UNIVERSITY OF CAPE COAST

FARMER ASSOCIATIONS' PERCEIVED APPROPRIATENESS AND

PRACTICABILITY OF ROLE PLAYING GAMES FOR

MAINTENANCE OF CHÓKWÈ IRRIGATION SCHEME IN

MOZAMBIQUE

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

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Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

Over the years, there has been a debate on the application of participatory tools in real life. Participatory tools such as role playing games have been developed and tested in different countries where, they have been discovered to influence people's behaviour towards solving their problems. This study was a part of European Union and African Union cooperative research aimed to increase food production in irrigated farming systems in Africa (EAU4Food) project in Mozambique. The aim was to assess the perceived appropriateness and practicability of role playing game among farmers' association for maintaining the Chókwè irrigation scheme. A formative evaluation research was undertaken. Four farmers' associations were purposively selected. The main solutions to the problems were to increase in maintenance capacity of the managers in terms of equipment and financial resources, a better transparency in the planning of annual maintenance, a strengthening of the mobilising capacity of water user associations and a better management of cattle in the scheme. The role playing game was appropriate in the cleaning of canals and actors' interaction on most associations. The players perceived it practicable and they were happy to participate. Hence, they expressed interest in organising more game sessions. More times farmers play the game, their perceived appropriateness of the game in solving the problems, increases. It is then recommended that the role playing game should be used with other Farmer Associations regardless of type of farmers. The solutions provided by the farmers should be evaluated to assess their effectiveness.

ACKNOWLEDGEMENTS

DEDICATION

To my mother Mrs. Isabel Joaquim Mambule and in memory of my late

father Aurélio Jaime Bucuane.

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LIST OF ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
ANOVA	Analysis of Variance
AREJOMA	Josina Machel Farmer Association
AREVERDE	Revolução Verde Farmer Association
CIS	Chókwè Irrigation Scheme
ComMod	Companion Modelling
CPG	Conselho Paritário de Gestão
D1R1	First Distributor at the Sector Rio
D3R1	Third Distributor at the Sector Rio
D5B	Part B of Distributor 5
D12	Distributor 12
D13D	Right part of Distributor 13
EUA4Food	European Union and African Union cooperative research to increase Food production in irrigated farming systems in Africa Project
FAEF	Faculty of Agronomy and Forestry Engineering
FRELIMO	Frente de Libertação de Moçambique
Ha	Hectares
HICEP	Hidráulica de Chókwè – Empresa Públic
HIV	Human Immunodeficiency Virus
Km	Kilometre
MINAG	Ministry of Agriculture
NGOs	Non-Governmental Organisations

PEDSA	Strategic Plan for Agriculture Sector Development
PM	Post Meridiem
PROMPAC	Programa de Melhoria da Produção de Arroz em Chókwè
R1	First secondary canal of Sector Rio
RPG	Role Playing Game
SAVAL	Local Supply of Agricultural Inputs Enterprise
STATA 11	Statistics and Data Version 11
Sq.km	Kilometres Square
UGBL	Unidade de Gestão da Bacia do Limpopo
UEM	Eduardo Mondlane University
WAG	Water-A-Game
43S	Tertiary Canal 43

CHAPTER ONE

INTRODUCTION

Role playing game is a participatory tool that can be used to simulate real situations of sharing different views of stakeholders involved in a natural resource allocation. The Chókwè Irrigation Scheme (CIS) is the largest irrigation scheme in Mozambique. The scheme is affected by poor drainage, watercourses blockage and canals damaged by cattle. The tool has been successfully used in South Africa and Asia to influence people solving problems similar to those of the CIS. In this chapter, the research presents the background to the study, the statement of the problem, objectives of the study, significance of the study, delimitations of the study, limitations of the study, assumptions of the study, definition of key terms and organisation of the study.

Background to the Study

This study was within the EAU4Food project, which is an European Union and African Union cooperative research aimed to increase food production in irrigated farming systems in Africa. The project in Africa is based in South Africa, Mali, Tunisia, Ethiopia and Mozambique. It started in 2011 with overall goal of addressing the need for new approaches that are capable of increasing food production in irrigated areas in Africa, while ensuring healthy and resilient environments. To move towards the attainment of this goal, there are two key strategies outlined by the project. The two

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strategies are firstly to utilise a true trans-disciplinary approach that involves active participation of all stakeholders in all relevant disciplines and, secondly, to determine and respect the sustainable production threshold. The threshold of sustainable production means a point at which the use of productive factors is in a way that meets the needs of the present without negatively affecting the future generations' needs.

The economy of Mozambique, one of the countries involved in the EAU4food project, is essentially agricultural. More than 90% of farmers practice small-scale agriculture that is characterised by low productivity mainly, because of low adoption of improved agricultural techniques, low access to inputs and unfavourable rainfall.

About 8.8% of family sector farmers use irrigation (MINAG, 2010). The Chókwè Irrigation Scheme in Chókwè District, Gaza Province in Mozambique, is the largest irrigation scheme in the nation and is being managed by a public enterprise, *Hidráulica de Chókwè Empresa Pública* (HICEP).

According to Chilundo, Munguambe and Namagina (2012), the climate of Chókwè District is semi-arid with large rainfall variability within and between years with an average rainfall of 622 mm. Rainfall occurs mostly during the rainy season (October to April) counting for 88% of total annual rain. The average evapotranspiration is about 1,408 mm, resulting in deficit of water of 786 mm (the difference between rainfall and evapotranspiration) that must be covered by irrigation, if the farmers need to produce (rice and horticultural crops) the main crops grown in this district.

Chókwè Irrigation Scheme as the largest scheme in Mozambique has over the years been affected by poor drainage, floods and salination. These problems include cleaning of canals and adverse effects of cattle inside the scheme. Maintenance of the irrigation infrastructure of the scheme is the primary function of management.

According to Skutsch and Evans, as cited by Becu, Neef, Schreinemachers and Sangkapitux (2007), with examples of two large irrigation schemes in Asia, highlighted that there is a direct relationship between adequate level of maintenance and overall agricultural production. Maintenance of the irrigation scheme is very important because it influences the distribution of water to the users.

For Chigozie (2012), many agricultural development interventions tend to fail because of use of administrative methodologies or "Top-Down" approach. This "Top-Down" approach considers the beneficiaries as "objects" that need to be changed to a "better" situation. Instead of considering them as "agents" that also have roles to play in expressing their needs and, how they think the problem can be filled. The interventions therefore tend to fail because of ignoring the needs of the target group of agricultural development.

Teaching process consists of the strategies that the development agents combine to assess the beneficiaries while the learning is a process where the beneficiaries get the deeper understanding of the subject matter. Administrative methodology in a learning process is considered the teacher or facilitators centred methods which assume that, the learners (target groups) have no knowledge. The "Bottom-up" approach, on the other hand, takes into

consideration students centred methods that take into consideration the knowledge of the target groups. There are different student centred methods wherein the role play, simulation and gaming are part of them (Chigozie, 2012). According to Reed (2008), participatory tools were developed in part as a response to the top-down, science-led transfer of technology paradigm.

The "Top-Down" and "Bottom-up" approaches are relevant theories of perception that are used as a process of acquiring and processing of information characterised by the direction of information flow. People's perception became the central question in the communication theory in modern design, as well as, in the newest advanced technologies. The theories of Perception used to be mainly the domain of philosophers trying to explain their own knowledge. Nowadays, the centre of research is shifting away from a purely human dimension and they are becoming more scientifically technological utilitarian matter. However, working with adults, their point of views should be respected (Démuth, 2012; Richards, 2006)

According to Chigozie (2012), role playing allows the adult student to experience something which they are aware of, and it encourages active participation on the part of adult students. To reduce the failures of development interventions, institutions of rural development have applied participatory methods (such as: Participatory Technology Development, Participatory Rural Appraisal) that enhance the rural community to be the mentors of their social and economic development. The participatory methods emphasize the strengths of experimental capability of local community.

Over the years, participatory tools, such as role playing games have received criticisms because it is difficult to envision a direct impact of these tools on the natural and economic environment, once it is so difficult to link this kind of actions to changes in the state of environment. Thus, the objectives of participatory tools are targeted towards improving accommodation processes rather than measurable changes in state of the environment. However, participatory tools are useful for building a common perception in a situation of changing rules and resource allocation where there are always conflicting points of views (D'Aquino & Bah, 2011).

In Chókwè Irrigation Scheme, small farmers expressed difficulties to proceed to the maintenance of secondary and tertiary irrigation and canals drainage that they are supposed to take charge of due to limited financial capital and level of equipment (Maduma, cited by Eau4Food report 2012). The manager of the scheme (HICEP) has notably reassumed responsibility for cleaning secondary and tertiary canals and has acquired new machinery to do so. The acknowledgement of these difficulties led HICEP to reform recently the maintenance organization. HICEP has also prohibited the use of cattle inside the scheme although enforcement of the new rules is weak because, farmers say that outside the irrigated scheme, the cattle are being stolen.

In the light of the poor maintenance, farmers in the irrigated scheme lose their production due to excess water (bad drainage) or lack of water (watercourses blocked). Because of bad drainage, the floods cause salination of soil and reduce its farming capabilities. The farmers therefore, face difficulties to pay back bank loans contracted, reducing their access to future loans.

The aim of the study was to assess the perception of farmers about the appropriateness and practicability of role playing games after playing the games at the Chókwè Irrigation Scheme, Chókwè district, Mozambique. A game session is only part of a larger work with both the managers and the farmers concerning development of participatory planning for maintenance. The idea was to assess the farmer associations' perceived appropriateness and practicability of the game on the maintenance of the irrigation scheme and then engage all actors in building their own plan of changes.

Statement of the Problem

In 2012, EAU4Food embarked on a field observation in Chókwè irrigated scheme by interacting with two Farmer Associations and one women's group in the scheme. The field observations of EAU4Food revealed some problems relating to poor maintenance of the irrigated scheme. The problems identified with the Chókwè irrigation scheme are quite similar to those found in Asia and South Africa. In Asia, participatory tools such as role playing games have been tested to support the creation of water institutions. In South Africa the approach was used to strengthen capacity building in watershed management (Waldron, 2013). Both experiments focused on the coordination mechanisms involved in sharing the water which is viewed as a common pool resource. In South Africa, the main problem was to address the complex implementation of Integrated Natural Resource Management (INRM), which was driven by the integration and communication of actors and stakeholders. This was a challenging process as it involved the evaluation and

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assessment of dynamics of the situation, as well as the development of an integrated mechanism based on predicted future scenarios.

Based on the observations, EAU4Food project proposed to use the tool in Mozambique. The role playing game as one of the participatory tools has been used to model and simulate the evolution of complex systems over time. Social simulation understands and strengthens the collective decision-making process of stakeholders on how to share common resource. Simulation is used as platforms for collective learning to integrate the different stakeholders' points of view. This simulation tool has not been tested in the case of Mozambique. Hence, the need for the project to find out the perceived appropriateness and practicability of role playing games among farmers' associations at the Chókwè irrigation scheme.

According to PROMPAC survey, cited by EAU4Food (2012) the five main issues regarding problems in the irrigated scheme include bad drainage, Watercourses blocked, lack of maintenance of minor watercourse, damaged canals and cattle owned by farmers caused damage. The main reason for that is the deficient cleaning of canals (irrigation and drainage) by the manager.

Since role playing game has shown good results in other areas (Asia and South Africa), it is anticipated that the tool can be used in the case of Chókwè Irrigation Scheme. That is why the approach applied in this work is the same applied in other areas. Therefore, it is important to find out the extent to which selected farmer associations perceive its appropriateness and practicability for the maintenance of the Chókwè irrigation scheme, Mozambique.

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Objectives of the Study

The general objective of the study was to assess the farmer associations' perceived appropriateness and practicability of role playing game for the maintenance of the Chókwè irrigation scheme in Mozambique

The specific objectives of the study were to:

1. Describe Farmer Associations in Chókwè irrigation scheme;

2. Identify perceived problems faced by Farmer Associations in using the irrigation scheme;

3. Describe the possible solutions to the problems of the maintenance of the irrigation scheme given by the farmer associations;

4. Assess the practicability of a role playing game as perceived by the farmer associations;

5. Assess farmer associations' perception about the appropriateness of the game to the solution of their problems; and

6. Determine the relationship between the number of times a player plays the game and the player's perceived appropriateness of the game in solving the problems at the Chókwè irrigation site, in terms of: cleaning of the water canals, re-location of cattle at the irrigated area and actors' interaction

Research Questions

The research questions were:

1. What are the characteristics of Farmer Associations in Chókwè irrigation scheme?

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2. What are the perceived problems faced by Farmer Associations in using the irrigation scheme?

3. What are the possible solutions for the problems of the maintenance of the irrigation scheme according to the farmers association?

4. What is the practicability of the game as perceived by farmer associations?

5. What is the farmer associations' perception about the appropriateness of a role playing game to the solution of their problems?

6. What are the relationship between the number of times a player plays the game and the player's perceived appropriateness of the game in solving the problems at the Chókwè irrigation site, in terms of: cleaning of the water canals, relocation of cattle at the irrigated area and actors' interaction?

Hypotheses of the Study

The hypotheses in the study were to further substantiate the last two objectives. The following non-directional hypotheses were tested at 95% confidence level:

H_0: There is no significant difference between small-scale farmers' perceived appropriateness of the game in the cleaning of canals and that of the medium-scale farmers

H_1: There is a significant difference between small-scale farmers' perceived appropriateness of the game in the cleaning of canals and that of the medium-scale farmer

H_0: There is no significant difference between small-scale farmers' perceived appropriateness of the game to the relocation of cattle and that of the medium-scale farmer

H_1: There is a significant difference between small-scale farmers' perceived appropriateness of the game to the relocation o cattle and that of the medium-scale farmer

H_0: There is no significant difference between small-scale farmers' perceived appropriateness of the game to the actors' interaction and that of the medium-scale farmer

H_1: There is a significant difference between small-scale farmers' perceived appropriateness of the game to the actors' interaction and that of the medium-scale farmer

H_0: There is no relationship between the number of sessions attended by the participants and their perceived appropriateness of the game in the cleaning of canals

H_1: There is a relationship between the number of sessions attended by the participants and their perceived appropriateness of the game in the cleaning of canals

H_0: There is no relationship between the number of sessions attended by the participants and their perceived appropriateness of the game to the relocation of cattle

H_1: There is a relationship between number of sessions attended by the participants and their perceived appropriateness of the game to the relocation of cattle

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H_0: There is no relationship between number of sessions attended by the participants and their perceived appropriateness of the game to the actors' interaction

H_1: There is a relationship between the number of sessions attended by the participants and their perceived appropriateness of the game to the actors' interaction

Significance of the Study

The description of the Farmer Associations, their problems in the irrigation scheme and the way they think the problems could be solved, would help the Eau4Food project and other development agencies to plan specific actions to improve the performance of the scheme. It would also contribute to increase the agricultural production in the area.

The farmers' participation in the game sessions would enhance their understanding of the collective consequences of their individual actions. The farmers in the game would see the constraints of the manager in terms of cleaning the water canals. During the game sessions and the debriefing after each session, managers' strategies in cleaning the canals would come out. The Manager of the scheme would benefit from the views of the farmers and apply the strategies suggested that could improve the performance of the irrigation scheme.

The results of the study would serve as a valid discussion basis between the irrigation scheme stakeholders (mainly scheme managers and farmers) on the infrastructural and organizational constraints and to define alternatives strategies aimed at improving the performance of the irrigation scheme.

So, if the Farmer Associations perceive the tool practicable and appropriate, solutions of the problems in the scheme will come out, such as relocation of the cattle by the farmers in a place where they cannot be stolen and they will not damage the tertiary canals and maintenance plan for the manager in terms of priority to start cleaning the canals (irrigation or drainage) depending on the season (wet or dry).

Since in the Chókwè irrigation scheme the farmers are classified into small, medium and large-scale farmers, the perceived appropriateness of the game will be assessed differently to each group. The main reason for that is different types of farmers have different number of cattle. The number of cattle is directly proportional to the scale of a farmer.

Delimitations of the Study

The unit of analysis was the farmer association. All activities in the role playing game were simulations and not real issues. People who answered the interview schedule were only those who played the game.

Limitations of the Study

The limitations of the study were the death of one member in one of the selected farmer association; the second workshop did not take place, so the triangulation was not done in this case. In the Graça Machel Farmer Association, the correlation between the number of sessions and the perceived appropriateness of the game on solving the problems was not done, because, the second workshop did not take place due to unavailability of farmers.

The main limitation of the design is that it cannot assess the effectiveness of the role playing game on the real problems of the irrigation

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scheme. The most it can do is to find out the perception of the associations concerning the appropriateness of the game to solving simulated problems during the game.

Assumptions in the Study

The assumptions stated below were the necessary conditions for undertaking the present study:

1. People who attended the workshops were actually members of the Farmer Associations ;

2. The farmer associations provided appropriate information regarding the performance of the irrigation scheme.

Definition of Key Terms

The following terms are defined based on how they were used in the study:

Appropriateness: Ability of the game to solve simulated irrigation scheme problems in the game.

Companion Modelling: Participatory modelling used to simulate complex socio ecosystem and enhances integrated knowledge on the functioning of the system and support collective actions.

Distributor: It is the secondary canal in Chókwè irrigation scheme.

Game appropriate: Game has the ability to solve the problems and the respondent is satisfied.

Game moderate: Game has the ability to solve the problems but it does not meet the satisfaction of the respondents.

Game inappropriate: Game does not have the ability to solve the problem.

