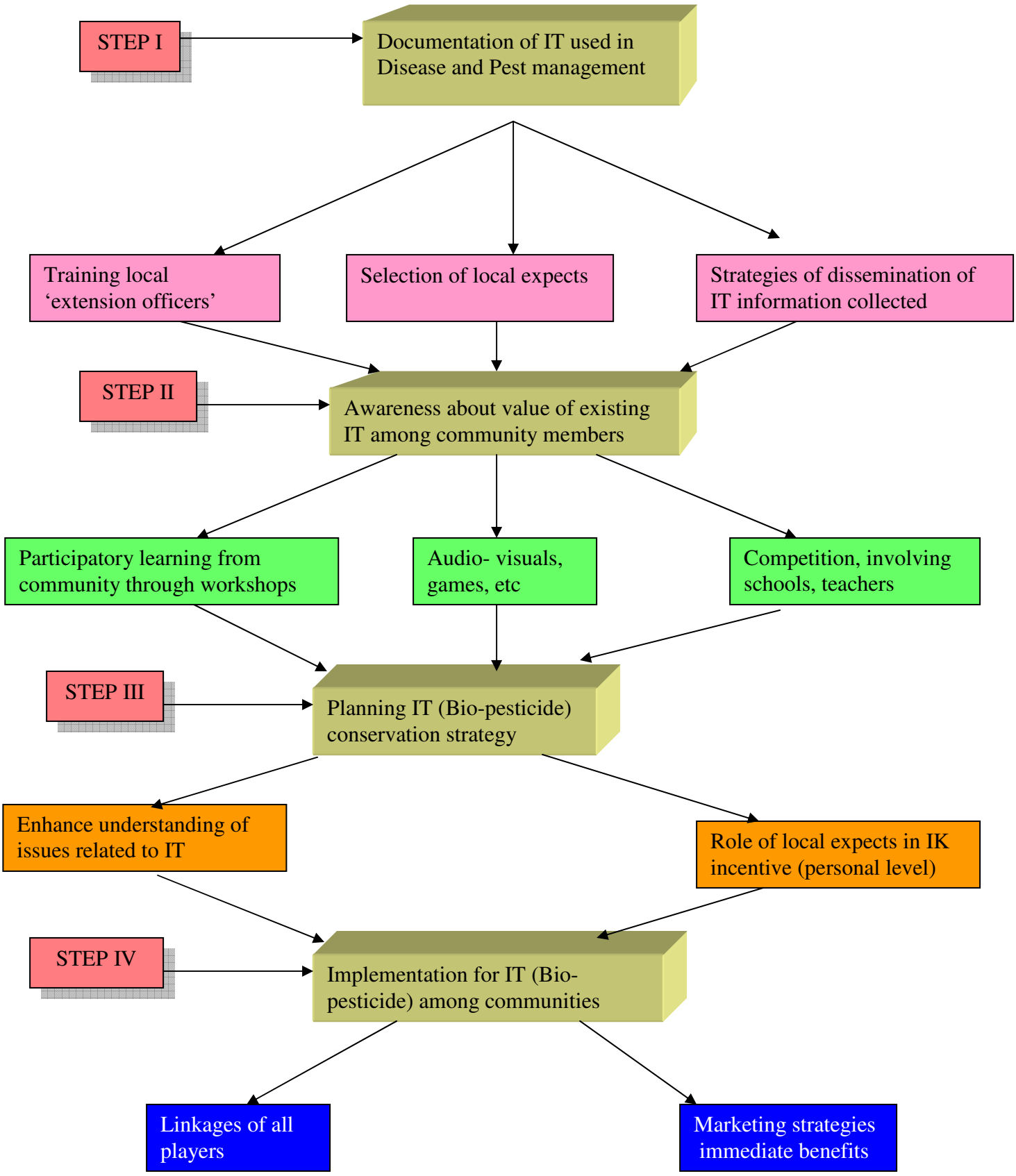


Figure 10: Proposed steps for implementing development strategies
Source: Adopted from Participatory approaches for Documenting and Conservation research

