Socioeconomic Factors Affecting Sustainability of Dikes & Spillways Constructed in the Rice Growing Ecologies of West Coast Region of The Gambia

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DEDICATION

This work is profoundly dedicated to my mother, Binta Kinteh, whose motherly love I very much cherish and adore. Also to my dear wife, Nyima Jarra Trawally and my daughters for firmly standing by me while undergoing my studies.

ABSTRACT

The Gambia has a land area of 11,000 km^2 and it is located on the Atlantic Coast in West Africa (between latitudes 13^o and 14^o N and between longitudes 13^o and 17^o W), with an estimated population of 1.8 million inhabitants. Rice is the staple food of The Gambia and is grown mainly in lowland ecologies of the country but consumption exceeds production by about 50%. Because crop production in the country is primarily rain-fed subsistence farming, principal limiting factors in rice production are water supply and salt-water intrusion into swamp fields.

Owing to its drive to narrow the import substitution gap and attain national food self-sufficiency through improved production and productivity of the staple rice crop, the Government of The Gambia has implemented series of Soil and Water Conservation (SWC) projects. One such project is the recently completed Gambia Lowland Development (GALDEP) Project which constructed water retention and anti-salt dikes and spillways for rice farmers in the West Coast Region of the country. This study was to determine socioeconomic factors influencing sustainability of these constructed dikes and spillways.

The study explored the socio-economic factors by investigating the socio-demographic, community participation, and social capital factors affecting sustainability of the constructed dikes and spillways. Paddy rice output comparison was also conducted to study the production dynamics. The basic concepts and theoretical foundations of the Social Construction of Technology (SCOT) was adapted

The study, made up of a sample size of 90 farmers within 6 villages, was carried out in 5 Districts (Kombo East, Foni Berefet, Foni Bintang, Foni Bondali and Foni Jarrol) of West Coast Region of The Gambia. Data was collected through survey and Focus Group Discussions (FGD) and a descriptive statistics and a binary logistic regression model (logit) were employed for the analysis.

Main study findings revealed that at 5% significant level, four socio-economic factors are statistically significant in influencing the sustainability of constructed dikes and spillways and these are individual perception on dike ownership, availability of financial resources, and availability of set rules/bylaws governing the upkeep of the constructed dikes and spillways as well as gender participation. However, 3 factors (perception on dike ownership, financial resources and rules/bylaws) have positive influence on sustainability given the coefficient values of 1.594, 1.416, and 1.532 respectively while gender participation shows a negative coefficient (-2. 259) on sustainability of the constructed dikes and spillways. The average paddy rice output realized by farmers is 1198 kg as compared to 913.79kg before the construction of the dikes and spillways. This difference between the two phases is statistically significantly at 1 % significant level. The results also indicated a significant difference at 5% significant level for cultivated area before (1.12ha) and after (1.30ha) dike and spillway construction.

The major conclusion from the study was that the constructed dikes and spillways are productive and can contribute positively to the food self-sufficiency drive of the government of The Gambia. However, it is recommended that local institutions at community levels be strengthened both technically and financially so that their full ownership of the dikes and spillways is further enhanced to foster greater sustainability. Gender mainstreaming is also important so that both genders (males and females) participate in the management of the constructed dikes and spillways.

Keywords: Sustainability, Socio-economic, Dike, Spillway, Community Participation, Social Capital

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ACRONYMS

ADB	African Development Bank
ANR	Agriculture and Natural Resource
ECOWAS	The Economic Community of West African States
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
GALDEP	Gambia Lowland Development Project
GNAIP	Gambia National Agricultural Investment Plan
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
LADEP	Lowland Agricultural Development Programme
MRQ	Main Research Questions
Nema	National Agricultural Land and Water Management Development Project
NEPAD	New Partnership for Agricultural Development
PAD	Project Appraisal Document
PCR	Project Completion Report
PIWAMP	Participatory Integrated Watershed Management Project
RAIP	Regional Agricultural Investment Program
SCOT	Social Construction of Technology
SLM	Sustainable Land Management
SPQR	Situation, Problem, Question and Response
SWCP	Soil and Water Conservation Project
SWMP	Soil and Water Management Project
USAID	United States Agency for International Development

CHAPTER 1
INTRODUCTION

1.1.0 SPQR Overview

SPQR technique is used in this thesis to describe the Situation (S), give definition of the Problem (P), and formulate research Questions (Q) as well as an explanation of the Respond (R).

1.1.1 Situation

The Gambia has an estimate of 70 percent of her population dependent on agriculture for their food and income. It is climatically-grouped alongside nine other African countries (Burkina Faso, Cape Verde, Chad, Guinea-Bissau, Mali, Mauritania, Niger, Senegal and Sudan) as the Sudano-Sahelian group based on the similarities of their rainfall patterns (FAO, 2014). This group is one of the driest and most variable in Africa, where extreme rainfall years are more likely below average (GNAIP, 2010). Crop production in The Gambia is mainly dependent on rainfall- and the system is characterized by a wide range of production and cropping patterns. The two main crop production farming systems, however, are upland and lowland. The upland system involves crops such as groundnut (*Arachis hypogea),* millet (*Pennisetum spp),* sorghum (*Sorghum bicolor),* maize (*Zea mays),* and horticulture crops while the lowland farming system is predominantly rice-based, usually characterised by rice ecologies such as rain-fed lowland, tidal mangrove, tidal freshwater and irrigated. Groundnut is the main cash crop and rice the main food crop. Despite being a staple food of the country, the consumption of rice exceeds production by about 50% (GNAIP, 2010) hence The Gambia has been listed as a low-income food deficit country again in 2013 (FAO, 2014). Thus The Gambia is currently food insecure, an issue which is now one of the main challenges and focus agendas of the current government and her development partners.

1.1.2 Problem

The main problem of food insecurity in The Gambia has several root causes. Amongst the several causative factors is the low productivity of the previously highly productive rain fed lowland ecologies of Western Coast Region of The Gambia. Rain-fed wetlands are generally characterized by lack of water control, with droughts and floods being potential problems (Hatibu et al., 2000; McLeanet al., 2002). The declining trend of food productivity in The Gambia is thus associated with factors of acidity, salinity and water retention which are often attributed to poor production methods and the declining trends of rainfall. In a bid to adequately address these problems of the lowlands, the government of The Gambia, has through The Gambia Lowland Development Project (GALDEP), constructed a series of water retention and anti-salt intrusion dikes to retain fresh rain water and prevent saline-water intrusion in the rice-growing areas, respectively. Spillways are also constructed to regulate water volumes in the areas where dikes are constructed. Liming is practised to counter excessive soil acidity in the rice fields. This direct investment by The Gambia government is piloted in one out of the six agricultural regions of the country.