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Maintenance: This is the primary function of the management of an irrigation scheme which include cleaning the irrigation and drainage canals, repairing of damaged watercourses and location of the cattle.

Participation: Process where farmer associations choose to play active role in making decisions that affect them.

Practicability: Ability of a role playing game to be done or put into action.

Role Playing Games: experimental situations based on partial representation of reality where players interact following rules and playing specific set of roles. In this study, the term role playing games was used interchangeably with games.

Organisation of the Study

This study consists of five chapters. The first chapter of the study presents the background to the study, the statement of the problem, objectives (general and specific) of the study, research questions, hypotheses, delimitation of the study, limitations of the study, assumptions in the stuy and finally definition of key terms. The second chapter presented relevant literature reviewed in the study. The third chapter described the role playing games, the research design, the study area, population and sampling, instrumentation, data collections and analysis. The fourth chapter presented discussion of findings of the study in accordance to the research questions. The last chapter summarised the study and also drew relevant conclusions and recommendations based on findings of the study.

CHAPTER TWO

LITERATURE REVIEW

The study is about the perceived appropriateness and practicability of role playing game among farmer associations for the maintenance of Chókwè irrigation scheme. In this chapter, the research provides information on literature directly related to the specific objectives of the study. The chapter consists of three sections. These are theoretical framework, conceptual framework of the study and, finally, the empirical review of related studies. After these sections, a summary of this chapter is also presented.

Theoretical Framework

In this section, the theoretical basis of the research is presented. The domains covered in this section are general overview of agricultural extension in Mozambique, methods of influencing human behaviour, perception studies, description of a farmer association in irrigation scheme, challenges faced by farmers in an irrigation scheme, maintenance of an irrigation scheme as complex system, validations of a qualitative research, participatory tools, typologies of participation, criticisms of participation, the Kolb's experiential cycle theory, the companion modelling approach, the process involved in developing a role playing game., assessment of a tool practicability and appropriateness.

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General Overview of Agricultural Extension in Mozambique

Mozambique is a vast country with an area of about 799,380 sq. km and around 2,400 km of coastline along the Indian Ocean (MINAG, 2010). According to MINAG (2007), the agricultural extension has had many steps in Mozambique. Before the independence in 1975, the agricultural extension looked at commercial fields to produce cash crops for export, with financial support from the organizations promoting those commodities. From 1975, it has been giving priority to state enterprises and cooperatives.

So, the weakness of production in Mozambique led to a changing paradigm for paying more attention to small-holder farmer's production and a large-scale of private sector's production. In this case, in 1987, was created Public System of Agricultural Extension which in law language is called Ministerial Decretory 41/87, 1987. The evolution of agricultural extension in Mozambique can be divided in four steps, as follows:

1. Establishment phase (1987-1992): First experience in some pockets based on Training & Visit;

2. Expansion phase (1993-1997): Introduction of modified Training and Visit; flexible use of the approach; extensive donor support for public and NGO extension;

3. Master Plan phase (1999-2004): adoption of pluralistic extension system;

4. Current Master Plan phase (2007-2016): adoption of decentralization to district level and deconcentration processes, multiple service

provider system, farmer empowerment and outsourcing extensions services.

According to MINAG (2010), the reason of developing the current Master Plan (2007 – 2016), is that Mozambique should develop its approach based on three key issues: decentralization, participation and partnership and outsourcing. The extension delivery services would be better through the farmers' associations and extension steering committees, and the approach will be based on learning, values and endogenous knowledge, participatory planning, evaluation and monitoring the programme and the farmers are really involved.

The contribution of Extension Department in the Mozambican agriculture is to improve food security, economic growth and poverty reduction, especially for male and female subsistence farmers, including female-headed and disadvantaged households, by increasing agricultural productivity and production through a steady uplift in production efficiency and the provision of new technology and institutional innovations while promoting participation and sense of ownership among producers (MINAG, 2010).

Methods of Influencing Human Behaviour

Van den Ban and Hawkins (1996) pointed out eight methods that can influence human behaviour. These are compulsion or coercion, exchange, advice, openly influencing a farmer's knowledge and attitudes, manipulation, providing means, providing service and changing the socio economic structure. Application of coercive power means that people applying the power are

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responsible for the behaviour of the people they are trying to change. It is possible to achieve behavioural change with a large number of people in a relative short time. Exchange method is a very efficient one for meeting the needs and interests of different groups, parties or individuals. Regarding the advice methods, advisers are responsible for the quality of their advice. While advisers' specialised knowledge may be put to good use, there is usually little development of the farmers' capacity to solve their own problems.

In openly influencing a farmer's knowledge and attitudes method is possible to achieve long-term behavioural change using this method. The farmers' self-confidence and capacity to solve other similar problems by themselves in the future are increased. Concerning the manipulation method, it is used when it is believed that it is necessary and desirable for farmers to change their behaviour in a certain direction.

Providing means method is used to change farmer's situation. The means in agriculture include short and long term credit for the purchase of land or inputs such as fertilizer or production subsidies. Correct and timely application of the means may result in large increases in individual farmers' incomes. Providing service method involves taking over certain tasks from farmers, such as, income tax, loan and subsidy applications, and other lengthy forms are an important but time-consuming part of modern farming. Methods for changing the socio economic structure in rural areas are important when farmers are not in a position to behave in certain way because of barriers in the economic and/or social structure. They are also used when it is believed that changes in the structure are desirable.

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Perception Studies

According to Démuth (2012), the way people see the world is nothing else but a set of perceptions, feelings and ideas. This author went further saying that phenomenalists agree to this viewpoint hat people's perceptions are the subject of our cognition. Through perceptions, people possess rational constructs, images and ideas created by themselves. Perception and sensing represent a unique source of how to experience something at all. As a result of rapid development of new research technologies and of interdisciplinary studies, a whole area of sciences and disciplines with a common interest in cognition came into existence and perception plays a crucial role in this area.

For Richards (2006), Gibson defines perception as "*the process by which an individual maintains contact with his environment*". To study perception, there are three theories, as far as this author is concerned: Information Theory of Perception, Passive Theory of Perception and Perceptual Learning Theory. The first theory is the one that spells out that information exists in the patterned flow of physical energy, so that no processing is needed for the subject immediately to perceive a world requires that some little is said about the character of this information. The passive theory of perception, namely that through perception we come to be acquainted with things as they really are. Lastly, the perceptual learning theory states that infants and young children cannot make the kinds of perceptual judgements of which adults are capable. They simply cannot see everything that might be seen in a situation. A perception study, therefore, is relevant in generating

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knowledge or feeling of people about certain aspect. So, it fits in the context of this research.

Description of Farmer Associations in an Irrigation Scheme

ACDI-VOCA (1999) defines a farmer association as a group of farmers who face similar problems and therefore similar needs. Those farmers come together to seek solutions to their common challenges through collective action. The challenges could be high fertilizer prices, crop marketing, low credit access and transport. The aim of a farmers' association is to help smallholder farmers realise higher profits from their farming business. Smallholder associations are organised around common needs and mutual interests of smallholder farmers. A Farmers' association is not organised to make profit for the association itself but for its smallholder farmer members who use the association's services. Associations are 100% democratically controlled and 100% owned by smallholder farmer members on an equal basis. Association's benefits are distributed 100% to smallholder farmer members in proportion to the amount they market produce and purchase inputs/supplies from the association. Farmers' associations, as per their by-laws are non-political and non-governmental.

The description above of a farmers' association in an irrigation scheme contributed to this work by helping the researcher to discuss the characteristics of the selected farmer associations in the study. The description of the associations helped to classify them in terms of small and medium-scale farmers in the role playing games.

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Challenges Faced by Farmers in an Irrigation Scheme

According to Chazovachii (2012), in an irrigation scheme in Zimbabwé, farmers face five types of challenges: transport, markets, labour, capital, and thieves and animals.

Transport: Food crops from irrigation farms are a challenge for many farmers once they lack the transport to carry their produce to the market. This tends to be a disadvantage to farmers who want to embark on horticultural production. Jackson cited by Chazovachii (2012) states that some small irrigation schemes face challenges of road and transport facilities mainly due to excessive water on the roads. Rural areas generally have gravel roads which are long and winding, some poorly maintained and inaccessible. Transport operators are in most cases reluctant to reach such areas and some of the farmers fail to get their produce to the market in time. Due to perishability of their product, farmers face the risk of running a loss.

Markets: Food crops such as cereals and horticulture crops from irrigation farms are either sold in local or urban markets. According to Chazovachii (2012), producers prefer selling to local markets in small quantities than in bulk. The main reason is that rural people in most cases cannot meet commercial quantities and qualities. Markets are unreliable especially during the rainy seasons when people are self-sufficient and reliant. In such times, the food crops are sold at very low prices, thus affecting income of farmers.

Labour: According to Hodder cited by Chazovachii (2012) irrigation farming is extremely labour intensive. An area under cultivation needs to be

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maintained and tends to make considerable demand on the time of farmers. Looking at the demographic characteristics of rural areas, it follows that women and children mostly attend to the plots. Watering the plots is particularly the worst challenge especially in times of water crisis, such as dry seasons.

Capital: Production under irrigation, like any other type of business, requires financial asset. It also needs agro-chemicals such as fertilizers and pesticides, seeds, in certain instances, irrigation pipes and sprinklers. Normally, farmers do not have money to purchase agricultural implements. Consequently, they are forced to do away with such important inputs and this negatively affects the quality of their crops. A lack of inputs is recognised as a major setback. In the end, these problems make irrigation farming fail in improving farmers' livelihoods (Chazovachii, 2012).

Thieves and Animals: According to Manzungu cited by Chazovachii (2012) in irrigation farming, protecting crops, when forage is scarce (dry season), from being destroyed by dangerous animals like Hippopotamus is scarce is a major problem. Existing fences are at times destroyed by the animals and it is quite expensive to repair them. Not only animals find their way into the fields but also human beings. Food crops are targeted by thieves who do not just steal parts of fences but occasionally raid the place for the crops and this tends to negatively affect the irrigation farming. Irrigation schemes can also be failures or be affected by internal and external human and physical threats to their survival. This can also lead to the stoppage of the scheme. So, this has resulted in some schemes not appropriately addressing

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their intended problems like eradicating peasant and communal poverty among farmers.

In an irrigation scheme in South Africa, the major challenges faced by farmers included funding, input shortages, lack of relevant training and expensive irrigation equipment (Chazovachii, 2012). Other challenges included an inflationary environment that eroded the value of irrigation funds, labour shortages and lack of relevant irrigation services. In Chókwè irrigation scheme, the problems identified that were used to develop the role playing game were based on the general problems of the scheme.

Maintenance of an Irrigation Scheme

Maintenance of irrigation is considered as a complex socio-ecosystem. Complex socio-ecosystem refers to a situation in which different actors count in decision-making process, involving human relationships, sharing a common natural resource (bio-physical characteristic) (Pisano, 2012). It is called a system, because the activities involved are interrelated and interdependent as a change in one of them consequently causes changes in the other activities.

According to Steins and Edwards, as cited by Ducrot (2009), social learning process lays the platform for discussion or decision making, gathering different stakeholders who perceive the same resource management problem, realise their interdependence for solving it, and come together to agree on collective action strategies for solving the problem. Failure to build constructive dialogue and social learning is often due to the mode of participation, for instance, selection of participants, legitimacy or even capacity to meaningfully participate, misunderstanding other parties' representations.

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Because of the interactions of humans (managers and farmers), nature (sharing a common natural resource like water) and technological aspect (canals of water), maintenance of irrigation scheme can be considered as a complex socio-ecosystem. According to Pisano (2012), human and the biophysical domains are interdependent. Humans live and operate in social systems that are impossible to separate with the ecological systems in which they are embedded; socio-ecosystems are complex adaptive systems that do not change in a predictable, linear and incremental fashion.

In a complex socio-ecosystem, optimal solutions are difficult to find because of the large number of variables to take into account and the divergent interests, objectives and strategies of the different stakeholders, especially, farmers. In these contexts, which are characterized by poor vertical integration, a large horizontal diversity and cooperative management, decision-making processes are rather based on negotiation leading to trade-off solutions (D' Aquino, 2007).

Validation of a Qualitative Research

The simulation tool used in this study is a participatory tool. A participatory study is a type of qualitative research. According to Golafshani (2003), a qualitative research is any type of study that produces results not arrived at by means of statistical tools or other means of quantification. As such, this kind of research has received a lot of criticisms related to its subjectivity, compared with quantitative research. However, both qualitative and quantitative researchers need to test and demonstrate that their studies are credible.

In quantitative studies, the credibility is assured by instrument construction while in qualitative studies the researcher is the instrument (Patton, 2002). Credibility is assessed by validity and reliability of the study. Unlike quantitative studies where validity and reliability are looked separately, in the qualitative, the two are combined into one term which is called trustworthiness.

Before going to the different ways of ensuring the validity and reliability in a qualitative study, it is necessary to present different views of the meaning of the two terms in this kind of research. For Winter as cited by Golafshani (2003), the concept of validity in qualitative studies is not single, fixed or universal. It implies that the concept is defined according to each case. Although some researchers in this field have argued that the term validity is not applicable to qualitative research, at the same time, they have realised the need to have some kind of qualifying check for their research.

According to Creswell and Miller, as cited by Golafshani (2003), validity is affected by the researcher's perception of validity in the study and his/her choice of paradigm assumption. So, different researchers have developed their own concepts of validity and have often generated or adopted what they consider to be more appropriate terms, such as, quality, rigor and trustworthiness.

With regard to reliability, it is a concept used for testing or evaluating quantitative study; the idea is most often used in all kinds of research. A good qualitative research would help readers understand a situation that would otherwise be enigmatic or confusing (Eisner, 1991). For Stenbacka (2001),

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reliability is a concept to evaluate quality in quantitative research with a "purpose of explaining" while quality concept in qualitative research has the purpose of "generating understanding". The difference in aim of evaluating the quality of researches in quantitative and qualitative research is one of the justifications that the concept of reliability is irrelevant in qualitative research.

However, for Patton (2002), validity and reliability are two factors which any qualitative researcher should be concerned about while designing a research, analysing results and judging the quality of the study. To be more specific with the term "reliability" in qualitative research, it is recommended for the use of "dependability" which closely corresponds to the notion of "reliability" in quantitative research.

For a qualitative research, to ensure validity and reliability, the term applied is trustworthiness. According to Shenton (2004), trustworthiness is the extent to which the findings of a qualitative study are sound. Although there are many debates to the acceptance of trustworthiness of qualitative study, frameworks for ensuring rigour in this kind of research have been in existence for many years. To ensure trustworthiness, qualitative researchers attempt to satisfy four aspects called Guba's Four Criteria. These are credibility, transferability, dependability and confirmability. In addressing credibility, researchers attempt to demonstrate that a true picture of the phenomenon under study is being presented. To allow transferability, the investigators provide sufficient detail of the context of the fieldwork for a reader to be able to decide whether the prevailing environment is similar to another situation with which he or she is familiar and whether the results could be applied to the other

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setting. To address the dependability criterion is not easy in qualitative research although researchers should at least attempt to enable a future investigator to replicate the study. Lastly, to achieve confirmability, researchers must take steps to demonstrate that the research's results emerge from the data and not their own predispositions.

For Shenton (2004), there are provisions that should be made by a qualitative researcher wishing to address Guba's Four Criteria for Trustworthiness:

a) Credibility (in preference to internal validity)

1. Adoption of appropriate well recognised research methods;

2. Development of early familiarity with culture of participating organisations;

3. Random sampling of individuals serving as informants;

4. Triangulation via use of different methods, different types of informants and different sites;

5. Tactics to help ensure honesty in informants;

6. Iterative questioning in data collection dialogues;

7. Negative case analysis;

8. Debriefing sessions;

9. Peer scrutiny of project use of "reflective commentary";

10. Description of background, qualifications and experience of the researcher;

11. Member checks of data collected and interpretations/theories formed;

12. Thick description of phenomenon under scrutiny and

13. Examination of previous research to frame findings.

b) Transferability (in preference to external validity)

1. Provision of background data to establish context of study and

2. Detailed description of phenomenon in question to allow comparisons to be made.

c) Dependability (in preference to reliability)

1. Employment of "overlapping methods" and

2. In-depth methodological description to allow study to be repeated.

d) Confirmability (in preference to objectivity)

1. Triangulation to reduce effect of investigator bias;

2. Admission of researcher's beliefs and assumptions;

3. Recognition of shortcomings in study's methods and their potential effects;

4. In-depth methodological description to allow integrity of research results to be scrutinised and

5. Use of diagrams to demonstrate "audit trail".

In the case of this specific thesis, Guba's Four Criteria suggested by Shenton (2004) were used. However, due to resource constraints and participants' unavailability, not all the provisions in each criterion were used. In a view of similar to Shenton as presented above, Ntifo-Siaw and Bosompem (2008), argued that due to fallibility of all measurements, post-positivism emphasizes the importance of multiple measures and observations, and the need to use triangulation across these multiple error-laden sources to try to get a better picture of what is happening in reality. The authors went further

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explaining that, if it is impossible for any one individual to see the world perfectly as it really is, then the best hope for achieving objectivity is to triangulate across multiple fallible perspectives. In a post-positivist view of science where certainty is no more considered attainable, probabilities and statistics play an important role in contemporary social study. Kolb and McKernan as cited by Ntifo and Bosompem state that action research, by facilitating triangulation and participation, provides a positive context for knowledge generation and learning. It implies that people tend to learn better from what they do rather than what they see and/or hear.