Table 14: Activities required and allocation of responsibilities

Activities for above strategies	Stakeholder	Contact person
• Documentation & case studies • Quality knowledge & value	• UL (CRCE) • ARC-SRL-IKS • LDA-Ext. officers • DOA • Biowatch • Eco-hope	• K. Mphahlele • Sister Angelica • Thabile Poto • Mokhupa Selepe • Peter Komane
• Research on system in rural areas on IKS	• LEDET collaborating: • LDA • ARD team	• Moeng Erol • Chuene Ricard • Chuene Richard • M.P Tswana • T. Poto
• Infrastructure improvement	• Municipality • LDA – Sekhukhune district	• Mr. Pappie Mashiane
• Sourcing & recovery of extinct seed for seed bank	• DOA (PLMP & genetic resource) • ARC- gene bank	• M. Selepe
• Research on land use & biodiversity	• ARC-ISCW • DWAF • LEDET • Land care	• R. Nemakanga • E. Moeng • M. Mokgole
• Risk ID management • Risk coping • Indigenous pest management	• LDA • ARC • ITSC/IKS	• J. Ramaru • T. Poto
• Social mobilization	• UL (URCE) • LDA • Biowatch • Eco-hope	• K. Mphahlele • P. Komane • Sister Angelic • Local ext. officers
• Water quality analysis	• ARC-ISWC • DWAF • LEDET	• M.P Tshwana

Table 15: Logframe for the Commercialization of Biological Pesticide at Diphagane Project

Narative Summary	Performance Indicator (OVIs)	Means of verification (MOVs)	Assumptions
Goal			
Promotion of indigenous knowledge			
Project Purpose			
To synthesis a biological pesticide to control pests & diseases & record IK technologies			
Project Outputs/ Result			
1. LDA to develop data base for indigenous knowledge technologies used	Data base developed for documenting indigenous technologies	Data base is used by communities	
2. Conservation of Indigenous plants used in the synthesis of the bio-pesticide	Conserved indigenous plant species	Biodiversity is maintained	
3. Nursery for cultivation of indigenous plants used for scaling up	Nursery developed	Nursuries used for propagation of indigenous plants	
4. The efficacy of the bio-pesticide on different pest and diseases will be tested	Efficacy testing will be done on the bio-pesticide	Efficacy tested	
5. Awareness will be raised on the importance of indigenous plants	Awareness will be raised on importance of indigenous plants	Communities will appreciate the economic value of the plants	
6. Awareness will be raised on the current policies and their role	Awareness will be raised on policies	Policies will be farmiliar to communities	
7. Commercialized bio- pesticide product		Product on shelves of pharmacies & retailers	
8. Active ingredients tested	Active ingredients& mode of operation known	Active ingridients known	
9.Means benefit sharing within the communities	Communities realizing economic benefits of ITs	Benefits shared	

8.4 Conclusions

According to the terms of reference, the research was to assist LDA to help commercialize the biological pesticide synthesized at the Diphagane project for the control of pests and diseases in both crops and livestock. The observations made by the team was that IK technologies cannot be fast tracked and commercialized before they can be verified and seen to be valuable by communities. The plants used in the Diphagane project are regarded as weeds and the farmer's knowledge on this is downplayed by the community. The study encourage that trade secrets be respected and promoted amongst community development workers, researchers and community members who have knowledge and expertise on IKS. The issue of intellectual property rights plays a significant role when such initiatives are to take place for a particular group.

Benefit sharing is a way of making certain that communities get what they deserve when they participated in research on a product. The Diphagane project members in particular need to be engaged on this issue for an informed decision on how to ensure a viable future for their product. The farmers can decide if they want to develop the product further, through fully understanding the advantages and disadvantages. It clearly surfaced during the interviews and farmer group discussion that it is important to respect trade secrets, as farmers had problems in sharing the IK technologies with the team. Farmers should also be familiar with the IKS policy and other related acts, for awareness of what they entail and benefits they present farmers with.