Since the constructed dikes and spillways are later handed over to farmers who are mostly subsistence growers, their long term satisfactory maintenance and sustainability are of great concern to the provider. However, sustainability issues are varied and complex, thus each case is specific. Hence the fundamentals of the historical and contextual realities of the evolved agrarian dynamics and farming systems (Carney, 1988**)** of each project beneficiary household should be given due consideration during project designs. This gives a lot of sustainability insights by illuminating and paying particular attention to the base structures and power politics of the intended beneficiaries including gender and diversity perspectives since rice production in The Gambia as alluded to by Carney and Watts, (1991) is highly gendered. Specifically this research is intended to look at the problem of sustainability of the constructed dikes and spillways relative to the socio-economic factors.

Owing to this phenomenon, the government has now secured funding to develop a comprehensive Land and Water Development Management policy framework which will, among others, serve as a regulatory mechanism. Therefore, this research is intended to determine socio-economic factors influencing sustainability of the constructed dikes and spillways in the rice growing ecologies of West Coast Region of The Gambia and by extension investigate what policy/strategies and/or incentives could government provide to facilitate sustainable maintenance/longevity of these SWC structures.

1.1.3 Research Questions

Naturally, there could lie a lot of questions on the flip side of this government direct investments and handing over of the finished structures to farmers who are then obliged to maintain them while using them. Though the resulting dikes are bigger and presumed stronger than the local ones, how appropriate is the technology? How is the sense of ownership of the structures transferred and instilled into farmers? What local capacities exist for upkeep and maintenance? Was it a bottom-up and demand driven (felt need) approach across the pilot region? In any case, the good news is that this was a pilot project in only one region and funds have now been secured for the development of the first agricultural Land and Water Development Management Policy of the country (Nema PAD, 2012). Therefore, answers to these and many more questions could provide adequate insight for such a policy. In parallel, my research question thus is ***which socio-economic factors influence sustainability of the GALDEP constructed dikes and spillways in the West Coast Region of The Gambia.***

Sub Questions

The subsequent sub research questions to better operationalise the main one are thus enumerated below:

1. Which socio-economic profile influences sustainability of the GALDEP constructed dikes and spill ways?
2. Which community participation and social capital factors influence the sustainability of the constructed dikes and spillways?
3. What is the paddy production dynamics within the study area?

1.1.4 Response

Since an Agricultural Land and Water Development Management Policy would be developed, it is imperative that it takes into account factors influencing sustainability of SWC structures provided by government through projects. Therefore my response involve an investigative research to determine socio-economic factors influencing sustainability of the GALDEP constructed dikes and spillways in the pilot site of West Coast Region of The Gambia. The methods employed are discussed in the methodology chapter of this thesis.

1.2 Background Information

Since attaining independence in 1965, the government of The Gambia has had many agricultural projects dealing with agricultural land and water management issues but often in an uncoordinated manner and under no clear cut agricultural policy guidance. The advent of the Agriculture and Natural Resource (ANR) Policy in 2009 was a milestone development for the sector. However, this policy just like many others did not prioritise Sustainable Land Management (SLM) in its bid to promote a market-oriented, commercialized value-chain production and productive systems aligned with macro-economic framework of the country. The only key strategic objective relative to SLM in the policy is the fourth objective which did so very vaguely by just indicating the need for sustainable effective management of the natural resource base of the sector (ANR Policy, 2009).

In a related development, the country's most recent important framework for agricultural development, The Gambia National Agricultural Investment Plan (GNAIP) has been finalized in 2010. Stemming from the requirements of the Regional Agricultural Investment Program (RAIP) of the Economic Community of West African States (ECOWAS), GNAIP is a very comprehensive framework that combines policy, institutional, infrastructure and technology-related measures to address the multiplicity of production, productivity and marketing constraints of the sector (NEPAD, 2014). In this vein, GNAIP is expected to integrate all related on-going projects into its framework as well as solicit funding for more interventions and then assume the role of a national program for food security (GNAIP, 2010). This is why all agricultural projects in The Gambia are now being supervised by a Central Projects Coordination Unit (CPCU) at the Ministry of Agriculture, Banjul.

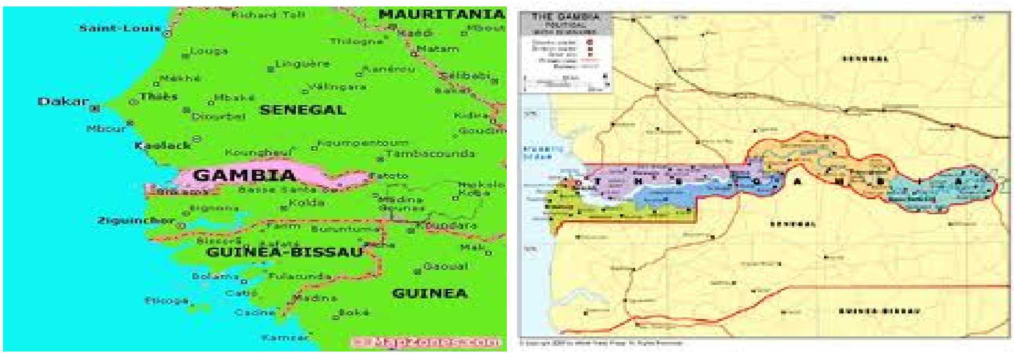

Fig. 1 Map of The Gambia (source: worldatlas.com)

The Gambia Lowland Development Project (GALDEP) has been completed in 2013. According to its Project Completion Report (PCR, 2013), GALDEP developed a cumulative total of 26.5 km of dikes and 1.7 km of spillways in 20 out of a total of 27 intervention villages for land reclamation and development. This opened 1,457.4 ha of lowlands for paddy rice production, representing 6% of the 25,000 ha target of the GNAIP. Since this was a pilot project premised on the unprecedented mechanized and out sourced (contracted) form of dike and spillway construction, it was limited to only one out of the six agricultural regions of the country. Previously, farmers used to provide unskilled labour while the government pays for skilled labour in constructing relatively smaller dikes and spillways. Under this pilot project, all dike and spillway construction for the first time were awarded on contract basis and the resulting relatively bigger and stronger dikes were finally handed over to farmers for use and management at no construction cost to the farmers.