In the light of the views presented above, describing the farmer associations involved in the study, their problems related to the issue of the study (in the irrigation scheme) and how the participants perceive that the problems can be solved would lead to the application of the provisions of Guba's Four Criteria of trustworthiness in this study. Once the simulation tool proposed to be tested has the final aim to bring about solutions of the problems of the scheme, it is necessary to find out the specific problems in each farmer association. The study was done in a participatory manner. Thus, in the study, participation means that farmer associations choose to take an active role in making decisions that affect them. However, there are different typologies of participation that are discussed under the next sub-heading.

Typologies of Participation

According to Reed (2008), there are four typologies of participation, as presented in Table 1.

Table 1: Typologies of Participation

Basis of Typology	Example
Different degrees of participation on a continuum	Arnstein's, ladder of participation, wheel of participation.
Nature of participation according to the direction of communication flows	Rowe and Frewer
Theoretical basis, essentially distinguishing between normative and/or pragmatic participation	Thomas, Beierle
Objectives for which participation is used	Okali, Michener, Warner, Lynam, Tippet.

Source: Reed (2008)

The key proponents (example in Table 1) were listed by Reed (2008). These typologies provide alternative basis for distinguishing between the numerous available methods and approaches for stakeholders' participation. They also support a basis for selecting the methods that are likely to be most appropriate to the purpose of the work in a given context.

Talking about the first typology, the basis of this typology is a continuum of increasing stakeholder involvement, from passive dissemination of information ("manipulation") to active engagement ("citizen control"). Reed (2008) describes the level of engagement as a relationship that can be "contractual", "consultative", "collaborative" and "collegiate". This typology (levels of engagement) is likely to be appropriate in different contexts

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depending on the objectives of the work and the capacity for stakeholders to influence outcomes.

The next typology, according to Rowe and Frewer, as cited by Reed (2008) focuses on the nature rather than the degree of engagement, identifying different types of public engagement by the direction that communication flows between parties. Based on this view, information dissemination to passive recipients constitutes "communication", gathering information from participants is "consultation" and "participation" is conceptualised as two-way communication between participants and exercise organisers where information is exchanged in some sort of dialogue or negotiation.

The third typology in Table 1 focuses on theoretical basis, essentially distinguishing between participation that is normative and/or pragmatic. The normative participation focuses on process, suggesting that people have a democratic right to participate in environmental decision-making. On the other hand, pragmatic arguments focus on participation as a means to an end, which can deliver higher quality decisions.

The last typology is based on the objectives for which participation is used. Reed (2008) citing Okali et al. distinguished between "research-driven" versus "development-driven" participation. Similarly, this author contrasted "planner-centred" participation that is focused on outcomes with "people-centred" participation. This (people-centred) builds capacity and empowers stakeholders to define and meet their own needs.

Other authors, such as Lynam et al. as cited by Reed (2008) focused instead on the operational objectives of participation, distinguished between

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"diagnostic and informing", "co-learning" and "co-management" methods. From the description of the typologies of participation, it is argued that participation can empower stakeholders through the co-generation of knowledge with researchers and increasing participants' capacity to use this knowledge.

Participatory Tools

According to Krishnaswamy (2004), participatory research presents people as researchers in pursuit of answers to questions that affect them in daily life. Tools are instruments, activities or methods used to implement a participatory research. The tools that can be used in a meeting are note card exercise, brainstorming creative solutions, Venn diagrams and field-based tools for building a shared understanding.

The note card exercise has the purpose of finding common ground and identifying shared priorities and values. The brainstorming creative solution is used by groups of people working on a project to expose their preliminary ideas about the project for all those involved to see. Venn diagrams are used to identify linkages and overlaps in ideas or perceptions. The examples for field-based tools for building a shared understanding are mapping the landscape, field trips and citizen monitoring. Mapping the landscape gives people a shared "bird's eye" view of the landscape. Field trips consist on abstract discussions based on different perspectives to a concrete, site specific context as a basis for common understanding. Citizen monitoring involves community members in assessing environmental and/or social change over time (Krishnaswamy, 2004).

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According to GSDRC (2010), the tools of a participatory research are: Participatory Rural Appraisal, Beneficiary Feedback, Key Informant Interviews, Most Significant Change Technique and Outcome Mapping. Participatory Rural Appraisal involves a range of methods to enable local people to analyse their own realities as the basis for planning, monitoring and evaluating development activities. Beneficiary Feedback seeks to gather stakeholder's views about the quality and impact of a development agency's work. Key Informant Interviews are a rapid assessment methodology that can be used as an intermediate indicator of outcomes as an alternative or supplement to full impact assessments. The Most Significant Change technique involves the collection of change stories from the field level, and the systematic selection of the most significant of these. Outcome Mapping is an alternative to theory-based approaches to evaluation that rely on cause – effect framework. The Outcome Mapping focuses on people and changes of behaviour and how far development interventions have built the capacity of the local community.

Criticisms of Participation

According to D'Aquino (2007), there a number of criticisms of participation that must be known by researchers when dealing with participatory studies. These are: difference of power among members, complexity of the social and political context that depends on social relations and positions of power between members of the community, underlying social and cultural stakes of each stakeholder and group involved. It is also difficulty to ensure that the chosen target populations are appropriate to achieve social

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evolutions and if researchers allow leaders to express themselves, thus reproducing social differentiations or intervene on behalf of a socially excluded group. Finally, it is difficult to ensure that facilitators during workshops go off course. Furthermore, the decision processes are not limited to the public eye alone, with a significant part taking place behind the scenes, depending on the varying modes of different societies. Collective interaction is the ideal place for social monitoring to occur, from setting the stage to affirmation of power, with choices being more dependent on mediation of power struggles than on mutual, rational cooperation. Practitioners might think they are changing modes of cooperation or social institutions, when they really have only attempted in the recasting, in a new context, of the existing roles and statuses, whether among technicians and civil society or among local leaders and inhabitants.

But it is also important to improve methods and tools in order to strengthen the gaps between "bottom up" participatory dynamics and the institutional "top-down" methods of decision-making (D'Aquino, 2007). The criticisms of participation guided the research in the sense of trying as much as possible to avoid the disadvantages of the participatory work. Some measures used were to involve all the participants in the discussion, repeat questions in different times.

Kolb's Experiential Learning Theory

According to Percy (2004), the Kolb Experiential Learning is a form of a cycle, as it is presented in Figure 1 below. Kolb's theory describes experiential learning as ''the process whereby knowledge is created through the transformation of experience.'' The theory proposes that experiential

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learning follows a cyclical process - from experience to reflection to conceptualization to application - with this cycle being continuously repeated. Most descriptions of experiential learning place it within the constructivist paradigm.
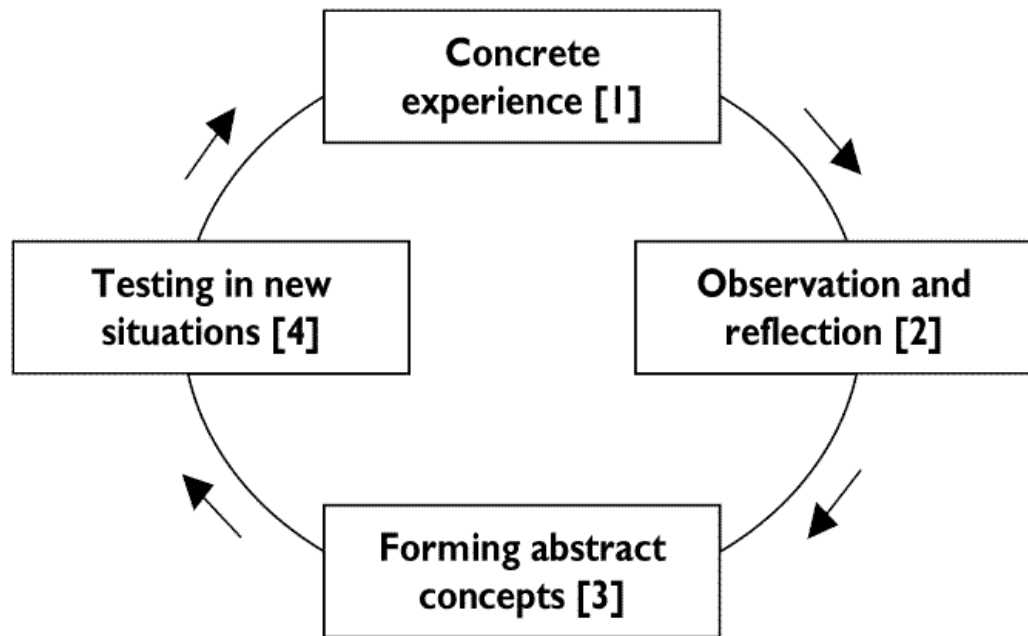
Figure 1: Kolb's Experiential Learning Cycle

Source: Percy, 2004

According to Percy (2004), the four steps at the cycle in Figure 1 are explained as follows: **Concrete Experience (CE)**: This stage of the learning cycle emphasises personal involvement with people in everyday situations. In this stage, the learner would tend to rely more on feelings than on a systematic approach to problems and situations. In a learning situation, the learner relies on the ability to be open-minded and adaptable to change.

Observation and Reflection (OR): In this stage of the learning cycle, people understand ideas and situations from different points of view. In a

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learning situation, the learner would rely on patience, objectivity, and careful judgement but would not necessarily take any action. The learner would rely on their own thoughts and feelings in forming opinions.

Abstract Conceptualisation (AC): In this stage, learning involves using theories, logic and ideas rather than feelings to understand problems or situations. Typically, the learner relies on systematic planning and develops theories and ideas to solve problems.

Testing in New Situations (TS): In this stage, learning process takes an active form-experimenting with changing situations. The learner would take a practical approach and be concerned with what really works, as opposed to simply watching a situation.

For Hays cited by Rydannykh (2011) game is an artificially constructed, competitive activity with a specific goal, a set of rules and constraints that are located in a specific context. So, in the game of this study, people are involved in a practical representation of the situation in the irrigation scheme; they go through a concrete experience. During the game, they observe and reflect on the collective consequences of their individual actions in the scheme. After the game, they are invited to a debriefing, where they do the abstract conceptualization, where they discuss ways to solve their problems. After some time of the game sessions have passed, the farmers use the lessons and ideas from the game in the new situations.

The Companion Modelling (ComMod) Approach

The approaches used in the ComMod intend to fulfil two main purposes. Firstly, they seek to understand the complex biophysical (natural

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resource) and social environment. Secondly, they aim to facilitate the negotiation of collective decision making process in the management of a certain natural resource (Becu, Neef, Schreinemachers & Sangkapitux, 2007).

As pointed by Becu et al. (2007) ComMod has been developed as a modelling approach that can be used to develop a platform where different stakeholders (managers and farmers) are involved in a continuous feedback. The authors go further spelling out that other approaches of ComMod have used role playing games assuming the difficult understanding of computer modelling by the stakeholders. According to Ducrot, Bueno, Barban and Reydon (2010) in the ComMod approach, role-playing games facilitate, through the social simulation, the social learning, biophysical events and the perceptions on the underlying conceptual model.

For Souchère, Millair, Echeverria, Bousquet, Le Page and Etienne (2009) ComMod is a community based scientific approach to facilitate collective action. The approach combines Multi-Agent Systems (MAS) and Role Playing Games (RPGs) to facilitate dialogue among different stakeholders by a given local issue of natural resource management.

The ComMod approach is used to construct a role playing game. A role playing game (play map and its rules) for this study has been developed by Eau4Food Project from June to August 2014. According to Becu et al. (2007), the approach has a form of a cycle, which starts with field study. The field study consists of primary data collection to calibrate a primary version of the model and subsequent interactions with the stakeholders to refine the model. For this, participatory sessions are used for the interactions.

During the sessions, the model and its hypotheses are presented to the stakeholders, simulations are run and the results are discussed. The discussions help the researcher to review the model's assumptions and to identify scenarios of interest to the stakeholders. A new version of the model is then developed and again discussed with the stakeholders for further refinement. Through this process the model is developed into a shared representation of the reality. This was the procedure used to get the map of the game and its rules.

Development of Role Playing Games

According to Waldron (2013), a role playing game developed for the South African case was in three phases, namely, Design Phase, Testing Phase and Application Phase. So it is presented in detail explanation of each phase, according to the same author.

a) **Design Phase**

The game or model simulation was created through calculated and relative representations of elements and dynamics in the area with the aim of highlighting key issues, challenges and activities present in the reality. The information used for this development was based on actual data as well as the perceptions and understanding of local actors, specialists and researchers which were gained through interviews. During this phase, the RPG was tested with various groups of participants, and refined after each game session to ensure accuracy and precision. The RPG was tested with specialists and stakeholders who have an in-depth understanding of the area and its dynamics as well as with university students to ensure the flow and 'playability' of the game.

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b) Testing Phase

RPG workshops were conducted with focus groups of stakeholders and actors, ensuring the involvement of a range of categories that covered a variety of sectors, organizations and stakeholders. The aim in this phase is to have focus sessions that allow stakeholders to have their perception, challenges, opinions, visions and thoughts captured, without the influence of other sectors. This stage also enabled in-depth testing of the RPG, allowing participants to critique the tool and its accuracy with the reality of the case study. This was done to ensure that the RPG accurately represents the dynamics, actions and systems in place on the ground. The feedback from each session was applied to the tool before the following workshop, not only to heighten its accuracy but also the test the alterations made.

After each focus group workshop, a detailed report was compiled, indicating the participants' reactions and responses to the RPG as well as feedback given about the tool. The reports also included the outcomes and discussions of the brainstorming session as well as a digital copy of the spatial analysis exercise. At the end of this phase, a report was compiled as a summary, highlighting the main outcomes and findings of all of the focus group workshops.

c) Application Phase

The final stage of the RPG is the main aim of the entire process, which is to test the strategies selected by stakeholders as a means of predicting future outcomes. Here, the outcomes of phase 2 were used to make final alterations to the tool, to ensure that it was accurate and real. This phase also involved the

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inclusion of elements of the draft strategies into the RPG so that the challenging actions could be 'acted out' through the RPG. The key challenging element that was identified in the drafting of the strategy workshop was its implementation. Therefore, the final RPG workshop tested various institutional mechanisms for implementation and conclusions were made based on the outcomes and stakeholders' discussions.

Assessment of a Tool Practicability

According to Foreman, Thomas and Gardner (2004), practicability of a tool or an activity is its ability to be done or put into action. Practicability is one of the aspects of determining the suitability of a tool. Practicability is assessed during workshops with people who use it. There are qualitative and quantitative analyses for assessing a tool practicability. The qualitative analysis is based on participant observation, discussions and plenary presentations. The quantitative analysis is based on individual interview schedule to the participants who used the tool. In the case of this specific research, only qualitative analysis of practicability assessment of role playing game was used. The techniques used were observation and debriefing sessions (discussions).

Biosca and Galimany (1993) pointed out that practicability includes a number of qualities that provide information about the wide range of possibilities a tool has under specific working conditions. A good evaluation of a tool practicability covers all aspects of analysis, both favourable and unfavourable and provides potential users with the information that will allow them to select a tool that best suits their specific working conditions. Based on this argument, the variables used in this specific research to assess the

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practicability were the strategy used by the manager and farmers in the role playing, importance of the tool, what drew more attention in the tool, realistic and not realistic aspects in the tool, lessons learned in the tool and the tool applicability in real life.

Assessment of a Tool Appropriateness

Appropriateness of a tool is its suitability for a particular situation or occasion. Roberts, et al. (2014) argue that qualitative and quantitative analyses could be used to assess tool appropriateness for a specific occasion. For the case of a role playing game, the qualitative analysis is based on the observations of the suggestions that emerged from the tool putting on in real life. Quantitative analysis is based on the rating of the tool by people who used.

For this specific research, only quantitative analysis of the appropriateness of a role playing game was done. Descriptive statistics were used to assess the tool appropriateness.

Conceptual Framework

After reviewing literature on the participatory tools on maintenance of the Chókwè irrigation scheme, including the determinants or factors to take into considerations in role playing games (RPGs), the conceptual framework of the study is presented in Figure 2. From the conceptual framework, the description of the farmer associations in terms of the leadership, the membership and the activities of the associations lead to the problems the members face in the scheme. The problems the farmer associations face lead to the possible solutions the members think can solve the problems. The solutions, therefore, lead to the maintenance of the irrigation scheme. The real

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problems in the farmer associations affect general problems of the scheme identified by EAU4Food (2012) and are related to poor drainage, salination, broken tertiary canals and blocked water courses. The general problems of the scheme were used to develop the model of role playing game. Role playing game was operationalised in its practicability and appropriateness. For its practicability assessment, the variables considered were the manager's strategy, farmers' strategy, importance of the game, what drew attention in the game, what was realistic and not realistic in the game and application of the game in real life. The practicability leads to the maintenance of the irrigation and affects its appropriateness in solving the problems of the scheme (cleaning of canals, relocation of cattle and actors' interaction).

Regarding the appropriateness of the role playing game, it was assessed using three variables (cleaning the canals, relocation of cattle and actors' interaction). The appropriateness leads to the maintenance of the irrigation scheme in the sense that if the farmers' perceive the tool appropriate, they can then use it in real life.