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Annexure 1: RESEARCH PLAN 1

Central Research Questions: What types of IT are used for controlling pests in crops and livestock, and how they are identified, and documented?

Secondary RQ	Tertiary RQ	Information needs	Source	Methods	Expected outputs
What mechanism can be used to unleash the potential, of these natural resources/ IT and system?	What are the risks involved when harvesting these medicinal plants	Identification of scientific names(plants that make pesticides)	Farmer	Questionnaires	Submission of the list IT being practiced
What are factors contribute/ constrains the use of IT systems	What can be done to improve sustainability of natural resources(medicinal plants)	Define what are indigenous medicinal plants are.	Municipality	Demonstrations	Researchable IT will be identified
	What T types of Indigenous medicinal plants are used for controlling pests and diseases	Type of storage Shelf life	Library Internet		The Bio-pesticides, livestock and vegetables will be marketed and sold to interested customers
	What can be done to improve the bio-pesticides, to improve the produce?	Where do they get these medicinal plants Dosage	Policies in IKS		
	what type of pests and how are they prepared	Materials used in pesticide management and for			
	What are the observations to prove the mixture is effective?	Efficiency of the pesticide			

Refined Research Plan 2

Objectives	Research Question	Target	Methods	Outputs
1. Identify and Document existing Indigenous technologies	What, how, when, where IT's are used, how and when are they used and where are they used and for **what purpose** are they used for	Farmers Livestock keepers Traditional healers Agric Officials Dept of Environ. Affairs	Checklist SSI Audio visuals (Luseba and Poppy to give info	List of Indigenous technologies Picture of plants
2 Share the collected information with the communities	What, where, and how info should be shared?	Communities and all the stakeholders involved	Workshops Meetings	Information modules in the local language
3R& D options	What options have R& D potential Present to Management of LDA & ARC		Presentation to Management/stakeholders through a meeting	Proposal

Research Plan Version 3

RESEARCH QUESTIONS	POTENTIAL ANSWERS	INFORMATION NEED	INFORMATION SOURCE	RESEARCH METHODS	EXPECTED OUTPUT
(C.R.Q) How can we maximize the potential of indigenous plants for greater utilization?					
(S.R.Q) **SOCIAL** Who control and make decision for the concerned communities to access the indigenous medicinal plants, and what are their perceptions held? (TRQ) 1. What are the indigenous medicinal plants used for in agricultural farming 2. How often do you collect and process your indigenous plants?			• Traditional leaders • Science and Technology	**Interviews** structured semi structured **Reports**	
AGRO (SRQ) 1. What are the characteristics of agro ecological resources in the area? 2. What is the effect of pests and diseases on the production on livestock and crop?			• Farmers • Traditional health practitioners • Community members • LDA • Institutions • Dpt of Health	Interviews Reports Seminars Internet	
ECONOMIC (SRQ) What is the potential for commercializing bio-pesticides? (TRQ) 1. What are the indigenous medicinal plants used for?					

Annexure 2: TERMS OF REFERENCE FOR THE ARD IKS/FOOD SECURITY THEME

STUDY TOPIC: Indigenous Pest and disease control in both Livestock and Crops

1. Names of ARD Hub Theme Group members

1. M Magoro, sociologist
2. Dr. M. Makwarela, conservationist
3. M.J. Ramaru, Sociologist
4. M.P Tshwana, Agronomist
5. R. Sasa, agronomist
6. Prof. Mashela, Horticulturalist
7. J. Mulaudzi, Animal scientist
8. H. Rootman

1.1 Other interested parties

- ProLinnova
- Biowatch
- Makhuduthamaga local municipality
- Makhuduthamaga Agricultural municipality
- Crop and livestock farmers

2. Background

The group to undertake the ARD study on IKS will be supplied with information about case studies currently being implemented by LDA and ARC-VOPI