1.2.1 Overview of Rice Production in The Gambia

Rice is the staple food of The Gambia. It is grown in all agricultural production ecologies in the country. Heavy alluvial soils of the river valley are better than the lighter upland soils for rice production. The principal limiting factor in rice production is the water supply and salt water intrusion into swamp fields. Yields of paddy rice are higher in the dry season than in the wet season (up to 6 tons/ha) because of higher solar radiation and reduced pest incidence (ANR Policy, 2009). But this is only possible where irrigation is carried out. Due to its diversity in its production ecologies, rice is mostly categorized into the following categories in The Gambia:

- Swamp rice
- Upland rice
- Chinese or Irrigated rice

Swamp Rice

This type of rice is grown in the inland valleys, mangrove swamps along the River Gambia and its tributaries and the back swamps of Upper River Region of the country. In the inland valleys (*wulumbango*) its production is purely rain-fed. These cultivars are intermediate between the early-maturing and the late-maturing cultivars grown on the upland and the mangrove swamp ecologies, respectively.

The late maturing cultivars of this type of rice are grown in the mangrove swamps. This ecology is seasonally fresh due to the dynamics of the interface between the fresh water from the mainland interior and the saline water from the Atlantic Ocean. The soils of this ecology are the potential acid-sulphate soils which are fertile under submerged conditions. Seeds are sown in nurseries and later transplanted to the main fields. However, the time of transplanting in the mangrove swamps is dependent on the "sweetness" (saline condition) of the water from the adjacent river. The yields of these varieties grown in this ecology are not as high as the Chinese or irrigated varieties. Average yields are between 2-2.5 tonnes per hectare (ANR Policy, 2009).

Upland Rice

This type of rice is principally grown on the colluvio-alluvial (transitional) soils in The Gambia. They are short duration varieties and are purely rain-fed. With the introduction of the NeRICA (New Rice for Africa) varieties, its production is expanded to the pure upland. These rice varieties are very adaptable to the freely drained upland soils and are early maturing (90 days from sowing). It is low-input rice, but responds well to applied fertilizers. The average yields of these varieties according to the ANR Policy, (2009) range between 1.0-1.5 tonnes per hectare depending on management.

Chinese (Irrigated) Rice

These varieties of rice were introduced into the country by the Chinese in the 1960s. They were principally introduced into the Central River Region of the country where the pilot irrigated rice development projects were located. This region coincides with the mature stage of River Gambia where the river banks are relatively flat. Irrigated rice production is therefore principally confined to the Central River Region of the country.

The government of The Gambia gives high priority to the goal of increasing rice production and therefore the bulk of the rice development resources have been devoted to exploiting the potentials of pump irrigation. Despite the several pump-irrigated projects embarked upon by the government, this system did not yield its expected result because of technicalities and high cost of maintenance. Pump-irrigation is not an option for most Gambian farmers. Rain-fed and or tidal irrigated lands are therefore the only available choices to most farmers in The Gambia for sustainable rice cultivation.

Recently, former pump-irrigated rice projects such as the Jahali/Patcharr project are being converted into tidal irrigation which is more sustainable for the resource-poor farmers. The government is now focusing on the development of tidal-irrigated rice production in the Central River Region with its donor partners. Yields of irrigated rice varieties can be as high as 6.0 tonnes per hectare depending on the management.

1.2.2 Soil Resource Conservation Projects in The Gambia

Environmental degradation in its many forms constitutes a significant threat to economic development and it has become evident during the past decades in The Gambia (Bensouda, 2013). Sound environmental management has been recognized as fundamental to the development process, and to the control of environmental degradation (Saidy, 1994). Land degradation in The Gambia includes sheet and gully erosion, soil compaction, water logging and salinization and nutrient depletion – all of which reduce soil productivity. Considerable areas of agricultural land have been lost for production in The Gambia as a result of this phenomenon.

Deforestation is significant not only because of its threat to natural habitats, but also because it is perhaps the most serious cause of land degradation in The Gambia (Saidy, 1994). Pasture and rangeland degradation are occurring in many regions of The Gambia due to human and livestock pressures which approach or exceed the carrying capacities of these range lands. Uncontrolled deforestation coupled with inappropriate soil management and cropping systems lead to land degradation in The Gambia. Where run-off and soil loss rates are relatively high, overland flow can be the dominant hill slope erosion process (Reij, 2005) and this appears to be true for many agricultural areas on non-cohesive soils of Central and Upper River Regions of The Gambia.

In The Gambia, water loss by run-off is a serious problem because the rainfall is concentrated in a relatively short season and falls in high intensity storms. Strikingly, precipitation, based on simulations is according to Hageman et al**.** (2013), projected to decrease in Africa by the end of the 21st century. The water loss is made worst by the fact that the rate of infiltration into most Gambian soils is much less than the rate of rainfall (Saidy, 1994). This coupled with the inefficient farming practices led to serious soil degradation which prompted the creation of the Soil and Water Management Project in 1978 which later became the Soil and Water Management Unit (SWMU) under the Ministry of Agriculture. This Unit has the following objectives:

1. To halt and reverse environmental deterioration due to the inadequacy of traditional farming practices.
2. To encourage the production of food, forage and wood and other cash crops.
3. To reduce the drought susceptibility factors involved in crop production
4. To develop the material and institutional capacity of the unit to deliver technical materials and educational services to the rural population.

Since its inception, the SWMU has been active in addressing the problems of soil degradation in The Gambia. This is done through the extension workers and the villagers concerned. The farmers (villagers) provide the labour force required for the conservation while SWMU provides the material and technical know-how. The resulting structures, mainly dikes and spillways have been generally smaller and thus they do not last longer. Hence, the introduction of GALDEP to construct bigger dikes and spillways without any labour contribution of the beneficiary communities was a milestone development in the sector. Several projects have been embarked upon before GALDEP to address soil and water conservation issues. These projects include:

- Soil and Water Management Project **(SWMP)** - Sponsored by USAID and The Gambia Government
- Soil and Water Conservation Project **(SWCP)** - Sponsored by GTZ and The Gambia Government
- Lowland Agricultural Development Programme **(LADEP)** - Sponsored by ADB, IFAD and The Gambia Government
- Participatory Integrated Watershed Management Project **(PIWAMP)** as a follow-up to LADEP - Sponsored by ADB, IFAD and The Gambia Government

The Government of The Gambia continues to be concerned with soil degradation and is pursuing it in all fronts because agriculture remains the backbone of her economy. Soil conservation structures employed in The Gambia include:

- Earthen dikes, for water retention, erosion mitigation and anti-salt water intrusion
- Contour bonds for erosion control and improved soil water infiltration.
- Grassed water ways for erosion control and reduction of sediment load in runoffs.
- Gully stabilization and control.

1.3 Main Purpose/Objectives

The general objective of this research is to determine socioeconomic factors influencing sustainability of the GALDEP constructed dikes and spillways in the rice growing ecologies of West Coast Region of The Gambia.