Description of the Farmer Association
- Leadership
- Membership
- Activities

Problems of the Farmer Association

Possible solutions to the problems of the Farmer Association

Appropriateness of the RPG
- Cleaning canals
- Relocation of cattle
- Actors' interaction

MAINTENANCE OF CHÓKWÈ IRRIGATION SCHEME

General Problems of the scheme
- Poor drainage
- Salination
- Broken tertiary canals
- Water courses blocked

Practicability of the RPG
- Manager's strategy
- Farmers' strategy
- Importance of the game
- What drew attention in the game
- Realistic and not realistic
- Lessons learned
- Applicability in

Key: Lead to ⟶ ; Affect ⟹

Figure 2: Conceptual Framework for the Maintenance of Chókwè Irrigation Scheme in Mozambique
      Source: Adapted by Roberts et al. (2014)   43

The role playing game was administered through sessions, where after each session a "hot" ex-post analysis was done. The analysis helped to do the triangulation and relate the perceived appropriateness of the game to the maintenance of the scheme.

Empirical Review

Role playing games (RPGs) as traditional tools for capacity building and training in the field of sociology have received renewed attention in the last decade due to advances in computing (Dorn, as cited by Ducrot, 2009).

According to Ducrot, Bueno, Barban and Reydon (2010), Companion Modelling has been used in different situations to strengthen the participation of community leaders in collective decision making. Examples of the areas of application of the approach are the management of the watershed of irrigated areas, of fire in a peri-urban environment and management of the development of water infrastructure. This approach contributes in several ways to help decision making in collective actions. Ducrot et al. say that it enhances the knowledge-sharing and knowledge-building as well as learning and helps develop interaction, communication and negotiating capacities. In the ComMod approach, role-playing games facilitate the learning of social and/or biophysical processes as well as discussions on the underlying conceptual model. However, 20 assessments of different case studies pointed out the contributions and limitations of the games. The main limitation lies in the legitimacy of the discussion arena, the tools used and the solutions proposed. The legitimacy of the discussion arena depends on the choice of participants, their representativeness, existing historical relationships, power asymmetry

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among participants and the relative position of the mediator (modeller). The legitimacy of the tools depends on their use, their transparency and how well the underlying conceptual model fits the participants' perceptions.

For an effective discussion platform, it needs the right equilibrium between a representation of real life complexity and the simplification. So, during the design stage of the tools, a participatory modelling is undertaken in order to calibrate the tools and suit the participants. The point is, if the tool is too close to reality, discussion often tends to remain without showing any progress because of real conflicts. If it is not real enough, the game is perceived by the stakeholders as fun to play but does not contribute to real life solutions (Bueno, Barban & Reydon, 2010).

For Souchère, Milair, Echeverria, Bousquet, Le Page and Etienne (2009) in a study of co-constructing with stakeholders, a role playing game to initiate collective management of erosive runoff risks at the watershed scale was assessed. The risk results from a conjunction of natural factors and human activity. They used a ComMod to develop a role playing game with one group of stakeholders. During the game, players were confronted with disastrous runoff in a fictive agricultural watershed. They managed to reduce runoff by 20 to 50% by engaging in a dialogue about grass strips, storage ponds and management of the intercrop period. The results of this study revealed that the modelling and simulation can be a very good way of accompanying the collective learning process.

In a study which was done by Aquino and Bah (2011), a multilevel participatory modelling process that links national policy makers, local

councils, and grassroots stakeholders using a combination of games and computerized simulations was developed. The challenge was to allow the target groups to design and evaluate collective adaptations to climate change that combine new collective rules for local, regional, and national regulations. The game showed to be an efficient way to reach assessments and proposals that are shared between local stakeholders and policy makers, and should thus help improve the design of policies to face up to climate change.

A study conducted in Thailand by Becu et al. (2007) using participatory tool to support collective decision making in two villages in a watershed in this country, revealed researchers face particular challenges in making local stakeholders understand the model as a reproduction of reality and not as a reality itself. The authors went further saying that during the game sessions the idea of a scenario simulation as a hypothetical situation was also difficult to convey. After the game sessions, an ex-post analysis was undertaken. The results showed that farmers who attended several sessions had a clear understanding of the model and one third of the participants thought the game useful to share viewpoints and to define new collective rules for water sharing.

Becu et al. (2007) affirmed that the understanding level of role playing games strongly correlated ($r = 0.64$, $p < 0.01$) with the number of times the stakeholders had attended the sessions. The results showed that the stakeholders, such as farmers and administrative staff, can learn to understand a game simulation but that it takes substantial time.

In the empirical review highlighted in this section, the ex-post analysis was undertaken. This could be justified by the time consumed in the role

playing game sessions, where the participants got tired and found it difficult to fill an evaluation questionnaire of the workshop.

The role playing games (RPGs) sessions with the tools calibrated to suit the participants (players) and well understood by the participants lead to a development of a platform that helps collective action in the maintenance of the irrigation scheme in a sustainable way. It also facilitates stakeholders' coordination and negotiation mechanisms and enhances the performance of the irrigation scheme.

Summary of Reviewed Literature

Although qualitative research has received a lot of criticisms due to its subjectivity, there are measures to be considered to ensure its validation. There are different views in considering the validity and reliability of a qualitative study. Unlike quantitative research in which these two concepts are considered separately, in qualitative research, they are combined into one concept which is called trustworthiness. Trustworthiness is defined as the extent to which the findings of a study are sound. To ensure trustworthiness, the concepts of credibility, transferability, dependability and confirmability are considered.

The implications of this aspect of ensuring trustworthiness in this specific research are the application of the provisions suggested by Guba for the four quality criteria in this kind of research. The provisions are using debriefing after the role playing games sessions and triangulation of information to ensure credibility; providing the background data of the phenomena in the study to allow transferability; provide the methodological description (designing of the game, characteristics of the game and rules) to

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ensure dependability and using triangulation to ensure confirmability of the study.

Literature has proved that a role playing game does not change people's practices. It is a tool of social learning. The expected changes are related to integrated knowledge about the functionality of a system. A role playing game influences farmers' behaviour themselves. While important changes in behaviour often can be achieved by directing influence at the farmer's situation.

After a role playing game session, to assess its appropriateness on solving problems in a system, it is recommended that an ex-post analysis is undertaken. The analysis can be "hot" or cold". A "hot" analysis is done immediately after the game session and "cold" is done 10 months after the game session. It implies that in this specific research, only a "hot" ex-post analysis was done.

The empirical results showed that farmers who attended several sessions had a clear understanding of the model and one third of the participants thought the game useful to share viewpoints and to define new collective rules for water sharing. The role playing games (RPGs) lead to a development of a platform that helps collective action in the maintenance of the irrigation scheme in a sustainable way. RPGs also facilitate stakeholders' coordination and negotiation mechanisms and enhance the performance of the irrigation scheme.

A role playing game is a type of learner centred teaching method where participants play a set of roles following specific rules. In the case of this study,

the irrigation scheme was represented on a table wherein farmers played different roles of the stakeholders of the irrigation scheme. The companion modelling is a qualitative approach used to develop the rules of a role play game. During the game, there are interactions among players ("stakeholders of the irrigation scheme"), which enhance the participation of the users of the irrigation scheme. A role playing game is a model of learning through practice. The Kolb's Experiential Learning theory supports that people learn easily what they have experienced before. In this case, farmers play different set of roles in the game and they learned the impact of cattle inside the scheme, the importance of sharing views regarding the production and the challenges that managers face in the maintenance of the irrigation scheme

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CHAPTER THREE

METHODOLOGY

The study is about the perceived appropriateness and practicability of role playing game among farmer associations for maintaining the Chókwè irrigation scheme. This chapter seeks to describe the research methodology used in this study. It is organised into the following sections: description of field work, description of the role playing game, research design, study area, study population, sampling procedure, instrumentation, data collection and finally data analysis. The research was based on one meeting with the leader of each farmer association and two workshops with the associations.

Description of the Field Work

The field work was based on meeting with the leaders of the farmer associations, first and second workshops with the selected farmer associations. The meeting with the leaders was undertaken in the first visit to the associations. The meeting was to get information about the association and to arrange for the workshops with 10 to 20 members. The selection of the members was based on the leaders' decision (in a participatory tool, the approach itself should be participative).

In the first workshop, the members of each farmer association listed the problems that the farmer associations face in the irrigation scheme. The problems were listed on a map of irrigation scheme that was drawn by a

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technician of HICEP, Nelson Cossa (manager of the irrigation scheme). The map was displayed in a flipchart. The map gave people a shared "bird's eye" view of the landscape. The group of farmers looked at it and imagined that they were looking at a "bird at the sky". The different elements in the map were shown to the farmer associations.

After listing the problems, the participants were taken through a role playing game. The game was played in the two workshops. The first workshop was to introduce the game to the farmer association and the second one was to repeat the game. In each workshop, there were two rounds of the game, which were "white" and "real" rounds. The "white round" was to explain to the players how to play the game and, in the "real" round, the players chose their decisions and played with their own. During the game sessions, observations were undertaken, at the final of the sessions, a debriefing (questions in the appendices) was done.

In the second workshop, the tool was used to identify the possible solutions to the problems identified in the first workshop. The brainstorming of the possible solutions (using flipchart) was used. The people were reminded of the main problems which were listed the first time, and were shown in the map in flipchart. Once the first list of the possible solutions was done, the people were asked if there was another idea, or something else could be done. After identifying the possible solutions to the problems, the participants played the game. At the end of the second workshop, the participants rated the appropriateness of the game in solving problems of the irrigation scheme.

Description of the Role Playing Game

Role playing game is a simulation tool that involves the stakeholders of any system of interact (an irrigation scheme) in an interaction following some set of rules. It does not allow changing people's practice. It rather changes their perception about the operation of the irrigation scheme. It is a tool for knowledge building and knowledge sharing. Role playing game allows knowledge sharing among different stakeholders (farmers, technicians and experts) about risks and constraints of their tasks. It enhances the knowledge-sharing and knowledge-building as well as learning and helps developing interaction, communication and negotiating capacities. Farmers get knowledge of the collective impacts of individual decisions, for instance leaving cattle inside the irrigation scheme.

The role playing game was played in two rounds: white round and real round. In the white round, there were 10 players (one manager and nine farmers). WAG represents the money in the game. The climatic scenario assumed was rainy season. The manager received 1700 WAG and 50 units of water. With the money received, the manager performed the activity of cleaning the canals. With the units of water, the manager performed the activity of distributing water to the secondary canals.

Each farmer received 250 WAG in the denomination of 1*100 WAG, 1*50 WAG and 10*10 WAG. The money they received was to perform agricultural activities (invest in producing the particular crop they wanted, buy fertilizers), pay a labour to look after cattle outside the scheme and pay water tax. Each farmer also received three units of labour, one mechanised rice

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activity card, one animal traction rice activity card, one cattle activity card and one unit of cattle. The activity card represents the action that the farmer wants to perform. To perform the agricultural activities, farmers placed the activity card, representing the technology (mechanised or tractor) they wanted to produce on a plot they have chosen. To place the cattle outside or inside the scheme, farmers located the card where they wanted to rare and placed the unit of cattle on the card. The unit of cattle represents three cattle.

After that, the facilitator explained that it was a "white round" to teach the players how to play. So the map of play was cleaned, leaving only the weeds. The next play was the "real play" with three types of farmers (large-scale, medium-scale and small-scale).

In the "real round", the activities of the farmers and manager were the same as the "white round" explained earlier. The difference was that in the "real play", there were different types of farmers (small, medium and large-scale farmers). The farmers chose to play a role of type of farmers they wanted. There should be a maximum of one large-scale farmer, four medium-scale farmers and six small-scale farmers. After that, they received the appropriate envelopes and they were placed accordingly in the map of the game.

Each small-scale farmer received one activity card of each crop (mechanised rice, tractorised rice, maze, tomatoes and beans), 250 WAG (3 notes of 50 WAG and 5 notes of 10 WAG), one unit of cattle and two units of labour. Each medium-scale farmer received two activity cards of each crop, 700 WAG (four notes of 100 WAG, 10 notes of 10 WAG and four notes of 50 WAG), two units of cattle and three units of labour. Each large-scale farmer

received six activity cards of tractorised rice, one activity card of tomatoes, one activity card of beans, 1300 WAG and six units of labour. The manager received 3800 WAG.

After the distribution of the envelopes, players had enough time to open and see what was inside. The participants were told that at any moment they could ask for more activity cards if they were missed any. For instance, they could tell the large-scale farmer that they had one card of tomato, but if they wanted to produce more plots of tomato they could ask for more from the facilitators. Farmers were also informed that at any moment they could buy a unit of labour, which was 20 WAG. During the game sessions, farmers were told that there was an association for each distributor and they could choose the president for each association. Below is explained how the "white" and "real" rounds were prepared, how water was flowing, how the weed was growing, how the rainfall and irrigation were doing, and how the yield of the crops and how the raring of cattle were done.

Preparation: All farmers were asked to choose only one plot where they will produce. The farmers were informed that in each secondary canals/distributor, there was an association and they should choose one president.

Water: The irrigation, drainage canals and water circulation were explained to the people. The work of the manager was also explained, that the manager will be responsible to distribute water according to the secondary canals. Water demand during a rainy season, when they all produce rice was explained and it was written at the beginning of each secondary canal.

Weed Growing: The dynamic of weed growing was done (2 in each irrigation canal and 1 in each drainage canal).

Rainfall and Irrigation: It was explained to the participants that it was a rainy season. So, one unit of water was placed in all plots and one unit of water for two plots. Facilitators did not talk about dry or wet season, they only said during the rainfall. The farmers were asked to water their plots, taking water from the secondary canals distributed by the manager.

Yield of the Crops: The activities cards of farming which did not receive the necessary quantity of water were closed (farmers lost their production). This process was well explained to the farmers, mainly those who lost. If farmers produced according to the requirements, they received the profit, depending on the crop. After that the facilitator did the drainage process starting from the upstream. The process was explained to the participants. After each season, farmers paid the water tax of 10 WAGs per plot to the manager.

Cattle: The cattle which were not guarded, were supposed to be stolen by the facilitators. The tertiary canal broke if there was one unit of cattle without guard or more than three (even with guard) at the same distributor. To repair the tertiary canal, farmers whose plots were watered by the broken canal paid 60 WAGs.

Variables of the Study

In the interactions with the leaders the variables collected were related to characterization of the farmer association such as:

1. Date of association creation;

2. Leadership of the association;

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3. Membership of the association and

4. Activities of the association.

The map of the distributor was used in the workshops with the farmer association to collect the variables of:

1. Problems faced by the association in the scheme and

2. Possible solutions to the problems identified.

Concerning the observational technique and debriefing (role playing game sessions), the variables measured were:

1. Manager's strategy;

2. Farmers' strategy;

3. Importance of the game;

4. What drew attention in the role playing game;

5. Realistic and not realistic aspects in the role playing game;

6. Lessons learned in the game and

7. Applicability of the game in real life.

In the "hot" ex-post, the variables were collected through 3 points Likert scale. The variables were:

1. Appropriateness of the role playing game for actors' interaction;

2. Appropriateness of the role playing game for cleaning the canals and

3. Appropriateness of the role playing game for relocation of cattle.

The variables collected through "hot" ex-post were quantitative. The reason for that was to triangulate the results obtained through observational technique and debriefing.

Research Design

According to Monette, Sullivan and Dejong (2008), research design is a detailed plan outlining how a research project was conducted. The conduct of a research depends on the goal it wants to accomplish. Research in the human services generally focuses on one or more of the following goals: description, prediction, explanation or evaluation. Descriptive research has as its goal the attempt to discover facts or describe reality. Predictive research focuses on prediction or making projections about what may happen in the future or in other settings. Explanatory research involves explanation or determining why or how something occurred. Evaluation research focuses on evaluation or the uses of scientific research methods to plan intervention programmes, to monitor the implementation of new programmes and the operation of existing ones, and to determine how effectively programmes or clinical practices achieve their goals.

For this study, the formative evaluation research, specifically participatory appraisal (type of qualitative research) and ex-post analysis (type of quantitative research) were done. There are two types of evaluation research: formative and summative. Formative is concerned primarily with ensuring a smooth-running, well integrated programme rather than with the ultimate worth or impact of the programme. Summative is concerned with the programme's effects; the purpose centres on assessing the effectiveness and efficiency of a

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programme (Monette, Sullivan & Dejong, 2008). The reason for this kind of research design is because the target groups (farmer associations) were taken through workshops to assess their problems, possible solutions of the problems and game sessions. At the end of the session, they rated the appropriateness of the game to solve the irrigation scheme problems.

The main weakness of the design is that it cannot assess the effectiveness of the role playing game on the real problems of the irrigation scheme. The best it can do is to find out the perception of the associations concerning the appropriateness of the game on solving simulated problems during the game.

Study Area

The study was undertaken in the Chókwè District of Gaza Province in Mozambique. According to Chilundo, Munguambe and Namagina (2012), Chókwè irrigation scheme covers an area of 35000 hectares. It is located in the Mozambican part of Limpopo River Basin, in the Chókwè District, Gaza Province. According to MINAG (2004), the Chókwè District occupies an aea of about 184,532 hectares, distributed in four Administrative Posts namely Chókwè-Sede, Macarretane, Lionde and Chilembene. From the 1997 Census, the annual population growth is about 0.4%. In this district, women represent 56% of the total population in 2004. More than half of the population (55%) is less than 19 years old. The illiteracy rate in the district is about 50% for men and 64% for women.