2.1 LDA Case study: Name of the project; Diphagane Project

- Location: Makhuduthamaga Municipality in Sekhukhune District
- Started in 1993
- Currently have 9 members
- Planting vegetables (Tomatoes, onions, spinach, butternuts, carrots, green beans, green peppers)
- Marketing is done locally at pension pay points
- Group won Best female farmer award three times (2x district level and 1x Provincial)
- Inputs that they use: Cattle manure
- Currently no crops in the field because of drought
- **What is IKS about it**: farmers develop the natural pesticide using following crops (Moologa, Mogalakane, Moshikadipela, Kgopa ya Draai).. material available in plenty numbers
- Currently the project is brewing the pest mixture in 25l drums and use it when pests emerge
- They also plant herbs within rows of their preferred crops (vegetables)-intercropping for the purposes of pest control

2.2 ARC-VOPI Case study

- What VOPI would want to do in collaboration with LDA around the theme of IKS should not be far from Diphagane (be part of the same population)
- List of possible areas of focus:
- Indigenous weather focus
- Post harvest technologies
- Indigenous farming systems
- Indigenous soil classification (ethno-pedology)
- Traditional medication for livestock

3. **Institutional Framework**

- Identify and document IK technologies
- Ensure that IKS is promoted
- Ensure application of Benefit Sharing Trust
- Comply with Trade Secrets (e.g. non-disclosure)
- Comply with Ethical Guidelines e.g. Informed Consent, IPRs, Compensation Rights (if commercialized), etc
- Ensure compliance with Amendment Bills and Biodiversity Act on IKS

4. Geography of the study area

- Sekhukhune District
- Makhuduthamaga Municipality
- Diphagane
- Population; Bapedi
- Other two villages will be part of the study (to be identified) within a diameter of 10km

5. Proposed Team composition

- Sociologist
- Agronomy
- Livestock and Veterinary
- Horticulture

6. Study objectives

- Identify existing indigenous technologies in crops and livestock production from selected areas
- Document the existing indigenous technologies in crops and livestock production
- Analyze the findings
- Present the findings to the selected communities for confirmation
- Identify researchable areas in IKS
- Identify areas or IK technologies or products/services with potential for commercialization - growth of local economies.
- Identify potential partners e.g. DST, NRF, iIKSA, DTI, PDAs, etc, to support researchable areas and (or) products/services to be commercialized

7. Expected Results

- Understand dynamics of the IKS system in selected areas
- Understand the importance of IKS in selected areas on crops and livestock production
- A comprehensively documented report on the study
- Confirmation of the findings through feedback to the communities
- Recommendations for future work

8. Field study process

Period: nine weeks staggered over three field phases of the ARD training programme

- Preliminary findings after 2weeks of the commence of the study
- Present and share the findings of the study to top management of LDA and ARC before finalizing the report
- Form of the report: Report, Compatible Disks and Video

9. Responsibility of the Field Study

Planning for the field study will be done at the end of each Knowledge acquisition phase of the training workshop on ARD

Annexure 3: IKS QUESTIONNAIRE FOR DIPHAGANE, GA-MASHABELA & GA-PHAAHLA

1. Date of the interview: ……..

2. Name of the interviewee:…….

3. Age of the respondent:…….

3. District:…….

4. Village:……..

5. Sex of respondent: 1. Male [ ] 2. Female [ ]

6. **SOCIAL**

6.1 Who has access to indigenous plants?.....

6.2 Who are the users of the indigenous plants?.....

6.3. Who are the other users of these plants?.....

.....

Who controls your indigenous plants?.....