1.3.1 Specific Objectives

However, three specific objectives are outlined below for this study:

1. To determine socioeconomic factors influencing sustainability of the constructed dikes and spillways

2. To determine the community participation and social capital factors influencing sustainability of the constructed dikes and spillways

3. To compare cultivated areas and production of rice (i.e. paddy rice in kilograms) before and after dike and spillway construction.

1.4 Research Hypothesis

The following hypotheses were postulated in this study

1. Socio-economic factors including socio- demography, participation and social capital affect the sustainability of constructed dikes and spillways.

2. High community participation and social capital within the community promote the sustainability of constructed dikes and spillways.

3. There will be a significant difference in cultivated area and production (paddy rice yield in kilograms) before and after dikes and spillways construction.

1.5 Justification of the Study

If a policy on Agricultural Land and Water Management Development is to be formulated for the country in 2015, it is prudent to gather as much relevant information as possible for possible incorporation. Hence this research was aimed at contributing just a bit of the bigger information requirement of that policy. Overall, the act of direct investment by government to build these relatively bigger SWC structures for farmers who are mainly subsistence and relatively resource poor could be seen as a worthwhile venture, but it could as well be counterproductive if the right mechanisms and social institutions are not in place for maintaining them. I believe that SLM measures that lay more emphasis on the aspects of the relationship between the SLM strategies and the societal autonomy of the intended beneficiaries are usually viable. Through such approaches indigenous social capital could be harnessed to influence local ownership and thus sustainability. Desirable social capital influences governance which according to Trieb et al, (2007) is an embodiment of institutional realities (polity), association of actors/actresses (politics) and a clear direction (policy), all of which have some bearing on the management of the dikes and spillways studied in this research. It is worth noting that this is important because SLM measures at the end of the day are mostly left with the farmers to manage and sustain hence their involvement in every stage of the developmental process is indeed very crucial in SLM measures as a whole. In fact state facilitation of farmers own efforts through subsidies may create more sense of ownership and thereby facilitating local property relationships which can serve as a trigger for the enhancement of collective action whenever needed and hence foster sustainability (Coward, 1986).

It is therefore justifiable that this research looks at the socio-economic factors that have a bearing on the sustainability of this direct government investment in the form of dikes and spillways. The fact that this project was a pilot makes this research even more justifiable since the findings can inform decisions on similar future interventions.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter discusses the basic concepts and theoretical foundations of SCOT that has been adapted to suit the information requirement of this study. This is captured in section 2.2 below followed by the discussion on sustainability (section 2.1.1) which constitutes a key concept of this research. Supporting concepts of participation and social capital are also elaborated upon in sections 2.2.2 and 2.2.3 respectively.

2.2 Basic Concepts and Theoretical Foundations of SCOT

Since the envisaged policy must provide a well-defined and stable framework for the development of an effective and sustainable agricultural land and water management sector in The Gambia, its formulation process must indeed be all inclusive. Therefore in my own little way this research used the socio-tech conceptual framework as a guide to help me focus more on the people and strategies cornerstone of the SLM specialization of my MSc. study program. Hence the theory of Social Construction of Technology (SCOT) was adapted to study the relations between farmers and the constructed dikes and spillways developed for them by the GALDEP project. Technology design is a social process in which different stakeholders interact. The nature of that process and different perceptions and interests shape the characteristics of the technology (Bijker, 2006; Bijker and Law, 1992). Pinch & Bijker, (1992) further posits that technologies produce particular effects, but this is context specific and non-deterministic. Hence the SCOT concept is adapted in this study to understand the effects of the constructed dikes and spillways by focusing on the socioeconomic factors affecting their sustainability.

The SCOT concept is mainly developed by Law & Bijker (1992) and emphasises that the physical object of technology can not strictly be distinguished from the social aspects it holds. Technology in itself is socially constructed; this means that actors have translated their interests, objectives and interpretations into physical objects (in this case dikes and spillways) which together constitute technology. This is an important and apt theory that is capable of helping one to understand how farmers perceive the introduction of bigger dikes and spillways as well as how they relate to it. This theory anchors on the principle that technology and the society they are intended for are a flip side of the same coin hence understanding the way technology is used, in this case dikes and spillways, requires a parallel understanding of the social context in which they are embedded in (Klein & Kleinman, 2002; Pinch & Bijker, 1992) In addition to this, Russell (1986) emphasises that: ‘An explanation of technological change must show not only what different social groups think about an artefact, but also what they are able to do about it. Understanding this relationship and its subsequent reactionary forces helps in achieving deducible lessons culminating into some more practical way forward. Delving into this social constructivist discourse key concepts such as community participation and social capital were elaborated upon as they influence sustainability.

Another important factor that came into play in this discourse is the concept of gender. This is because The Gambia is historically and traditionally situated as a patriarchal society and hence the patrilineal representation favours men in terms of land acquisition which could pose issues of ownership of the land behind the developed dikes and spillways (Mollett and Faria, 2013). The problem of gender segregation of labour in The Gambia is also so pronounced that rice cultivation is almost a no go area for men. Such mentality of the colonially imposed sexual division of labor as described by Maddox (1996) confine men into cash crop production at the uplands and thereby rendering little or no maintenance assistance to the women at the lowlands. This is yet another important concern as it relates to women's' capacities and capabilities for sustaining the dikes and spillways. In summary the key theory of social construction of technology will be reinforced with concepts of community participation and social capital with gender issues cross cutting across.

2.2.1 Sustainability/Longevity

Sustainability in general is a very fluid concept and therefore can be interpreted in various forms depending mostly on perspective and context. In any case, the concept in many instances refers to the endurance/maintenance of systems and/or processes for balanced utility values, the achievement of which is of course a huge social challenge. Sustainable land management in specific, which is a necessary building block for sustainable agricultural development, is also anchored on the same wider perspective of support, maintenance and endurance of systems and processes for prosperity. Hence the goal of sustainability in this regard is to *"live and labor in accordance with bio-physical limits of the environment"* (Ciegis, Ramanauskiene et al. 1990). Although the implementation process of GALDEP may be consultative and participatory (GALDEP PAD, 2006), its conception could be supply led and therefore susceptible of falling short of the adequate degree of social learning capable of ensuring and maintaining beneficiary ownership of the SWC structures developed. This may hinder the long term sustainability of such interventions since local problems as argued by Ison et al, (2007) need to be locally recognized as problems and then solutions collectively identified and sought instead of problem solving through instrumental interventions in isolation from their inherent social contexts.

Narrowing down the perspective, this research was intended to look at socio-economic factors influencing sustainability/longevity of the GALDEP constructed dikes and spillways. Emphasizes was on concepts of participation and social capital as they have bearing on the capacity and interest of farmers to maintain the productive function of the structures for a reasonable number of years. Therefore answers to the questions on these concepts informs the prospect of the studied dikes and spillways as well as paving way for recommending policy/strategies and or incentives.