The Chókwè Irrigation Scheme is irrigated with water that comes from Limpopo River. The inundations risks increase due to situation downstream of

a river which is about 7 metres under sea level. The agency responsible for the catchment management and enforcement water legislation is the Regional Water Administration (ARA-SUL) through its management unity (UGBL). The Chókwè Irrigation Scheme is divided into three main irrigation sectors, as it is shown in Figure 3: Sector "Sul" which represents about 50% (11,000 ha) of the area, Sector "Rio" represents about 30% (6,650 ha) of the irrigation scheme area and Sector "Montante" accounts for about 20% (4,600 ha) of the area. The infrastructure has a principal canal (15 km) which brings water from the Macarretane Weir to the Lionde Village where, it divides into two secondary canals or distributors. They then divide in tertiary canals which are locally called "caleiras" (Chilundo, Munguambe & Namagina, 2012).
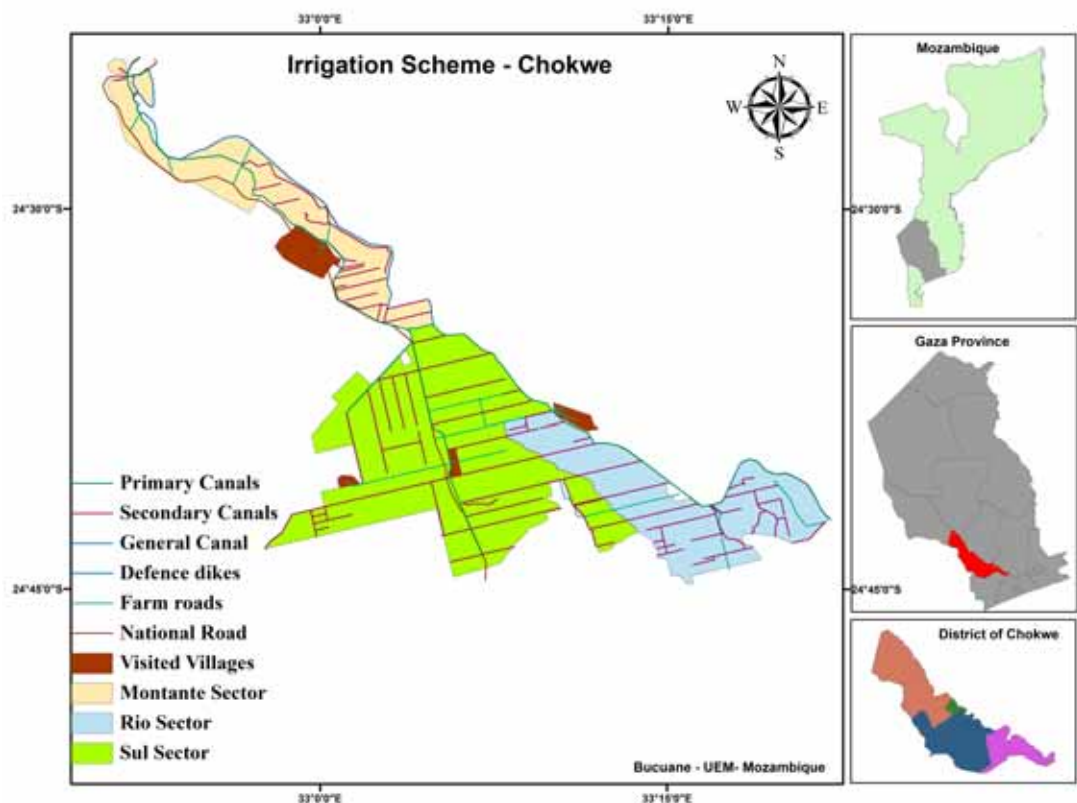
Figure 3: Map of Study Area

Source: The author, using ArcGIS 9.2

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Study Population

In the Chókwè Irrigation Scheme, there are 33 Farmer Associations distributed in three sectors locally called "Sul", "Rio" and "Montante" (EAU4Food report, 2012). The population of the study are all the farmer associations in the scheme. In each sector, there is a chairperson who works for the manager of the irrigation scheme (HICEP). The leadership of the Farmer Associations in the irrigation scheme is composed by three parts: Directory, General Assembly Board and Fiscal Council. Each part is comprised by a President, Vice-President and Secretary.

The leaders of the Farmer Associations represent the Association in the meetings at the Sector and Central level (Headquarters of the Management of the Chókwè Irrigation Scheme). According to ACDI-VOCA (1999), a Farmer Association is non-governmental and non-political. By its by-laws it is 100% democratically controlled and owned by the members.

Sampling Procedure

All the 33 Farmer Associations of the Chókwè Irrigation Scheme met on 11th September 2014 and balloted to elect four Farmer Associations as sample for the study. The balloting strategy was partitioned according to the three irrigation sectors: "Sul", "Montante" and "Rio". This ensured that all the three sectors had at least one representative Farmer Association, as shown in Table 2.

Table 2: Farmer Associations Selected in the Workshop with the Stakeholders

Sector	Farmer Association	Number of Farmers Selected
Montante	21 de Maio	30
Sul	Revolução Verde	29
Sul	Graça Machel	34
Rio	Josina Machel	30

Source: Field Data, 2014

The members of each Farmer Association were purposively selected by chairman of the respective association, based on availability and interest of the members to attend the workshops. The selection of members by the chairman ensured that 50% of members were small-scale farmers and 50% medium-scale farmers. This difference of small and medium-scale farmers was applied only for Farmer Association with these types of farmers. For Farmer Associations with only small-scale farmers, the chairman selected those small-scale farmers.

The game as a participatory tool stipulates approximately 10 to 15 players (Chigozie, 2012) from each Farmer Association. Anything more than this number, increases the distraction and complexity of the game. That is why the chairman was told to invite 10 to 15 members, for each type of farmer (small and medium-scale), as shown in Table 2.

Instrumentation (Validity and Reliability)

The instruments used were check-list (Appendix B), flipchart, digital camera, tape-recorder, open-ended questions for debriefing (Appendix C) and interview guide for "hot" ex-post analysis (Appendix D). To attain the first objective, a check list was used in interactions with the leaders of the Farmer

Associations. For the second and third objective, a flipchart was used to list the problems and the proposed solutions during workshops with members of the Farmer Associations. For the fourth objective, open-ended questions for debriefing was used after the role playing game sessions. For the fifth and last objectives, an interview guide was undertaken.

The validity and reliability of the study were assured using the concept of trustworthiness, suggested by Shenton (2004). The author says that to assure the trustworthiness, there are Guba's Four Criteria:

Credibility (Debriefing and Triangulation – Internal Validity): After each game session, a debriefing was done. The questions in the debriefing were based on the game. The model of the game used was validated through Companion Modelling approach. Triangulation was done using information from the debriefing and the "hot" ex-post analysis.

Transferability (Background data of the phenomena in the study – External Validity): To allow transferability, the research provides background information of the farmer associations regarding the use of the scheme as well as the problems the associations face in the scheme.

Dependability (Methodological description - Reliability): To ensure the dependability, the research provides the entire methodological description.

Confirmability (Triangulation - Objectivity):   To allow the confirmability of the study, after each game session, a "hot" ex-post analysis was done. The same information gathered in the debriefing was also gathered in the "hot" ex-post analysis.

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Data Collection

The data of the study was collected using interactions with the leaders of the associations, workshops with the members of the associations, naturalistic observation and debriefing after role playing sessions. The data collection was done from September to October 2014. It was done by the researcher and one teaching assistant at the Faculty of Agronomy and Forestry Engineering of the Eduardo Mondlane University, Maputo, Mozambique. The researcher was trained in the methodology by Ducrot Raphaele (Senior Researcher in Eau4Food Project). The teaching assistant was then trained by the researcher of this thesis.

The main challenge encountered in collecting data was that October 2014 was time of presidential election in Mozambique, so to gather people was not an easy task. They were busy with party campaigns. Thus, data collected for each objective and the analysis procedure are as follows:

a) **To describe Farmer Associations in Chókwè irrigation scheme**

In each selected association, information gathered from the leaders was on:

   1. Date of association creation;

   2. Leadership of the association;

   3. Membership of the association and

   4. Activities of the associations.

With the qualitative information gathered, a report for each association and pictures were taken.

b) **To identify the perceived problems faced by Farmer Associations in using of the scheme**

From a map displayed on flipchart representing the distributor for each association, farmers' associations were asked to show and note where they face problems (drainage, salination, maintenance, water accessibility, watercourses damaged) during the first workshop. Notes were taken.

c) **To describe the possible solutions of the problems given by the farmers association of the maintenance of the irrigation scheme**

In the second workshop with each association, the map on the flipchart presented in the first workshop was displayed and the members suggested the specific solutions to solve the problems.

d) **To assess the practicability of the game as perceived by the farmer associations**

The variables used to operationalise the practicability of the game were collected in the two workshops. The variables were:

1. Manager's strategy;
2. Farmers' strategy;
3. Importance of the role playing game;
4. What drew attention in the role playing game;
5. Realistic and not realistic aspects in the game;
6. Lessons learned in the game and
7. Applicability of the game in real life.

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e) To assess farmer associations' perception about the appropriateness of the game to the solution of their problems

The data to attain this objective was collected after the second workshop, immediately after the debriefing. The variables collected were the appropriateness of the game in solving problems related to:

1. Cleaning the canals

2. Relocation of cattle at the irrigated area

3. Actors' interaction

f) To determine the relationship between the number of times a player plays the game and the player's perceived appropriateness of the game in solving the problems at the Chókwè irrigation site, in terms of:

1. Cleaning of the water canals

2. Re-location of cattle at the irrigated area

3. Actors' interaction

The objective above intends to find out the association or relationship between farmers who attended the role playing game sessions and the perceived appropriateness of the game in solving the problems at the Chókwè irrigation site. The perceived appropriateness was assessed in an interview guide. The appropriateness was measured in terms of solving the three problems cited above in Likert type scale with three scales (1- Inappropriate, 2 – Moderate, 3 – Appropriate). So, the means were interpreted as follows: 1 – 1.54: Inappropriate; 1.55 – 2.54: Moderate; 2.55 – 3: Appropriate.

The correlation analysis was done to associations where the two workshops were undertaken. The analysis was to find out if there is a relationship between number of times (1 or 2) participants attended the sessions and their perceived appropriateness of the game in solving the problems.

The correlation analysis was done using Spearman Coefficient Correlation at 95% of confidence level. The reason for using Spearman is because it is a non-parametric test. The non-parametric techniques are used when the sample was collected using non-probabilistic method. In this research, the sampling method was convenience sampling (Non-probabilistic).

To test differences stated in the hypotheses, Kruskal-Wallis test was used. Kruskal-Wallis test is a non-parametric test equivalent to ANOVA in parametric techniques. Although in non-parametric techniques of testing differences of groups, there is a Mann-Whitney test for two groups and Kruskal-Wallis for two or more, in this study, Kruskal-Wallis test was used.

Data Analysis

The analysis was qualitative and quantitative. The qualitative methods were in terms of description of the naturalistic observation, interactions with the stakeholders through debriefing (focus group discussion) and pictures. According to Monette, Sullivan and Dejong (2008), in qualitative data analysis, it may seem at times as the research is talking about the process of data collection in the field. The reason for that is in the qualitative research, data collection and data analysis often occur simultaneously. The quantitative methods were relational analysis according to the objective. The unit of

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analysis was farmer association. The statistical package that was used was STATA 11.

CHAPTER FOUR

RESULTS AND DISCUSSION

General Overview

In this chapter, the research presents the findings and discusses them, in accordance with the research questions.

Description of Farmer Associations

The leader of each association was met to describe the farmer associations. The farmer associations are the water users in the scheme. The description was based on the date associations were created, leadership responsibility, membership of the association and activities of the associations.

Date of Association Creation

21 de Maio Farmer Association is formed by women small-scale farmers who produce rice, maize and horticultural crops. Revolução Verde Farmer Association is about 15 km off the road that links Chókwè district to Macia district. Graça Machel Farmer Association is located about two kilometres from the road that links Chókwè district to Macia district and it is a part of South Sector of the irrigation scheme. Josina Machel Farmer Association is located about 25 km from the street that links Chókwè district to Macia district.

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Table 3: Date of Association Creation

Sector	Distributor	Farmer Association	Location	Date of Creation
Montante	D5B	21 de Maio	Chókwè	1983
Sul	D13D	Revolução Verde	Nwachicolwane	14/08/10
Sul	D12	Graça Machel	Conhane	15/12/03
Rio	R1 and derivates	Josina Machel	Muianga	15/11/04

Source: Field data, 2014

The results showed that the oldest farmer association among the four is 21 de Maio (Table 3). Despite that, it is the only one that does not have a meeting room. Surprisingly, it is located in Chókwè city. It implies that even if the extension agents intend to undertake training with 21 de Maio Farmer Association, they will face challenges due to the lack of the meeting room. This association is therefore disadvantaged compared with others in the study. The reason for that could be because 21 de Maio is formed by only women; they are normally neglected when it comes to access to goods and services.

Leadership in the Association

In Josina Machel Farmer Association, during the interactions with the leadership, they pointed out that leaders are chosen by voting. With regard to other tasks that the leaders perform in the village, the president of the Directorate and the Fiscal Council said that the president of the Fiscal Council is the Head of Block. The President of General Assembly Board works with National Institute of Social Welfare that deals with offering money to old

people. It implies that people who work with other organizations in the village have more advantages to be in better positions in the associations. The secretary of the General Assembly Board works on sanitary issues in the village. The Vice President of the Directorate is the Head of Block. The Vice President of Fiscal Council is the secretary of a Quarter. The Vogal of Directorate is the secretary of the political party (FRELIMO).

Regarding Revolução Verde Farmer Association, the process of choosing the leaders was done by Mr. Abel Lumbela (Head of section in HICEP that deals with communication between HICEP and farmers). Farmers in this distributor (D13D) were advised to be organized in association, so that they can easily get access to credit. In terms of other tasks that the leaders of the association do in the village, the respondents affirmed that the president of Directorate of the association has three other responsibilities in the village. These are pastor, president of fiscal council of associations union in the scheme and secretary of SAVAL (local enterprise that supplies agricultural inputs). The President of General Assembly Board is the Vice President of the association's union in the scheme. The Vogal of the Directorate is the Prime-Secretary of a political party.

In Graça Machel Farmer Association, according to the members in the meeting, leaders in the association are elected through voting. The leaders do not have another occupation apart from the association. To be a member, a person should be introduced to the board of general assembly. In the association, farmers work independently. Each one in his/her own farm. The directorate of the association represents the farmers in general meetings with

the manager (HICEP) and the sectors. The meeting is called *Conselho Paritário de Gestão* (CPG).

With regard to 21 de Maio Farmer Association, the leaders are chosen through voting. During the interactions with the president of the association, it was clear that some leaders of the associations were involved in some activities in the village. For instance, the Vice President of fiscal council is also a chief of a Block. The President of the General Assembly Board is also a member of a political party.

The results of the study showed that only in Revolução Verde that the leaders were not chosen by voting. In most of the farmer associations in the study, except Graça Machel Farmer Association, the leaders perform other leadership roles in the community related to the political party. Coincidently, the political party is the one currently ruling the country. Because of that, the farmer associations are not in accordance with characteristics suggested by ACDI-VOCA (1999) which states that farmers' association as per its by-laws is non-political, and non-governmental. Furthermore, farmer associations are 100% democratically controlled and 100% owned by smallholder farmer members on an equal basis. In the case of the farmer associations where leaders have other activities in the community, other members of the association do not feel 100% democratic because the same leaders in the association are heads in other sectors (political party). In the light of these situations, transparency becomes an issue between the members and the leadership of the association.

Membership of the Association

The president of 21 de Maio Farmer Association did not know the size of area under cultivation by the association, that is why the ratio (ha/member) in Table 4 was not computed. The association is made up of only small-scale women farmers.

Table 4: Membership of the Association

Farmer Association	Area (ha)	Members	Ratio (ha/member)	Male	Female
21 de Maio	NA	89	NA	0	89
Revolução Verde	1765	836	2.11	632	204
Graça Machel	821	539	1.52	354	185
Josina Machel	400	553	0.72	408	145

NA: Not Available; the leader of the association did not remember

Source: Field data, 2014

In the Revolução Verde Farmer Association, there are small and medium-scale farmers. Everyone that has a farm in the distributor (D13D, it represents the name of the distributor) of the association automatically belongs to this association.

In Graça Machel Farmer Association, there are small-scale and medium-scale farmers. Josina Machel Farmer Association is made of only small-scale farmers (each farmer produces in less than 3 hectares). To be a member of the association, a person should have a farm in the distributor (R1 and derivates) that belongs to the association.

The results of the study indicate that in all farmer associations, once a farmer has his/her farm in one of the canals of the main distributor, he/she automatically belongs to that association. This is to facilitate the water sharing from the scheme manager to all farmers. Belonging to an association, a farmer has advantage because the association may provide an assured market or source of supplies and services where none exists. The association can respond to member needs that are not addressed by any other organization, such as grading assistance, extension training services (farmer to farmer approach).

The findings in this case are all in accordance with the working definition of farmer association proposed by ACDI-VOCA (1999). A farmer association is a group of farmers who face similar problems and therefore similar needs. So, if a farmer is at the same secondary canal with others, he/she faces similar challenges. The farmers therefore should come together in a collective action to solve the problems.

Activities of the Associations

The official statute of Josina Machel Farmer Association was signed on 15th November 2004 and it was written in the public constitution on 1st January 2005. The main work of the association is to produce rice, though they also produce maize. Members of the association meet twice in a month to discuss issues related to beginning the farm season and crops to produce. In the perception of the leaders (President of the Directorate and President of Fiscal Council), the association is working normally in terms of relations among the members; the main challenge is lack of fertilizers.