T. A		M .leaders		T. healers		Policies		

7. Land

7.1 Who has access to the land?.....

Crop farming		Livestock farming/grazing		Residential sites		Business site

7.2 Who controls your land?.....

Traditional leaders		Municipality	

Annexure 4: SEMI STRUCTURED INTERVIEWS; KNOWLEDGE OF INDIGENOUS PEST CONTROL METHODS IN YOUR COMMUNITY

Sources	Frequency	Percentage
Pest awareness Aware of pest Not aware of pest **Effect of pest/damage** When do these pest/disease occur in the season Mortality Poor quality on product Reduced price None of the above **Methods of pest control** Chemical control Non-chemical control **Knowledge of indigenous pest control** Aware of indigenous control methods Are u using the Indigenous control methods Not aware of indigenous control methods		

Annexure 5: IKS ACTIVITY PROFILE FOR FIELD WORK PHASE 09/07/2007

Date	Activity
09/07/2007	Preparation for field visits. Courtesy visit to Ga-Mashabela and Ga-Phaahla
10/07/2007	Development of questionnaire. Checklist for specific technologies. Collected B/plan templated from LIBSA offices in M/Hall.
11/07/2007	Reviewed questionnaire Reviewed Chapter 1
12/07/2007	Reviewed the problem statement Formulated the rationale of the study, hypothesis Secured appointment at Ga-Phaahla and Ga-Mashabela livestock farmers for the 17th and the 18th. Did budget for 2-days with the total of R400 for food provision.
13/07/2007	Wait for the facilitators, Plan for the following weeks visits.
16/07/2007	Preparation and allocation of responsibilities
17/07/2007	Visit to Ga-Mshabela, reflection
18/07/2007	Visit to Ga-Phaahla
19/07/2007	Reflection on visit, established contacts with extension officer, councilor, interest group rep and youth representative.
20/07/2007	Draw strategic activity plan for the coming week.
23/07/2007	Writing report, polishing chapter 1, write chapter 2. Confirmation of appointment.
24/07/2007	Report writing cont'. (Transect walk) field work.
25/07/2007	Meet reviewer
26/07/2007	Field visit, video-taking at Diphagane. Socio-Agro-Economic exploration. Meeting with councilor and youth representative at 9hrs
27/07/2007	Exposure visit to Magadi at Magatle.
30/07/2007	W/shop on IKS
31/07/2007	W/shop on IKS
01/08/2007	W/shop on IKS
02/08/2007	Report editing and writing
03/08/2007	Report Writing

Annexure 6: MINUTES FOR IKS MEETING HELD AT TOMPI SELEKA AGRICULTURAL TRAINING CENTRE

Date: 17/05/2007
Time: 11:00

1. **Subject**
Meeting with Dr Makwarela facilitator of IKS team, and BIOWATCH representative Mr. Komane Petrus.

2. **Purpose**
First meeting with IKS research team to discuss terms of references as developed for implementation.

3. **Summary**

- Indigenous knowledge systems (IKS) is one of the themes as identified by the Department of Agriculture Limpopo Province.
- The IKS theme consists of 7 team members that are busy with ARD course.
- The team went through the terms of references and made recommendations, drawn the research plan and work plan.
- The team have also done the community mobilization and had focus group discussions in the community on the 9th and 16th of May 2007 respectively.
- The meeting of the 17th May 2007 is about getting clarity on the TOR as outlined in the discussions below.

4. **Discussions**
4.1 Dr Mkwarela has taken the team into paces on the background of the IKS and related issues. He has also highlighted the ARC VOPI focus as:

- Indigenous soil classification (ethnopedology).
- Indigenous weather focus.
- Post harvest technologies.
- Indigenous farming systems.
- Traditional medication for livestock.

4.2 The mist on TOR was partially cleared pending the meeting to be held on a date to be identified by Dr Mkwarela.
4.2 Partners were identified as LDA, University of Limpopo, University of Venda, ARC, BIOWATCH and that they should be given equal opportunity to identify and prioritize problems/opportunities.
4.3 The topic of the IKS team was identified as (**Identifying and documenting potential crops and innovations; and development of relevant production systems**).
4.4 Dr Makwarela has emphasized that Mr. MP Tshwana should be applauded for his consistency and contributions in the ARD issues.