2.2.2 Community Participation and Social Capital

In the past, efforts at helping the small producer have had little or no positive impact because of the failure to seriously incorporate popular participation into the processes - either inappropriate innovations were put forward, or the project or programme ended up supporting the least appropriate groups in the community (Cain et al. 1999). Thanks to earlier criticisms of such instrumental technical interventions in isolation of their social contexts by authors including Wade & Chambers (1980), participatory approaches began emerging. Although participation has several levels, this study only focused on the community participation in the upkeep and management of the constructed dikes and spillways. Participation parameters looked at in this study were level of community involvement, gender and age groups of participating individuals and degree of contributions (labour and finance).

Most literatures argue that four levels of capital are critical for any technology adoption and sustainability (Brunori and Rossi 2000, Elasha *et al* 2005, Knutsson 2006, Scoones 1998), (1) The natural capital: this refers to the natural resource stocks (water, air, soil etc.) and environmental services from which resource flows and services required for livelihoods are derived. (2) Economic or financial capital: refers to the cash/credit, savings, basic infrastructure and production equipment which are necessary for the pursuit of any livelihood strategy. (3) Human capital: refers to the skills, knowledge, ability to labour and good health as well as physical capabilities to pursue different survival means. (4) **Social capital:** refers to the social claims, networks, relations, affiliations and associations upon which people draw when pursuing different livelihood strategies which require coordinated activities. Thus, in order to create sustainable livelihoods, people combine different capital endowments which they have access to and control over (Scoones, 1998). Lochner et al. (1999, cited in Njuki et al 2008) refers to social capital as "features of social organization such as networks, high levels of interpersonal trust and norms of mutual aid and reciprocity which act as resources for individuals and facilitate collective action" Although determination and quantification of social capital factors are difficult and context dependent, social capital related factors are significant determinants of investments in sustainable land management (Cramb, 2004; Glaeser et al., 2002)

The four important features of Social capital (Cramb, 2004; Njuki et al 2008; Nooteboom, B. 2007) are:

1) Relations of trust: this is the platform upon which all other features depends on, but it takes quite a time for it to be establish between people.. Although it's difficult to measure and quantify, it generates confidence between people to the extent that each have trust on the other for any transaction or activity to be embarked upon. Subsequently each is obliged to act accordingly without the other's watch and thus foster cohesion and cooperation within a given community.

2) Reciprocity: based on the foundation of trust and mutual respect, members of society exchange goods, knowledge and services since each is assured of getting back whatever is given in one form or the other. This is an integral ingredient for sustained contributions and investments in sustainable land management endeavors.

3) Common rules, norms and sanctions: still based on the trust that developed over time and space, common rules which are mutually agreed-upon are fairly applied to guide and drive behaviors and actions within the community. Acceptance of such rules gives confidence to individuals to invest in collective goods or services. In the case of dikes and spillways individuals may be willing to repair part of a dike that might have been washed away due to unseasonal heavy down pour of rains when they are confident that rules are in place to punish anyone caught boring a hole through the dike when water regime in the fields is low.

4) Connectedness in networks and groups: Njuki et al (2008) identified three types of social capital relative to connectedness in networks and groups; (1) Bonding social capital is seen as the horizontal relationship between people with similar objectives hence Szreter and Woolcock (2004) sees it as a trusting and cooperative intrapersonal relationships of people that are socio-demographically similar. In the case of The Gambia examples of bonding social capital includes Village Farmer Associations, Age groups locally known as *kafoos,* Farmer Field Groups etc. (2) Bridging social capital: is the capacity and ability to link with others. While bonding social capital characteristics are trust and norms within a given localized community based organization, bridging social capital transcends vertically across social units or structures premised on collaboration and coordination to achieve set goals (Beugelsdiyk and Smulders, 2003; Njuki et al 2008). This type of social capital is further characterized by comparatively large loose networks and a thinner type of trust. Examples of bridging social capital in the context of this studies is the networks between Village Farmer Associations of different villages or between age group associations within the same or different villages as well as gender group associations of different communities. (3) Linking social capital: this refers to the capacity and ability to engage with external agencies. While referring to bonding social capital at micro level as intra-community ties, Cramb (2005, pp 215) describes linking social capital as “extra-community networks that enable individuals and groups to tap outside sources of information, support, and resources, not just enabling them to ‘get by’ but to ‘get ahead’”. By the same token Njuki et al (2008) describes it as social interactions across “explicit, formal, or institutionalized power or authority gradients in society”. Hence linking social capital is a requirement for the enhancement of economic emancipation within a given locality. Examples of this type of social capital includes links to traders and financiers, extension agents, NGOs, projects, research institutions etc.

The study also confined itself to Social capital parameters influencing community capacities and abilities in maintaining the dikes and spillways. These includes networks, affiliations, social claims (ownership), common rules and sanctions, mobilization strengths and availability of knowledge and skills.

CHAPTER 3
METHODOLOGY

3.1 Introduction

This chapter outlines the methodology aspect of the study used for the purpose of achieving the objectives of the study. The chapter is categorized into sub sections of mainly conceptual framework, data collection process, questionnaire design and finally the analytical methods used to analyse the collected information.

3.2 Conceptual Framework

The theory of Social Construction of Technology is adapted to study the sustainability dynamics of the constructed dikes and spillways within the study area. This was fine tuned to look at primarily the socio-demographic profile of the respondents as well as concepts of community participation and social capital factors influencing sustainability of the constructed dikes and spillways. This is premised on the basic principle that society and technology influences each other and that technologies produce particular effects, but this is context specific and non-deterministic. Thus by looking at these socio-economic factors, produced effects of the constructed dikes and spillways relative to sustainability factors could be illuminated.

In a related move, paddy rice production dynamics was also conceptualized and studied to see if the dikes and spillways have increased output or not. Paddy rice output trend is an important indication to see if farmers in the study area have an incentive in terms of increased paddy output for sustaining the constructed dikes and spillways.