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In the Revolução Verde Farmer Association, the official statute was approved on 14th August 2010. The main tasks of the association is to protect the members, distribute water, rent tractor, supply agricultural inputs and coordinate the linkage between farmers in the association and the scheme manager (HICEP). In his perspective the association is working in a smooth way.

The Graça Machel Farmers' Association has had its own official statutes since 2003. The activities are to produce rice and horticultures (tomatoes and cabbage). From the president's view the association is working normally. In 21 de Maio Farmer Association, the members work in collective manner. The association undertakes activities i crop production, HIV-AIDS advertisements and gender issues. The association has its official statutes published.

The study revealed that only in the 21 de Maio Farmers' Association that the members work in a collective manner. The reason could be because it is made of only women. This aspect contradicts the characteristic of an association which is that the members come together to seek solutions to their common challenges through collective action. In all farmer associations the activities are related to agricultural production. The results are in accordance with ACDI-VOCA (1999) which says that smallholder farmer members may receive better prices for their products and provide goods and services to farmers at lower costs through bulk purchasing, and bulk service arrangements. The association may improve the operation of markets themselves by acting as

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a measure of competition, improving quality of services, forcing produce prices upwards, and input prices downwards.

Problems Identified in the Distributors

In the Josina Machel Farmer Association, the members present in the workshop listed in the map represented in Plate 1, general problems they have with agricultural production and the specific problems related to the distributor R1 and derivates. The general problems were:

a) Lack of agricultural inputs;

b) Lack of uniformity in irrigation;

c) Holes at the tertiary canals;

d) Difficulty watering the farms during the dry season and

e) No means to transport the rice due to inundation.
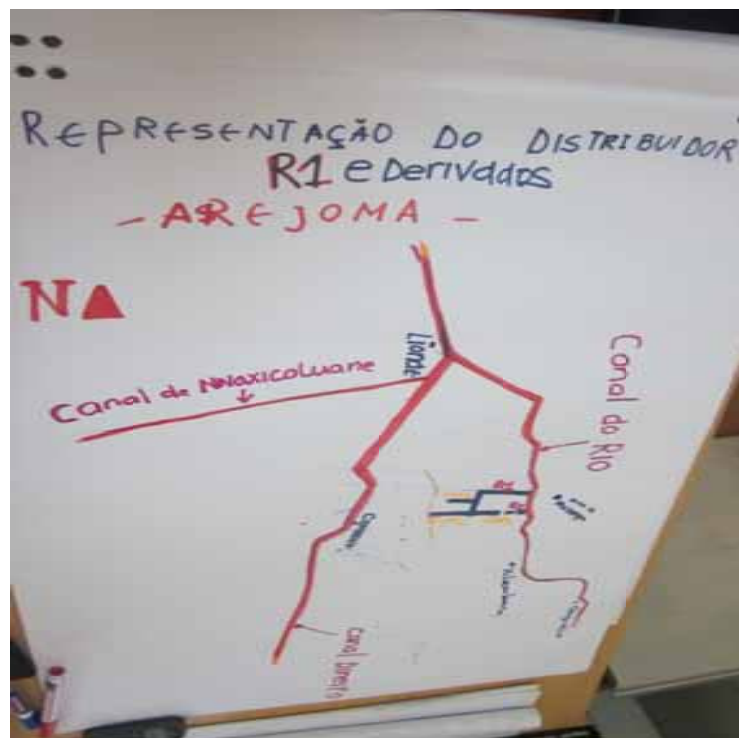
Plate 1: Representation of the Distributor R1 and Derivates

Source: Field Data, 2014

With regard to the distributor and derivates, the participants listed the specific problems which were inundation and salination. The salty areas are in both parts of D1R1 and the left part of D3R1 (represented in the map). The problems affect all the members of the association. The problems listed in this association are the same with those encountered by EAU4Food in 2012 during the needs assessment in other farmer associations. The facilitators (Joaquim Bucuane and Nelson Cossa – Technician of HICEP) presented the map to the farmers and it was clear that the farmers were getting the picture of the map. Because of this, most of them were saying "*La ya yi kaya ka papayi...*" which means that "That is the father's house…" the workshop was in local language (*Changana*). With regard to Revolução Verde Farmer Association, because there are small and medium-scale farmers, the workshop was separated.

In the morning, the workshop was with small-scale farmers and in the afternoon, was with medium-scale farmers. At the beginning of the workshop with small-scale farmers, there were only seven people out of 15 invited through the President of Directorate in the first meeting. The main reason for that, according to the president, was because it was time for presidential elections in the country. A map of the distributor of this association was drawn by Nelson Cossa a technician of HICEP (manager of the irrigation scheme), as shown in Plate 2.
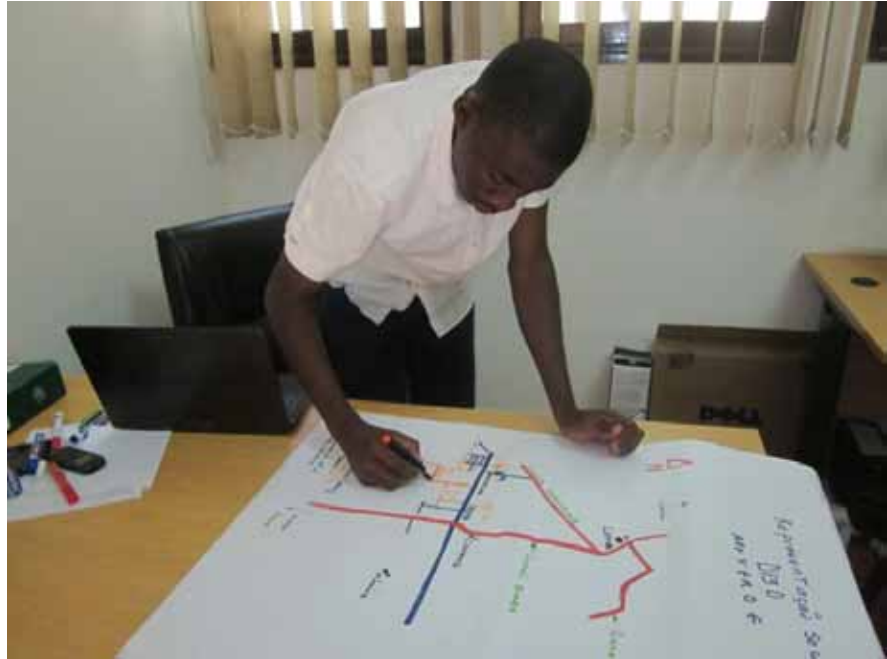
Plate 2: Eng. Nelson Cossa Drawing Map of Distributor D13D

Source: Field Data, 2014

In the association, members suggested some corrections to the map regarding change to the orientation so that it can really look like what happens on the field. The problems were classified as they affected all the members and they were listed by the small-scale farmers:

At the farms, there are no water courses due to lack of regulators in the distributor;

 a) The manager does not clean the drainage canals;

 b) When regulators are opened in other distributors and unwanted water flows in and inundates the area and

 c) The water flows with high pressure. It therefore waters where it is not needed.

Regarding the medium-scale farmers, the same map was shown to them on the same day in the afternoon after the workshop with small-scale farmers.

It was scheduled to start at 1:00 PM, because the facilitators were waiting for the participants to reach a number suitable (6 to 7) to start the workshop. It started at 2:00 PM. The participants were told that the same work was done in the morning with a group of small-scale farmers and the same exercise will be done in three more associations. In order to capture the participants' interest, once they seemed to be in bad mood, they were told that the results of the four associations will be compared.

Thus, the problems identified by medium-scale farmers were:

    a) The water reaches the end of the distributor (D13D) with high pressure;

    b) There are no boundaries of the farms between small and medium-scale farmers;

    c) Due to lack of regulators, the farms are inundated and they then become salty and

    d) The farms are not flat, so there are inundated places.

In this group, the team of facilitators did a mistake of using the same map in the morning with small-scale farmers and in the afternoon with medium-scale. This might have biased the medium-scale to build on the same problems that were identified by the small-scale farmers.

Regarding what the association has been doing to solve the problems, according to the participants, the distributor is on the responsibility of the manager of the scheme (HICEP). However, a technician of HICEP was at the workshop and explained that the distributor of this association (D13D) is a secondary canal and not principal. So, it used to be the responsibility of the

association, but now HICEP has the responsibility. This fact is confirmed by the documents during the preparation of this project by EAU4Food 2012.

In the Graça Machel Farmers' Association, like the previous association, there are small and medium-scale farmers. The work started with some clarifications on the map concerning the representation of the scheme. This was done by the president of Directorate. However, it should have been done by all members present at the workshop.

The problems listed by small-scale farmers were:

Between the drainage 43S and D12:

 a) The soil is salty;

 b) Cattle damaged the tertiary canals;

 c) Drainage canals damaged by floods in 2013;

 d) Drainage canals return water to the field.

With regard to what the association was doing to correct the problems, the members affirmed that they tried to put bags with sand to stop the water but it was not being helpful. The left part of the distributor (D12) and farms that were in the final part of the distributor suffered more.

Regarding medium-scale farmers, the same exercise was done. Although the workshop had started, some participants were still coming. Some suggestions were given by the farmers to facilitate the understanding of the map. Thus, the problems listed by medium-scale farmers were:

 a) There was a slope in one part of the distributor and water did not go up.

b) The tertiary canals did not water all the farms, there was running-off of the water.

c) Drainage canals were closed.

d) People stole the regulators of the canals.

e) Soil was salty.

The farms mostly affected were those close to the drainage canal 43S. Concerning what the association had been doing to solve the problems; the participants affirmed that they were in a project called "Wanbão" with a Chinese organisation to work on technology transfer on producing rice. "Wanbão" is working on the left part of the distributor, after that they will work at the other site and the association members were waiting for the agricultural season to open, so that they could produce. With regard to the 21 de Maio Farmer Association, there was no meeting room. Thus, the workshop was held under a tree, as shown in Plate 3.

Plate 3: First Workshop with 21 de Maio Farmer Association

Source: Field Data, 2014

The problems in the distributor (D5B) of this farmer association were listed in the map displayed on a flipchart, as it is shown at Plate 4.

Plate 4: Map Representing the D5B

Source: Field Data, 2014

The problems listed were:

    a) Drainage canals were broken due to floods in 2013.

    b) The water to water meant for plots passed by other farms and caused inundation.

    c) The tertiary canals were inside the drainage canals.

    d) The soil was salty.

Regarding if the problems affected all the farmers, the women group said that they affected all the members (women) in the association. The association tried to build drainage canals to reduce the inundations that caused salty soils. It was not appropriate because the weed was growing inside the drainage canals and the women group was not capable of cleaning them. The

women were not capable of cleaning them because the work was very tedious and required mechanised power to remove the weeds.

In all cases, the first typology of participation suggested by Reed (2008) was observed. This is based on different degrees of participation on a continuum. In all associations, it was observed that the leaders tried to give only their opinions concerning the map and the problems faced by the farmers. However, the facilitators overcame this aspect that is considered as criticisms of participation, by asking the members of the association the same questions.

The findings of the study indicate that the problems faced by the farmers are in the three components of the complex system of an irrigation scheme, suggested by Pisano (2012). Firstly, in the interactions of humans (managers and farmers), there is a problem of trust, transparency between farmers and the irrigation scheme manager. The second problem was, nature (sharing a common natural resource, water). From the results in many cases the water reached points where it was not needed and it therefore created inundation. After some years of inundation, the areas become salty and unavailable for agricultural production. Reducing the area for agriculture reduces the production and finally reduces the income of the farmer. The third issue is the technological aspect (canals of water). In all farmer associations, the problem of blocked canals was raised. The amount of water from the principal canal to the secondary canals (distributor) is dependent on the status of the canals and their capacity. So, if the canals were blocked, farmers did not receive the quantity of water they wanted. They therefore failed to water their production. Irrigation has a direct relationship with agricultural productivity.

Moreover, the results indicate that the problems identified in all farmer associations were in accordance with those identified by Chazovachii (2012) relating to transportation, labour, capital and theft. In terms of transportation, rural areas often have gravel roads which are long and winding, some poorly maintained and inaccessible. Transport operators are in most cases reluctant to reach such areas and some of the farmers fail to get their produce to the market in time. This is the case of Chókwè, where products are sent to Maputo (capital, located about 200 kilometres) to be sold, because the local market does not guarantee good prices.

Regarding labour, based on the demographic characteristics of rural areas, it follows that women and young children attend mostly to the plots. This is the main reason 21 de Maio Farmer Association affirmed that they could not clean the canals themselves. In terms of capital, normally, farmers do not have money to purchase agricultural implements. Due to that, they are forced to do away with important inputs which negatively affect the quality of their crop. A lack of inputs is a major setback. With regards to theft, food crops are targeted by thieves who do not just steal irrigation infrastructures but occasionally raid the place for the crops and this tends to drawback production. This case was reported in the Graça Machel Farmer Association.

Possible Solutions for the Identified Problems

Among the Josina Machel Farmer Association, the second workshop was not done because a member of the association had died. All the other members went to the house of that member. Coincidently, on that day, there was a meeting between the manager of the scheme and the presidents of the

association. That is why the president of this association nominated someone to stand in for him during the workshop even though the workshop did not take place. The second workshop was supposed to come out with solutions to the problems identified in the first workshop.

Regarding the Revolução Verde Farmer Association, the second workshop provided solutions to the problems, as shown in Plate 5. For small-scale farmers, the participants suggested that, where they have placed bags of sand, the manager should use a machine to improve the place.

Plate 5: Map of D13D Showing the Problems

Source: Field Data, 2014

According to the members, the rainfall is poor and there are elephants damaging the crops, so the solution would be to open a drainage canal at the end of the distributor D13D. Another solution proposed by the small-scale farmers was that the manager should bring the machine to clean the canals. However, the scheme manager has only three machines for 33 farmer associations in the scheme.

Out of 15 members invited, there were only four at the beginning until the end of the workshop. This fact could be justified because it was a period of presidential elections and most of the medium-scale farmers in this association were members of political parties.

The solutions provided were that:

a) The regulators should be placed in the canal.

b) The drainage canals should be cleaned.

c) All the tertiary canals should be cleaned.

d) The cattle inside the scheme should be removed.

e) The machine to clean the drainage canals should be brought.

The participants argued that people do not accept to remove the cattle inside the scheme because, outside the scheme, there is no food for the cattle and the cattle die due to illness. If there was a veterinary centre outside the scheme, at least for the case of the illness, farmers would be motivated to remove the cattle inside the scheme. For the Graça Machel Farmers' Association, it was decided in the workshop with the key stakeholders to be part of one of the associations because of the Chinese project. At the first

workshop members of the association talked about the project. The second workshop where the members were supposed to suggest ways to solve the problems that they identified could not take place. The reason for that was suddenly the "Wanbão" project left the association without giving any explanation. The facilitators met with the president of the Directorate and he explained that the members of the association gave their land to the project to do their own trials and when the season opens they will help the farmers in land preparation using tractors. But when the season opened the "Wanbão" project left the association and moved to another district (out of Chókwè district). That is why he said it was not possible to gather people to do the workshop because they were concentrating on producing as the project had promised them to do the land preparation.

With regard to the 21 de Maio Farmers' Association, the second workshop took place at the same place of the first workshop. The workshop started with a display of the map of the problems identified by them, just to remind the women group, as show in Plate 6.

Plate 6: Solutions Identification in 21 de Maio Farmer Association

Source: Field Data, 2014

In 21 de Maio Farmer Association, the solutions proposed for the problems underlined below, were:

<u>Damaged drainage canals</u>:

     a) The machine to remove the weed inside the canals should be used.

     b) The canals should be cleaned before the rice season starts.

     c) Rounded stone canals should be placed.

<u>Salty Soil</u>:

The weed should be removed to allow water to flow and reduce inundations.

<u>Water does not reach high locations</u>:

Small bridges should be built in the distributor D5B.

The Practicability of Role Playing Game

Naturalistic observation and debriefing were used to assess the manager's strategy, farmers' strategy, importance of the game, what drew attention in the game, realistic and not realistic aspects of the game, lessons learned in the game and applicability of the game to real life.

Manager's Strategy

In the Josina Machel Farmers' Association, the strategy of the manager was getting better as the game was going on, once the money to clean the canals was reducing. Initially he was working in an isolated way and, after with the interaction, he noticed that the money was reducing. Because in the real life he is a technician of HICEP, he used manual cleaning in the drainage canals. There was a tendency of the manager to prioritise the irrigation canals more

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than the drainage. The manager benefited from the farms close to him. It was not clear the reason of benefiting from those farms. It was probably "by chance" because of where he was placed around the table in the game. Regarding the strategies of the farmers during the play, it was based on producing rice during wet season and vegetable and maize during dry seasons. In the debriefing, the participants pointed out that the manager stayed without money and that, if they had gone to the next round, they would have stayed with problems of inundation, once the drainage canals were already full.

In the Revolução Verde Farmers' Association, during the first workshop with small-scale farmers, the strategy of the manager was to prioritise the irrigation canals than the drainage. This is because of the cost involved in cleaning the drainage canals that are more expensive than that of the irrigation canals. At the second workshop, due to reduced number of participants there was not representation of the large-scale farmer. It facilitated the work of the manager because he did not clean the canals that go to the farm of the large-scale farmer. Another aspect discussed during the game was that the manager should prioritise areas that were being cultivated. Regarding the medium-scale farmers, during the game session, a peaceful environment of the play was noted. However, there was no clear strategy of the manager on cleaning the canals.