5 **Recommendations**
5.1 The IKS team should investigate how much Diphagane people are spending for their production and how much are getting in return.
5.2 To investigate whether Diphagane farmers have their own cattle or they get kraal manure from other farmers.
5.3 IKS team to investigate the shelf life of the natural pesticide medicinal mixture that the Diphagane farmers are using.
5.6 Researchers should always have their business cards so that they can give them to clients and or stakeholders.
5.7 IKS team should also consider the other indigenous vegetables and not only had those planted in a fenced area only, e.g. commercial vegetables. We must refer to our farmers as the previously

disadvantageous and not the poor. The IKS team should be careful that data they are collecting should not be biased.

6. **Study Areas Identified**
- Diphagane (visited thrice)
- Ga Mashabela (not visited)
- Ga Phaahla (no mobilization yet)

7. **IKS Team Experiences To Date (Achievements)**
- Drawn research and work plan
- Held the first community meeting on the 9th of May 2007.
- Held focus group discussion on the 16th May 2007.
- Documented some technologies.
- Got some partial secondary data.
- Done transect walk

8. **Way Forward**

8.1 Mr MP Tshwana should hand to Thabile the IKS team coordinator the typed minutes on Friday the 18th of May 2007. Thabile should email them to Dr Makwarela on or before 21 May 2007. Dr Makwarela will circulate the minutes to the entire IKS team and hub members.

8.2 Dr Makwarela will communicate with the other identified stakeholders.

8.3 The following will be provided by Dr Makwarela to the team
- IKS policy
- NEMA Act
- Regulation and ABS
- Mr Petrus Komane will E-mail the final baseline study report to Dr Makwarela for circulation to the IKS team.

9. **Resources Required**

Dr Makwarela promised to do the follow up on the following items.
- Tape recorder
- Digital camera
- Stationary

10Attendants
- Mr MP Tshwana (LDA) tshwanamodisephilemon@yahoo.com
- Ms Thabile Poto (ARC Nelspruit) thabile@arc.agric.za
- Ms Poppy Makabanyane (ARC Onderstepoort) makabanyanep@arc.agric.za
- Mr Joseph Dolamo (LDA) 082 337 8829
- Mr Richard Chuene (LDA) chueners@agricho.norprov.za
- Mr Petrus Komane (BIOWATCH) bwsapk@mweb.co.za
- Mr Tebogo Serapelwane (Team reviewer from ARC-SRL co-coordinator North West Province) tebogo@ARC.agric.za
- Dr Makwarela (ARC VOPI) IKS theme coordinator makwarela@arc.agric.za

Annexure 7: TOOLS TO BE USED DURING COMMUNITY MEETING

Tools	What Is It Used For?	Who Should Do It
Resource mapping	To identify different natural resources e.g. water source, indigenous plants, vegetation and soil type. To know different activities that took place over the year.	MP Sindi
Seasonal calendar	**CROPS** ***LIVESTOCK*** Rain patterns *Vaccination program* Planting patterns. *Dosing program* Spraying programme. *Dipping program* Fertilizer application. *Auction* Weeding *Deworming* Harvest *Dehorning* Storage *Brand marking* Sales. *Castration*	Dolamo Poppy
Time line	To know different activities that took place over a period of time. How do you compare the use of plants in crop farming in ten years interval from 1970	MP Sindi
Venn diagram	To know different organization, working with the communities, different roles and accessibility. To familiarize and witness the activities and the natural resource existing.	Dolamo Poppy Thabile
Transect walking	Bringing out a topic for discussing but there are strict NO LIMITS. Ask a question but allow others to arise.	Thomas Thabile Thomas
Semi-structured interviews		

Annexure 8: RECONNAISSANCE SURVEY AT DIPHAGANE VILLAGE

The following survey was conducted on the 16/05/2007

Village	District	Agric activity	Type of farm settlement	Soil type	Vegetation	Distance from team base
Diphagane	Sekhukhune	Crop production (millet and sorghum) Animal production- the grazing area is used by small stock (about 200 goats) and very sheep.	Tribal settlement	Red sandy loam from the up-slope to clay in the bottom valley	The area below the mountain is a light forest with shrubs and trees. It falls under the grazing area but recently has been targeted for residential purpose. This could affect the medicinal plants population since that area is a potential habitat.	About 70km.