Figure 2 below gives a sketch of the adapted SCOT

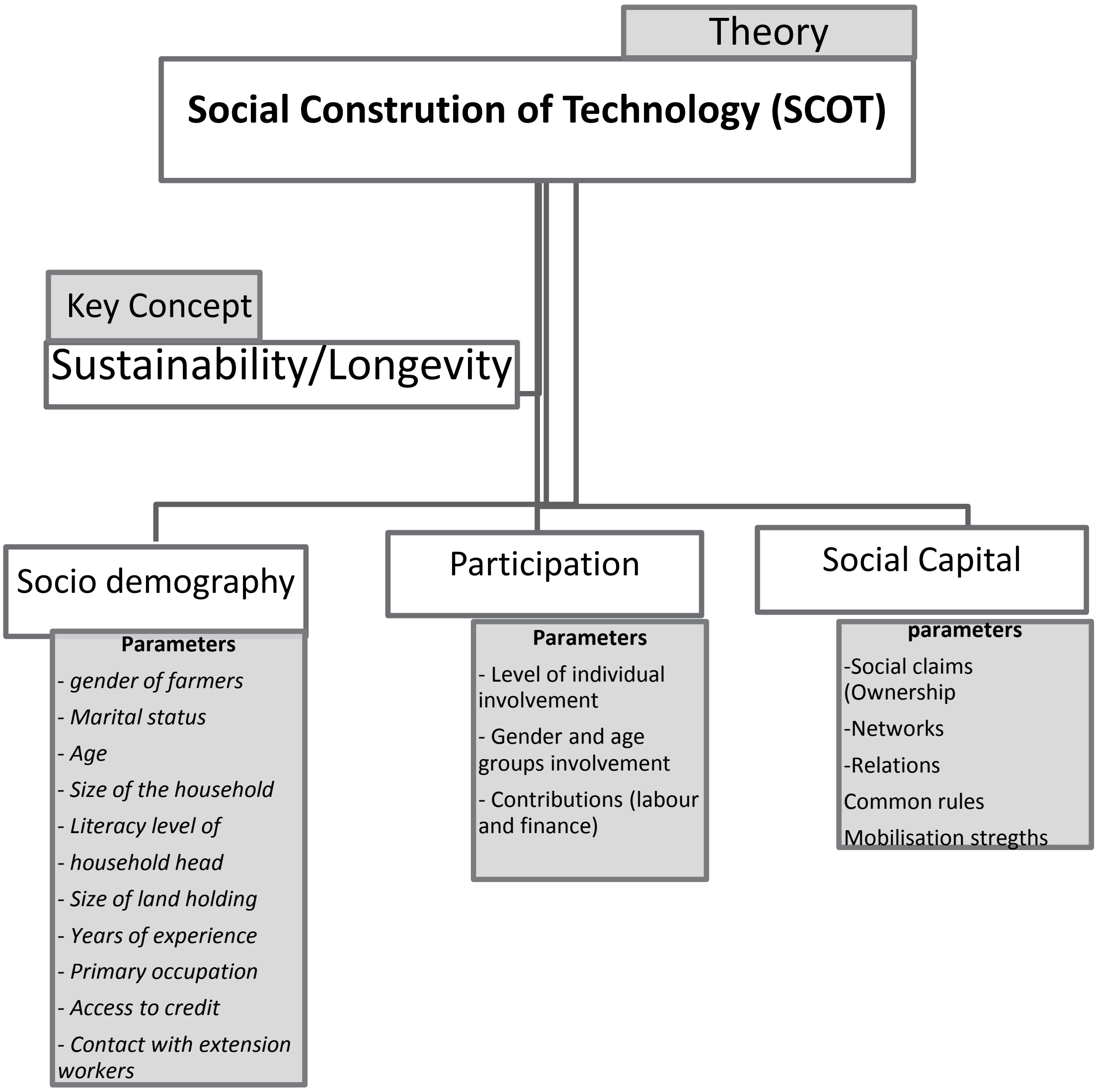

Fig 2: Conceptual framework (Adapted from Bijker (1992)

3.3 Data Requirements

In order to address the objectives and test the hypotheses presented in Chapter 1, the table below (table 1) captures the analytical tools and the data used in the study**. S**tructured household questionnaires were used for primary data collection backed up by key informant interviews and focus group discussions to establish the circumstances under which the constructed dikes and spillways are as well as the socioeconomic factors influencing their sustainability.

Table 1: Data Analysis Matrix

Objective	**Hypothesis**	**Analytical tool**	***Data required***
1. To determine the socio-economic factors that affects sustainability of constructed dikes and spillways	Socio-economic factors including community participation and social capital affects the sustainability of constructed dikes and spillways	-Descriptive statistics -Logistic regression model	*Primary data* - *gender of farmers* - *Marital status* - *Age* - *Size of the household* - *Literacy level of* - *household head* - *Size of land holding* - *Years of experience* - *Primary occupation* - *Access to credit* - *Contact with extension workers* - *Participation* - *Social capital*
2. To determine the influence of community participation and social capital on sustainability of the constructed dikes and spillways.	High community participation and social capital within the community promotes the sustainability of constructed dikes and spillways.	-Descriptive statistics -Logistic regression model	- *level of community involvement* - *Gender and age groups* - *contributions (labor and finance)* - *Resource mobilisation (labor and finance)* - *Committee formation process* - *social claims* - *(perception on dike ownership)* - *networks* - *common rules* - *mobilization strengths* - *availability of knowledge and skills*
3. To compare cultivated area and production (paddy output) before and after dike and spillway construction	There will be a significant difference in cultivated area and production (paddy output) before and after dikes and spillways construction	Descriptive statistics (t-test)	***Production (output)*** - *Before and after dike and spillway construction* ***cultivated area*** - *before and after dike and spillway construction*

3.4 Sampling Techniques

Naturally, the unit of analysis of this research was based on rice growing farmers (who are mainly women) within the boundaries of the GALDEP pilot project in the West Coast Region of The Gambia. Simple random selection was applied to select six (6) villages (Faraba Banta, Sohm, Berefet, Bintang, Kanwally and Jarrol) out of the 20 beneficiary villages, representing 30% sample size. A questionnaire was administered to a total of ninety (90) at random given fifteen (15) farmers per sampled village. However, eighty seven (87) respondents were analyzed in this study after the data cleaning. Similarly a total of six (6) FGDs was conducted (one (1) per sampled village) as well as observations of the dikes and spillways in the sampled villages for triangulation. A framework of data collection and analysis is presented below.