Regarding the problems that affect the manager during the game, the participants affirmed that the water tax paid by the farmers was not enough for the manager to clean all the canals. The participants perceived that the strategy

of the manager was good. According to participants, the manager prioritised large and medium-scale farmers because he gains a lot of money with them.

The small-scale farmers in the Graça Machel Farmer Association pointed out that the strategy used by the manager in this round seemed to start the cleaning of canals from where he was standing. However, the facilitator explained to him that he can start cleaning the canals from where he wants to. The participants perceived the manager's strategy good, though he did not have sufficient money to clean all the canals. With regard to medium-scale farmers, during the game session, it was not easy to find out the strategy of the manager in cleaning the canals. What caused problems during the play was the cleaning of drainage canals due to insufficient money that the manager had. Moreover, the water tax paid by farmers was not enough for the manager to clean all the canals. During the debriefing, the participants affirmed that the manager had good strategy, when he started cleaning from principal canals.

During the first session of the 21 de Maio Farmers' Association, the environment of the play was not favourable because of the wind and the game session was under a tree. Despite the environment of the play, the quick understanding of the game among the participants was notable. During the play, the tendency of the manager (president of the association) not to clean the irrigation and drainage canals that go to the farms of the large-scale farmer was clear.

The manager was always saying *"...yi bava Taelane lweyo a ni male...",* what in local language means "...This is Mr. Taelane, he has money...". The person is a well-known large-scale farmer in the irrigation

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scheme who normally cleans his canals himself. This implies that for the small-scale farmers (this association), medium and large-scale farmers have money to clean their canals themselves. The manager therefore prioritised the small-scale farmers.

During the debriefing, the person who played the role of manager said that the money she received (3500 WAGs) was not enough to clean all the canals. The canal left led to a lot of losses of production. The manager prioritised where there were more farmers (right canal). In the second session, all farmers paid the water tax in all the rounds.

The manager cleaned only the irrigation canals. The manager's strategy was to clean only the irrigation canals and was left with some money for the next round. In the debriefing, the manager suggested that when the money got finished, the farmers should have organised themselves and cleaned the canals using their money. This information was not surprising since the manager in the game was the president of the association, so, in a way, being able to mobilise the members contributes towards the success of the associations, she suggested. The results of the manager's strategy used by all the managers in the game sessions were typically related to Kolb's Experiential Learning theory in the sense that the managers were changing the strategies as the game was going on.

Farmers' Strategy

In the Josina Machel Farmer Association, there was a good environment for the game play, with people motivated and happy with the play. During the game, there was a tendency for all farmers to place their cattle

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outside the scheme. All farmers produced rice using animal traction without using fertilizers since they had to pay to place the cattle outside the scheme. Regarding the strategies of the farmers during the play, it was based on producing rice during the wet season and vegetable and maize during dry seasons.

Concerning cattle, the farmers placed them outside the scheme, even after the explanation of the facilitators that the cattle could be placed inside the scheme, though with all the consequences. Due to a limited amount of money given to small farmers, they did not buy fertilizers; the money was only enough to produce rice and the cattle was placed outside the scheme. This implies that if, in reality farmers place their cattle outside the scheme, they should reduce the money supposed to buy fertilizers to pay to secure their cattle. All farmers paid the water tax at the end of each season.

During the first workshop with small-scale farmers in the Revolução Verde Famers' Association, the environment of the play was good, though with low level of interaction among the participants. The players were still undecided on applying fertilizers, though they were mindful about placing the cattle outside the scheme. Small and medium farmers in the game lost their production due to rainfall although they had already watered their farms. In the second workshop, all farmers decided to apply fertilizers in their farms. The play was going on with normal interaction among the participants regarding the quantity of water to apply money for the investment and the labour to use. However, in the first round, small-scale farmers lost their production due to the rainfall after they had watered their farms. In the debriefing, the manager

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affirmed that he distributed water correctly but the farmers were not able to share it correctly; that is why they lost their production during rainfall.

With regard to medium-scale farmers in the Revolução Verde Farmer Association, the strategy used by farmers was to place their cattle outside the scheme and they did not apply fertilizers. What was difficult to them was to allocate the money needed to invest, water needed and the labour according to crops that they produced.

In the Graça Machel Farmer Association, during the workshop with small-scale farmers, two small-scale farmers asked for loans of 100 WAGs at the bank but they could not pay back because their farms lost due to lack of labour. The strategy mostly used by the farmers in the game during the two workshops (small and medium-scale farmers) was application of fertilizers and interactions among them. The farmers' strategy was to help them concerning what to produce and the quantity of inputs to apply.

Among the 21 de Maio Farmer Association, during the game session, the uniformity of producing rice using animal traction was clear. This aspect could be justified in two ways. Firstly, the amount of money they had was not enough to produce mechanised rice, even with the bank's assistance; the characteristic of small farmers is not to apply for loans. The other reason is that, because they are small-scale farmers, they normally do not use tractors; they rather used animal traction or even manual land preparation. The strategy of the farmers was to change the crops according to the season.

Importance of the Game

During the debriefing with the Josina Machel Farmer Association, the participants pointed out that the game was a good idea to represent the scheme on a table wherein all the participants could interact and suggest activities that would not have been possible using the entire scheme in real life.

In the first workshop with the small-scale farmers in the Revolução Verde Farmer Association, the participants affirmed that it was a very good initiative to represent the scheme in a simplified way and it was good if it could be repeated over and over again. They found it important that if the irrigation and canals are not cleaned, the farmers lose the production due to inundation and/or lack of water. Concerning medium-scale farmers, the most important aspect of the game was that the farmers learned that they had to use the right amount of money, fertilizer, labour that was needed. They also learned that the cattle damaged the canals inside the scheme.

With regard to Graça Machel Farmer Association, small and medium-scale farmers perceived the game extremely important. They said that it was beautiful because it taught them something. The most important lesson in the game was the canal cleaning, functioning of the scheme in the play and application of money to invest.

In the 21 de Maio Farmer Association, the participants pointed out that the important aspect of the game was the situation of cattle inside the scheme. Where a tertiary canal was damaged by cattle in the game, and the farmers of that tertiary canal had to contribute money to pay 60 WAGs to repair the canal.

What Drew Attention in the Game

In the Josina Machel Farmer Association, what drew most attention during the game was the problem of management of the scheme, which was the difficulty the manager had in cleaning the canals. Other aspects are related to the cattle inside the scheme. Specifically, if there are cattle inside the scheme the tertiary canals can be damaged. For small-scale farmers in the Revolução Verde Farmer Association, concerning what drew attention during the game; the participants affirmed that if, they do not apply the correct requirements of the crops, they may lose the production. While for medium-scale farmers in the same association what drew much attention was that the game represents what happens in the field, mainly about cleaning the canals.

In the Graça Machel Farmer Association, the participants said that what drew more attention was the contribution of fertilizer in the yield was notable during the game. In fact, it was not surprising since they are medium-scale farmers in real life they apply fertilizer in their farms. For the 21 de Maio Farmer Association, what drew more attention was the impact of the cattle inside the scheme and the interactions between the farmers and the irrigation scheme manager.

Realistic and not Realistic Aspects in the Game

Among the members of the Josina Machel Farmer Association, participants pointed out during the debriefing that the "history" of the game is realistic, all the rules and functioning of the game is what is happening in the field. For instance, the manager does not clean all the canals, manager lacks

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resources to operate the entire scheme, and farmers lose their production due to inundation.

In the Revolução Verde Farmer Association, the participants affirmed that all that was represented in the game is what is really happening in the real life. The participants affirmed that what was in the play happens in reality where the manager does not clean the canals, so that water can flow and reduce the risk of salty areas. The participants said that, in reality farmers leave their cattle inside the scheme. Unlike what happened in the game that they placed the cattle outside even with the payment of a tax. For medium-scale farmers, everything in the game is realistic in the field, mainly the issue of cleaning the irrigation and drainage canals.

With regard to the Graça Machel Farmer Association, the small-scale farmers declared that almost everything in the game happens in reality. However, the cleaning of irrigation and drainage canals does not happen in the real life. The medium-scale farmers pointed out that the canals cleaning is the most realistic aspect; while money that farmer received to start the game is not realistic. The participants had a point. However, the main issue was to simulate situations where farmers invest and they feel losses. For the 21 de Maio Farmer Association, in terms of the reality of the game, the participants declared that losses of production due to inundation and the effect of cattle on the tertiary canals exists in reality. When farmers discuss collectively about the impact of the cattle in the scheme, they could come out with suggestions to overcome the issue and they could then be more motivated to place their cattle outside the

scheme. It would reduce the canals breaking. However, farmers will also be interested in a safe place outside the scheme where they can place their cattle.

Lessons Learned in the Game

In the Josina Machel Farmer Association, the participants learned with the game that if they do not use good agricultural practices they may lose their production, the financial limitation of the manager to clean all the canals. Among the Revolução Verde Farmer Association, the participants learned that the cattle damage the canals inside the scheme. When farmers get knowledge about the financial and machinery limitations of the manager, it can raise the transparency between farmer associations and the manager. The farmer associations can also do some activities of cleaning their canals if they can do and not only wait for the manager.

Small-scale farmers in the Graça Machel Farmer Association learned why the manager is not capable of cleaning all the canals in the scheme. The medium-scale farmers affirmed that, with the game, they know that they have to use good agricultural practices such as fertilizers, labourer and correct quantity of water. Regarding the 21 de Maio Farmer Association, the participants pointed out that they learned from the game that if they do not apply good agricultural practices, they may lose their production. A role playing game does not change people's behaviour (practice), it rather influences. With a role playing game farmers get knowledge about a system with different actors and share views to improve the performance of the system. Farmers understood why sometimes they produce and they lose their

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production, especially in rice production where they thought it can tolerate water as an aquatic plant.

Applicability of the Game in Real Life

For the Josina Machel Farmer Association, the participants affirmed that they can use what they learned in real life. It implies that if any agricultural extension intervention takes place in this association with the aim on agricultural practices, the farmers who attended the workshop will have more probability to accept the intervention, once they know the risks of not using the recommended practices. For the rest of the farmer associations, the participants perceived that what they learned can be done in real life, once the conditions applied in the game are put down in the reality.

The "Hot" Ex-Post Analysis

This analysis was used to attain the last two objectives. The results and discussion are following:

Appropriateness of the Game to the Solution of the Irrigation Scheme Problems

The appropriateness of the game to the solution of the irrigation scheme problems was assessed in the associations where the second workshop took place. So, it was assessed in the Revolução Verde, Graça Machel and 21 de Maio Farmer Associations. The comparison between small and medium-scale perceived appropriateness was also assessed.

In the Revolução Verde Farmer Association, small-scale farmers received a piece of paper to rate the appropriateness of the game in terms of

three components: cleaning of canals, relocation of cattle and actors' interaction and the results are presented in Table 5.

Table 5: Descriptive Analysis of the AREVERDE Small-scale Farmers' Perceived Appropriateness of the Game

Variables	Observations	Mean	St. Dev.
Actors' interaction	14	2.79	0.43
Cleaning of canals	14	2.29	0.61
Relocation of Cattle	14	1.93	0.47

Scale: 1- Inappropriate, 2 – Moderate, 3 – Appropriate; STATA 11

Source: Field data, 2014

From Table 5, the perceived appropriateness of the game for small-scale farmers is considered moderate (mean in the range 1.55 – 2.54) for cleaning of canals and relocation of cattle. While actors' interaction is appropriate (mean in the range 2.55 – 3.0). It implies that farmers found the interaction among them very important. When farmers collaborate with each other, and with managers, they can then help each other on what and how to produce. The collaboration in an irrigation scheme is very important because understanding between managers and farmers can be reached. This could overcome the paradigm of technology transfer. In the sense of, if a policy recommendation comes from views sharing with all stakeholders, it is more likely to be successful. The aspects of actors' interaction were related to sharing views among farmers on what to produce; manager interacts with farmers about the canals cleaning.

Concerning the cleaning of canals, the results are in conformity with those encountered in the debriefing where the farmers pointed out that manager

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should prioritise the cleaning in areas that are being cultivated. That is why the game was not appropriate in the aspect of cleaning the canals.

The relocation of cattle has the lowest mean due to some aspects of food, water and veterinary treatment of the cattle that are needed in real life which were not represented in the game. From the standard deviation (measure of tendency), is clear that the discrepancy of the way the people rate the appropriateness of the game was not high. Regarding the medium-scale farmers, likewise small-scale farmers, the participants rated the appropriateness of the game and the descriptive statistics is presented on Table 6.

Table 6: Descriptive Statistics of the AREVERDE Medium-scale Farmers' Perceived Appropriateness of the Game

Variables	Observations	Mean	St. Dev.
Cleaning of canals	15	2.47	0.52
Actors' interaction	15	2.4	0.63
Relocation of Cattle	15	1.93	0.59

Scale: 1- Inappropriate, 2 – Moderate, 3 – Appropriate; STATA 11

Source: Field data, 2014

The medium-scale farmers perceived appropriateness of the game on the cleaning of canals, relocation of cattle and actors' interaction is moderate (1.55 – 2.54). The differences among them in Table 7 could be explained because the game was more centred on cleaning of canals and actors' interaction. The lowest value for the relocation of cattle (1.93) could be explained because during the game, all farmers had strategy of placing their cattle outside the scheme. It implies that they were already aware of the impact of cattle inside the scheme.

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Because in this association there were two workshops with small and medium-scale farmers, a test of hypothesis to find out the difference of their perceived appropriateness of the game on solving the problems of the scheme was done and presented in Table 7.

The null hypotheses tested were that there is no significant difference between small-scale farmers' perceived appropriateness of the game on the cleaning of canals/relocation of cattle/actors' interaction and that of the medium-scale farmers. The results are presented in Table 7.

Table 7: Kruskal Wallis Test for the Difference on Perceived Appropriateness of the Game between AREVERDE Small and Medium-scale Farmers

Variables	χ^2 value	P value	Observation
Cleaning of canals	0.458	0.4987	Not significant
Relocation of cattle	0.000	1.0000	Not significant
Actors' interaction	2.333	0.1266	Not significant

n = 29; P < 0.05; STATA 11

Source: Field Data, 2014

From Table 7, according to the Kruskal Wallis test at 95% confidence level, the results fail to reject the null hypotheses. It means that there are no evidences that show that the small-scale farmers' perceived appropriateness of the game in solving the problems of the scheme differs with that of medium-scale farmers. The results in this case imply that the game can be perceived appropriate or not regardless of the type of farmer (small or medium-scale).

With regard to the Graça Machel Farmer Association, the small-scale farmers rated their perceived appropriateness of the game and the results are summarised in Table 8.

Table 8: Descriptive Statistics of the Graça Machel Farmer Association Small-scale Farmers' Perceived Appropriateness of the Game

Variables	Observations	Mean	St. Dev.
Actors' interaction	15	2.79	0.41
Cleaning of canals	15	2.74	0.45
Relocation of Cattle	15	2.32	0.84

Scale: 1- Inappropriate, 2 – Moderate, 3 – Appropriate; STATA 11

Source: Field data, 2014

The small-scale farmers' perceived appropriateness of the game on the cleaning of canals and actors' interaction was appropriate (mean in the range of 2.55 – 3.0). While for the cattle, was rated to be moderate (1.55 – 2.54). It implies that farmers are willing to meet among themselves and with the manager of the scheme to discuss issues related to the irrigation scheme. Since role playing game is a tool of social learning, the actors of the irrigation scheme are getting closer; it contributes to strengthen trust among the stakeholders. The trust could help in building changes in practices in real life (cleaning of canals and actors' interaction).

The results are in conformity with those gathered in the debriefing where, small-scale farmers affirmed that the strategy mostly used by the farmers was interactions among them. So, that gives high rate to the appropriateness of the game in actors' interaction. For cleaning the canals, in the debriefing the participants perceived the manager's strategy to be good. But the manager did not have sufficient money to clean all the canals. It implies that when farmers are all aware about the costs of cleaning the canals, the money that manager has and the tax farmers pay, farmers tend to understand

the financial constraints of the manager. Based on the debriefing session, the most important aspect of the game, according to the farmers, is the process of cleaning the canals. Moreover, it was not surprising because the cattle did not have an effect during the game, if the farmers place them outside the scheme, while in real life the farmers do not place their cattle outside the scheme. The medium-scale farmers also rated from 1 to 3 the appropriateness of the game and the results are summarised in Table 9.

Table 9: Descriptive Statistics of the Graça Machel Farmer Association Medium-scale Farmers' Perceived Appropriateness of the Game

Variables	Observations	Mean	St. Dev.
Relocation of Cattle	19	2.89	0.32
Actors' interaction	19	2.79	0.42
Cleaning of canals	19	2.68	0.48

Scale: 1- Inappropriate, 2 – Moderate, 3 – Appropriate; STATA 11

Source: Field data, 2014

The medium-scale farmers' perceived the appropriateness of the game in the three aspects. The game was rated to be appropriate (2.55 – 3.0), according to the scale presented. It implies that, for the medium-scale farmers the game is appropriate to solving the problems of cleaning of canals, relocation of cattle and actors' interaction. The information gathered in the debriefing for the two types of farmers (small and medium-scale) did not differ. A test of hypothesis was done to find out if the perceived appropriateness of the game differs between small and medium-scale farmers. The results of the Kruskal Wallis test were summarised in Table 10.