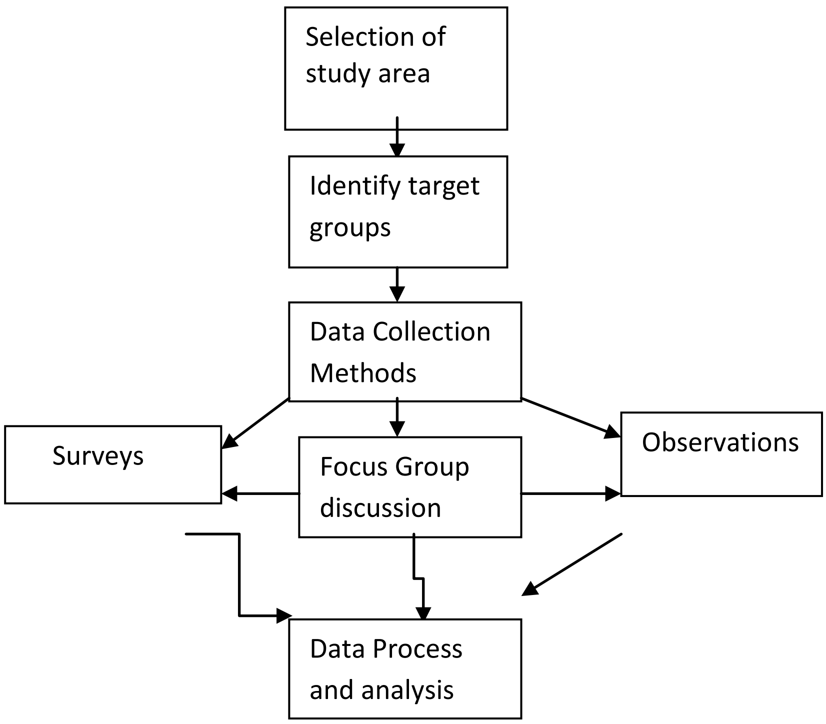

Fig 3: Framework of data collection and analysis steps

3.5 Data Collection

A structured questionnaire was used to collect data from each selected household. The main types of data collected were household characteristics, rice production dynamics social capital and community participation variables in each community. Focus Group Discussions were also held mostly in the field so that we see what we discuss about. The data collecting instruments are shown in Appendix 1 and 2.

3.6 Analytical Tools

Primarily two analytical tools were used in the data analysis and these are descriptive and the binary logistic regression models. Both are respectively described in sections 3.6.1 and 3.6.2 below.

3.6.1 Descriptive Analysis

Descriptive analysis is the summarization of the quantitative data into a simpler summary to make it easier to understand measure, and interpret. It was used to characterize sampled farmers in the study area. Frequency distribution was drawn to view how frequently each category in demographic and socioeconomic variables of the farmers behave in this research. The descriptive analysis was done primarily using SPSS version 20.

3.6.2 The Binary Logistic Regression Model

The logit regression model was used with the aid STATA software. The study analysed dichotomous responses, i.e. whether the constructed dikes and spillways are likely sustainable or not. In that regard, a binary logistic regression model (logit) was used. The model was used to describe the relationship between one or more independent variables (e.g., age, sex, etc.) where there is a binary response variable – the likelihood of sustaining the constructed dikes and spillways within the communities - which is expressed as a probability. This model was chosen for its simplicity and its ability to take as many regressors. Mujeyi (2009) also attest to the fact that parameter estimates of the logit model are asymptotically efficient and consistent in addition to variables not being necessarily normally distributed.

The log odd of the outcome in logit model is a linear combination of the predictor variables. The simple form of logistic model, according to Peng et al., (2002) is shown below:

$$\text{Logit(Y)} = \text{natural log (odds)} = \ln \left(\frac{\pi}{1-\pi}\right) = \alpha+\beta xi \qquad (1)$$

This equation helps us to predict the likelihood of the occurrence of the result of interest. This is using antilogs in both sides of equation (1) as shown below:

$$\pi = probability\ (Y = outcome\ of\ interest/\ X = x)\ =\ \frac{e^{\alpha+\ \beta x}}{1+\ e^{\alpha+\ \beta x}} \qquad (2)$$

Where;

π= probability outcome of interest

x= Y intercept

β= regression coefficient

e= 2.71828 (the base of natural logarithms)

x= binary or continuous variables

This study was intended to determine sustainability of the constructed dikes and spillways in the selected communities. Therefore, the dependent variable (Y) stands for the probability of sustainability of constructed dikes and spillways in which the variables is coded as 1 and 0. The variable is coded as 1 if the constructed dikes and spillways are likely to be sustainable and if otherwise is coded as 0.

For questions related to sustainability of the dikes and spillways in the community, sustainability indicators were assessed using seven (7) point likert scale (Appendix 1D). Statements were given for respondents to indicate their opinion with respect to some of the determined sustainability indicators such as availability of funds to sustain the constructed dikes and spillways, availability of functional management committee to manage the constructed dikes and spillways, level of community participation, availability of both skilled and unskilled labor to sustain dikes and spillways, level of governance within the community and finally the level of social cohesion within the management committee. Respondents rated these statements based on their opinion using seven (7) likert scale from point 7 “very high” to point 1 “not at all”.

The statements from each respondent were computed to establish mean score. An average score of 4.5 and above indicates the presence of sustainability indicators within that community while an average score of less than 4.5 is an indication of inadequate sustainability measures within the community. To make the variable dichotomous as used in the logit model, all average score of 4.5 and above is coded as 1, that is the constructed dikes and spillways are likely to be sustainable while mean score of less than 4.5 is coded as 0 (meaning the constructed dikes and spillways are not likely to be sustainable in the community).

Independent variables (x) represent the factors that are likely to influence sustainability of constructed dikes and spillways. Most of the independent variables are coded as dummy variables, as several researchers have coded all independent variables as dummy variable by using binary logistic regression (Jose and Ladislao, 2012; Chan et al.,2006; Darren,2007).

Coding all the independent variable in binary logistic regression as dummy variables allows easy interpretation and calculation of the odd ratios, increases the stability and significance of the coefficients, and also representing information in the form of dummy variables makes it easier to turn the model into a decision tool (Garavaglia et al., 1998).

The first model was used to determine the extent to which selected socio-economics variables influence sustainability of the constructed dikes and spillways. While the second model was run to determine only the social capital and community participation factors that influence sustainability of constructed dikes and spillways. The difference between the first and the second logit regression models is that the first one looked at all the determined socio-economic factors (i.e. socio-demography, community participation and social capital variables), while the second one was limited to only the community participation and social capital factor variables. In other words the first was run to determine key socio-economic factors within relatively broader socio-economic variables while the second narrowed the focus using variables of community participation and social capital factors. The description of the variables used in the model is given in table 2 below.