Table 10: Kruskal Wallis Test for the Difference on Perceived Appropriateness of the Game between Graça Machel Small and Medium-scale Farmers

Variables	χ^2 value	P value	Observation
Cleaning of canals	0.328	0.5671	Not significant
Relocation of cattle	16.328*	0.0001	Significant
Actors' interaction	0.003	0.9585	Not significant

n = 34; P < 0.05; STATA 11

Source: Field Data, 2014

The null hypotheses were that there are no significant difference between the small-scale farmers' perceived appropriateness of the game on cleaning of canals/relocation of cattle/actors' interaction and that of the medium-scale farmers. From Table 10, only one aspect (relocation of cattle) was statistically significant based on the Kruskal Wallis Test at 95% of confidence level. It means that there is significant difference between small-scale farmers' perceived appropriateness of the game on relocation of cattle and that of medium-scale farmers. While for the other aspects, the results fail to reject the null hypotheses. It means that there are no evidences that show that the small-scale farmers' perceived appropriateness of the game on the two aspects differ with that of the medium-scale farmers.

For the case of the relocation of cattle, the small-scale farmers normally have less quantity of cattle compared with the medium-scale. That is way they are mindful of not perceiving the game appropriate on relocation of cattle. Regarding the other two aspects, the results were not surprising because the game was more centred on aspects such as, prioritisation on the cleaning of the

canals and interactions between farmers and manager in the game. So, the farmers perceived the appropriateness of the game in the same way.

In the 21 de Maio Farmer Association, because it is composed only by small-scale farmers, there was no comparison test. The descriptive statistics of the appropriateness of the game is shown at Table 11.

Table 11: Descriptive Statistics of the 21 de Maio Farmer Association's Perceived Appropriateness of the Game

Variables	Observations	Mean	St. Dev.
Actors' interaction	30	2.93	0.25
Cleaning of canals	30	2.13	0.68
Relocation of Cattle	30	1.7	0.75

Scale: 1- Inappropriate, 2 – Moderate, 3 – Appropriate; STATA 11

Source: Field data, 2014

From Table 11, the women's farmer association perceived the game to be appropriate (mean in the range o 2.55 – 3.0) on actors' interaction, and moderate (mean in the range 1.55 – 2.54) on cleaning of canals and relocation of cattle. It implies that in their perception, the game does not aim at the relocation of cattle. It was rather looking at the cleaning of canals and actors' interaction. It was not surprising because, according to Ducrot et al. (2010), if a game is not real enough, the game is perceived by the stakeholders as fun to play but does not contribute to real life solutions. That is what happened with the cattle because, in the game, there was no problem of lack of food or another damaging action to the cattle outside the scheme; it was not looking like a real situation. In real life, the decision to place the cattle outside the scheme is not known and when canals are broken by the cattle, farmers do not share costs of

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repairing them. It was observed in the game in this association. Based on the debriefing, this aspect of sharing costs drew the attention of the participants.

Relationship between the Number of Sessions and the Perceived Appropriateness of the Game

According to Becu et al. (2007), the number of times stakeholders attend a game session is correlated to the understanding of it. So, in Table 12, the number of sessions attended by small-scale farmers was correlated with the perceived appropriateness of the game.

Table 12: Spearman Correlation Coefficients between AREVERDE Small-scale Farmers' Number of Sessions and Perceived Appropriateness of the game

Variables	Number of sessions
Cleaning of canals	0.5707*
Relocation of Cattle	0.4494
Actors' interaction	0.1005

n = 14; P < 0.05; STATA 11

Source: Field Data, 2014

The null hypotheses were that there are no relationships between the number of sessions farmers attended the game sessions and their perceived appropriateness of the game to solve the problems of cleaning of canals, relocation of cattle and actors' interaction. In Table 12, the results reject the null hypothesis only for the first case (cleaning of canals). Where there is positive substantial (r = +0.5707; based on Davis Convention) relationship between the number of times farmers attended the sessions and their perceived appropriateness of the game on the cleaning of canals.

For the case of relocation of cattle and actors' interaction, the null hypotheses were not rejected. It implies that, based on the data, with confidence level of 95%, there is no significant evidence to say that there is relationship between the number of times farmers attended the game sessions and their perceived appropriateness of the game on relocation of cattle and actors' interaction. However, in the case of relocation of cattle, there is a positive moderate (r = + 0.4494) relationship with the number of times farmers attended the sessions and, for actors' interaction, there is a positive and low relationship (r = + 0.1005). The positive signal at the correlation coefficient in all cases means that, when the number of times farmers attend the game sessions increases, the more appropriate they perceived the game to solve the problems of the scheme.

For Becu et al. (2007) in a similar study, the number of sessions stakeholders attended a workshop was highly correlated with the understanding of a role playing game. AT 21 de Maio Farmer Association, the workshops were on two separate days, a correlation analysis was done to find out the extent to which the number of sessions was correlated with the women farmers' perceived appropriateness of the game. In this case, Table 13, tests the null hypotheses that the number of sessions women farmers attended the workshop is correlated with their perceived appropriateness of the game to solve the problems of cleaning of canals, relocation of cattle and actors' interaction.

Table 13: Spearman Correlation Coefficients between the 21 de Maio Farmer Association's Number of Sessions and the Perceived Appropriateness of the Game

Variables	Number of sessions
Cleaning of canals	0.6607*
Relocation of Cattle	- 0.218
Actors' interaction	0.2182

n = 30; P < 0.05; STATA 11

Source: Field Data, 2014

The results on Table 13 only reject the null hypothesis on the case of cleaning of canals. It means that, based on the Spearman correlation test, at 95% of confidence level, the number of sessions attended by the women farmer association is correlated with their perceived appropriateness of the game on the cleaning of canals.

Thus, this result is in accordance with the results obtained by Becu et al. (2007). According to Davis convection, there is positive, substantial (r = +0.6607) and significant relationship between the number of sessions attended and the perceived appropriateness of the game on the cleaning of canals. It implies that, the more women farmers attend the sessions, the more appropriate they perceive the game.

On the other hand, the null hypotheses were not rejected for the case of relocation of cattle and actors' interaction. It means that there is no evidence to say that the number of sessions the women farmers attended was correlated with their perceived appropriateness of the game on relocation of cattle and actors' interaction. However, there was negative and low relationship (r = - 0.218) between the number of sessions and perceived appropriateness of the

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game on the relocation of cattle. And there was a positive and low relationship

(r = +0.2182) between the number of sessions and perceived appropriateness of

the game on the actors' interaction.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

General Overview

In this chapter, the summary, conclusions and recommendations of the research work are presented. It also presents suggested areas for further studies.

Summary

This study was a small part of a big project of EAU4Food in Mozambique with the aim to address the need for new approaches to increase food production in irrigated areas in Africa. The general objective of this study was to assess the farmer associations' perceived appropriateness and practicability of role playing game for maintenance of the Chókwè irrigation scheme.

The hypotheses of the study in null form were:

1. There is no relationship between the number of sessions attended by the participants and their perceived appropriateness of the game in the cleaning of canals;

2. There is no relationship between the number of sessions attended by the participants and their perceived appropriateness of the game on the relocation of cattle;

3. There is no relationship between the number of sessions attended by the participants and their perceived appropriateness of the game to the actors' interaction;

4. There is no significant difference between small-scale farmers' perceived appropriateness of the game to the cleaning of canals and that of the medium-scale farmer;

5. There is no significant difference between small-scale farmers' perceived appropriateness of the game to the relocation of cattle and that of the medium-scale farmer;

6. There is no significant difference between small-scale farmers' perceived appropriateness of the game to the actors' interaction and that of the medium-scale farmer.

The hypotheses were tested at 95% confidence level and they were applied where applicable depending on the type of farmer association (small-scale farmer only or small and medium-scale farmer) and the number of sessions that took place in each four associations. The research design used was a formative evaluation research (participatory appraisal and ex-post analysis). The Farmer Associations were selected in meeting with all the 33 Farmer Associations and balloted to choose Farmer Associations as sample for the study. So, the farmer associations for the study were four.

The selection of the members in each Farmer Association to participate in the workshop was done by the chairman of the respective Farmer Association. The sampling procedure for selecting the farmer associations and the members was purposive. It was based on farmers' availability and interest.

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With regard to the practicability of the role playing, a qualitative analysis was done, based on observational techniques and debriefing session. The appropriateness of the role playing game was measured using an interview schedule for farmers who played the game. The quantitative analysis was based on descriptive statistics and test of hypotheses (correlation analysis and means comparison). The perceived appropriateness of the game was measured using a Likert type scale with three scales. The appropriateness was operationalised in the work as the ability of the game to solve simulated irrigation scheme problems in the game. The reason for using three is that, literature supports that from three scales it is enough to be called interval scale.

The aim was to find out if the game was appropriate and not much concerned with the level of appropriateness, since the game is a participatory tool (simulation of the reality), it would have been difficult to interpret with more than 3 scales. The qualitative information was triangulated with the quantitative data gathered through the interview schedule.

The results showed uniformity in terms of the problems that affect the four associations. The main solutions are related to increasing machines to clean the canals. Regarding the game, the associations perceived it important, appropriately doable if the conditions of the game are really put down in reality. With regard to the game sessions, farmers understood why sometimes they produce and they lose their production, especially in rice production where they thought it could tolerate water as an aquatic plant. Farmers were interacting during crop production in the role playing game. The interactions were related to the placing the cattle inside or outside the scheme, collective

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payment on repairing a canal if cattle damaged it, and suggestions on where the manager should start cleaning the canals. The aspect of interaction relates to real life in the sense that farmers realised that if the actors in the scheme collaborate with one another, the problems of the scheme would be reduced and it could improve the maintenance of the scheme.

Even though some farmers played a role of the manager, the role playing game was calibrated based on the information gathered from the manager of the scheme. So, farmers got knowledge of financial and machinery limitations of the manager to clean all the water canals (transparency). With the role playing game, farmers were able to discuss about the impact of the cattle inside the scheme. From their discussions, suggestions to overcome this problem, such as, farmers from the same canal that was damaged by cattle should join money to repair the canal; there should be safe place outside the scheme where farmers can leave their cattle. It was observed that farmers are willing to meet among themselves and with the manager of the scheme to discuss issues related to the irrigation scheme. Since role playing game is a tool of social learning, the actors of the irrigation scheme are getting closer; it contributes to strengthening trust among the stakeholders. The trust could help build changes in practices in real life.

All the farmer associations perceived the game appropriate to the cleaning of canals and in terms of actors' interaction. But they perceived the game moderate to inappropriate in terms of the relocation of cattle.

Conclusions

After the field work and analysis of data, conclusions were written in order to answer the specific objectives. The conclusions are based on only the farmer associations included in the study and not all of the farmer associations in the Chókwè irrigation scheme.

Apart from 21 de Maio Farmer Association, which is formed of small-scale women farmers, the rest of them have both sexes. This is the oldest association among the four. Yet, it does not have a meeting room. The main reason for that could be that the members of the association are women. Women are less empowered. The problems identified in the farmer associations included, cattle affecting the tertiary canals, poor drainage, floods and salination. The main solutions were to increase in maintenance capacity of the managers in terms of equipment and financial resources, a better transparency in the planning of annual maintenance, a strengthening of the mobilizing capacity of water users association and a better management of cattle in the scheme. Regarding the game, the farmer associations observed the cattle impact inside the scheme at the first session. In the next session, most of the players placed them outside the scheme. The farmers in the game experienced the consequence of not applying good agricultural practices in their production. The financial limitation of the manager (HICEP) in terms of cleaning the canals was also observed by the farmers.

The game was appropriate in the cleaning of canals and actors' interaction on most associations. The players perceived it practicable and they were happy to participate. Hence, they expressed interest in organising more

game sessions. Based on the Kruskal Wallis test at 95% of confidence level, there is no evidence that shows that the small-scale farmers' perceived appropriateness of the game to solving the problems of the scheme differs from that of medium-scale farmers. The results in this case imply that the game can be perceived appropriate or not regardless of the type of farmer (small or medium-scale). On the other hand, based on Spearman correlation coefficient, at 95% of confidence level, the number of sessions farmers attended the workshop was correlated and significant only for the case of cleaning of canals. It is not surprising because during the game, most of players placed their cattle outside the scheme and if the players pay, nothing happens to the cattle while in real life outside the schemes, there is no food or water.

Recommendations

To the Farmer Associations:

1. During the game, to improve its appropriateness on actors' interaction, farmers should approach the manager and discuss about what they will produce in a given season.

2. The Farmer Associations in the game should apply the required quantity of water to irrigate their farms to improve the practicability of the game.

3. Members that were in the workshops should teach what they learned to those who could not participate, for improving the applicability of the game in real life.

To the Manager of the Chókwè Irrigation Scheme

1. To improve appropriateness of the game on cleaning the canals, the manager should prioritise irrigation canals during dry season and drainage canals during wet season.

2. The manager should meet with the farmers before each season to plan for the water distribution and canals cleaning, in order to improve the appropriateness of the game on actors' interaction.

To the EAU4Food Project

1. The researchers can apply the simulation tool in other farmer associations regardless of type of farmers (small or medium-scale).

2. To improve the game appropriateness and practicability, the project should incorporate impact of the cattle outside the scheme, even if the farmers pay money to control them so that it will look real, since outside the irrigation scheme there is neither food nor water.

To the Government

1. The Ministry of Agriculture and Food Security should guarantee an area outside the scheme that the conditions of food and water are assured for the cattle.

2. The Ministry of Agriculture and Food Security should establish a veterinary centre around the Chókwè irrigation scheme.

Suggestions for Further Research

From this study, based on the results encountered in the field, the areas indicated below are relevant for further research:

1. Evaluation of the solutions to the problems proposed by the farmer associations.

2. The researchers should undertake the "cold" ex-post analysis in September/October 2015 (10 months after the game sessions) to assess the effectiveness of the game in solving the irrigation scheme problems.

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APPENDICES

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Appendix A

Game Sequence of Playing

Wet Season

1. The manager receives 50 units of water and starts the water distribution;

2. The dynamic of the weed growing;

3. Agricultural activities;

4. Cleaning of canals

5. Rainfall

6. Farmers water their farms;

7. Assessing farms with excess or lack of water;

8. Drainage

9. Profit of farms which are successfully produced

10. Assess the effect of the cattle inside the scheme

Dry Season

1. The manager receives 35 units of water and starts the water distribution;

2. The dynamic of the weed growing;

3. Agricultural activities;

4. Cleaning of canals

5. Rainfall

6. Farmers water their farms;

7. Assessing farms with excess or lack of water;

8. Drainage

9. Profit of farms which are successfully produced

10. Assess the effect of the cattle inside the scheme

Appendix B

Check-list

1. Date of Association creation.

2. Area under cultivation in the Association.

3. Crops produced.

4. Membership of the Association (number and sex of members, requirements to be a member).

5. The leadership of the Association (selection, activities in the association and outside the association).

6. Activities of the Association (member work individually or in collective).

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Appendix C

Debriefing

After each session of testing the role playing games, the debriefing was undertaken to refine and clarify some aspects of the game. The facilitator used recorder and notes were taken of the discussion. The points addressed were:

1. Were you able to attain your objectives? (Farmers to produce and get profits, managers to clean all canals and pay back the money to the bank, banks to receive back the money borrowed) why?

2. Were there farmers' strategies in the game?

3. What was the manager's strategy in cleaning the canals?

4. Are you happy to participate in the game? Why?

5. How was the equilibrium of the game? (How easy or difficulty was it?)

6. What do you think about the nature of the game? (How close to reality was it? And why?)

7. What were the main problems faced by the manager in the game?

8. What have you learnt with the game? (concerning water sharing, difficulties of the managers, interactions among stakeholders of the scheme)

9. How will you use the knowledge you gained in the game sessions?

10. Did the game provide opportunity to all stakeholders to interact with themselves? Why?

11. What are the suggestions to improve the game?

Appendix D

Interview Guide

After the debriefing, a "hot" ex-post analysis was undertaken to assess the stakeholder's perceived appropriateness to solve the problems of the irrigation scheme.

INSTRUCTION: Please tick in appropriate place according to the key;

Keys: 1 – Inappropriate; 2 – Moderate; 3 – Appropriate.

S/No	Item on Cleaning of canals	Inappropriate (1)	Moderate (2)	Appropriate (3)
1	There is priority to start cleaning the irrigation or drainage canals.			
2	There is priority on where to start cleaning.			
3	Farmers receive water whenever they need.			
4	Farmers receive the exact quantity of water needed.			
5	Farmers receive help from the manager of the scheme whenever they need.			
S/No	**Item on Re-location of cattle**	**Inappropriate (1)**	**Moderate (2)**	**Appropriate (3)**
1	The location to place the cattle will be known.			
2	The location is affordable to the farmers.			
3	If farmers from the same secondary canal place their cattle inside the scheme and the tertiary canal is damaged, they will share the cost to repair it.			
4	Farmers from the same secondary canal can coordinate to place some cattle outside the scheme and some inside.			

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S/No		Inappropriate (1)	Moderate (2)	Appropriate (3)
5	Farmers will be comfortable to place their cattle to the new location.			
S/No	**Item on Actors' interaction**	**Inappropriate (1)**	**Moderate (2)**	**Appropriate (3)**
1	With the game farmers share views on what to produce.			
2	Managers interact with farmers on the cleaning the canals.			
3	Farmers get access to loans in the bank.			

Thank you for your time

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Appendix E

Table of Davis Convention

Interpretation of correlation coefficient based on Davis Convention

Spearman Correlation Coefficient (r)	Interpretation
$0.01 \geq r \geq 0.09$	Negligible
$0.10 \geq r \geq 0.29$	Low
$0.30 \geq r \geq 0.49$	Moderate
$0.50 \geq r \geq 0.69$	Substantial
$r \geq .70$	Very Strong

Source: Lamm & Israel, 2013