Table 2: Definition of Independent and Explanatory Variables used in the Logistic Regression Model

No	Variables	Description	Codes
	Independent variable		
	sustainability	Probability of constructed dikes and spillways to be sustainable	1 = likely to be sustainable 0 = not likely to be sustainable
	Explanatory variables		
I	gender	Gender of rice farmers	1 = Male 0 = female
Ii	maritalstatus	Marital status of a farmer	1 = head 0 = spouse
iii	age	Age of the farmers	Continuous
iv	hhsize	The number of people in the household	Continuous
V	edu	Education status	1 = educated 0 = not educated
vi	farmsze	The number of hectares cultivated after dike construction	Continuous
vii	expe	Production experience of a farmer	1 = more than 10 years 0 = less than 10 years
viii	pryoccup	Primary occupation	1 = farming 0 = otherwise
ix	credit	Access to credit	1 = yes 0 = no
X	extension	Access to extension services	1= yes 0 = no
xi	Mngcommitte*	Availability of management committee for the constructed dikes	1 = yes 0 = no
xii	genderpart*	Gender participation in the maintenance works of constructed dikes and spillways	1 = male 0 = female
xiii	agepart*	Age group participation in the maintenance works of constructed dikes and spillways	1 = youths (12- 25 yrs) 0 = adults (26- 50yrs)
xiv	cmmteform*	Committee formation process	1= selection 0 = otherwise
xv	resoumobls*	Resource mobilisation within the community	1= mobilised by the community 0 =otherwise
xvi	Dike ownership*	Individual perception on dike ownership	1 = owned by the community 0 = otherwise
xvii	labresources*	Availability of labour resources within the community	1 = yes 0 = no

xviii	finresources*	Availability of financial resources within the community	1 = yes 0 = no
xix	skillskno*	Availability of required skills and knowledge in maintenance of constructed dikes and spillways	1 = yes 0 = no
xx	networking*	Group networking	1 = yes 0 = no
xxi	rulesbylaws*	Availability of set rules rules/bylaws governing the upkeep of constructed dikes and spillways	1 = yes 0 = no

Note: Variables with asterisk are considered community factors. However, all these variables were assessed at individual/household level to check their perception about the availability of these community variables within the community.

Each of the regression coefficients describes the size of the contribution of that factor to the sustainability of the constructed dikes and spillways. In other words, the coefficients tell how much the logit changes based on the values of the predictor variables. A positive regression coefficient means that the explanatory variable increases the probability of the outcome, while a negative regression coefficient means that the variable decreases the probability of that outcome. Furthermore, a large regression coefficient means that the factor strongly influences the probability of that outcome, while a near-zero regression coefficient means that the factor has little influence on the probability of that outcome. In this regression model, the Maximum Likelihood Method was used to estimate all the parameters using the STATA computer programme where model appropriateness was analysed through the chi-square test.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Descriptive Statistics

This descriptive statistics section features the analysis of the socio-demographic profile of the respondents, Community Participation and Social Capital factors. An analysis of production dynamics before and after the construction of dikes and spillways using descriptive statistics was also treated.

4.1.1 Socio Demographic Characteristics of the Farmers in the Study Area

Table 3 below shows the socio demographic profile of farmers in the study area. The results show that 93% of the respondents were female while the remaining 7% were males. This indicates that rice cultivation, as is the norm, is still female dominated. Such perpetuating mentality of the colonially imposed gender division of labor (Maddox, 1996) still confines men into cash crop production at the uplands and thereby rendering little or no maintenance assistance to the women at the lowlands. This trend poses sustainability problems of SWC structures in rice growing ecologies since men are usually always preoccupied with farm activities in the upland fields. Further disaggregation of the data showed that majority of these women farmers (43%) are in the age bracket of 46 to 55 years and their average household size is between 8 to 14 persons representing 53% of the total respondents. This indicates that there is a limited number of youths involved in rice cultivation in the study area, a situation which can hider sustainability of the constructed dikes and spillways since maintenance of such earthen up dikes is often labour intensive. Paradoxically, these old women are responsible for feeding the mostly extended family systems (8 to 14 persons) because rice remains the main food crop of the country.

The majority of the respondents (58%) in the study area are Mandikas by ethnicity, a tribe that is historically tied to rice cultivation based on their mastery of the art of rice cultivation (Carney and Watts, 1991). Almost all of them (94%) indicated that they are married and their household status being spouses (79%), depicting that they are within extended family units where increased production is necessary for feeding the family. Such need for increased production therefore require sustainable land management including sustainable management of the constructed dikes and spill ways for enhanced production and productivity.

With respect to education, as shown in Table 3 below, 76 farmers indicated that they did not attain any formal level of education. This represents 87% of the total respondents, which indicates that the population of the study area could require routine extension follow ups to serve as a reminder on key sustainability measures since their ability to read and write is too low.

The fact that the primary occupation of the respondents is farming (97%) and that 98% of them have 10 or more years of production experience is encouraging. But how these and the other socio demographic factors affects sustainability of the constructed dikes and spill ways is further discussed under the logit regression analysis.

Table 3: Socio Demographic Characteristics

Variables	Frequency	Percentage
Gender		
Male	6	6.9
Female	81	93.1
Age of the farmers		
30 to 45 yrs	29	33.3
46 to 55 yrs	37	42.5
56 to 65 yrs	17	19.5
Above 65 yrs	4	4.6
Household size		
1 to 7	7	8.0
8 to 14	46	52.9
15 to 21	26	29.9
Above 21	8	9.2
Ethnicity		
Mandinka	50	57.5
Fula	1	1.1
Jola	36	41.4
Marital status		
Married	82	94.3
Single	1	1.1
Widowed	3	3.4
Divorced	1	1.1
Household status		
Head	18	20.7
Spouse	69	79.3
Education		
Yes	11	12.6
No	76	87.4
Level of education (n=11)		
Primary	5	45.5

Secondary	5	45.5
Madarassa	1	9.1
Production experience		
Less than 10 years	2	2.3
10 to 20 years	24	27.6
21 to 30 years	41	47.1
31 to 40 years	19	21.8
Above 40 years	1	1.1
Primary occupation		
Farming	85	97.7
Civil service	1	1.1
Trading	1	1.1

4.1.2 Community Participation, Social Capital and Management of the Constructed Dikes and Spillways

It's encouraging to see that majority (74%) of the respondents in the study area claims ownership of the constructed dikes and spillways since ownership rights as argued by Coward (1986) is a good trigger for the enhancement of collective action whenever needed and hence foster sustainability. Furthermore, this phenomenon is supported by the availability of labour resources as claimed by 93% of the respondents for unskilled labour requirements for the maintenance of the constructed SWC structures. However the fact that 66% of the respondents echoed lack of financial resources for dike and spillway maintenance requirements is a bit worrisome because money would sometimes be needed to purchase materials like cement, rods, gravel, and sand in an event of spillway repairs.

Table 4 below further shows that all the respondents (100%) belong to an association and 81% of them reported that they have management committees in place for the management of the constructed dikes and spillways and also 97% of them affirmed that the committees were formed by the community themselves. Although majority of them (69%) says that the committee formation process is through selection as opposed to preferred elections which recorded only 7%, the mere availability of the committees is an indication of a relevant social capital factor for the management of the constructed SWC structures. Other important social capital factors are the availability of knowledge and skills for maintenance works, and the availability of common rules recording 55% and 53% respectively. While these are just a little above average, 98 % of the respondents says they do group networking which enables a good deal of social learning.

To illuminate community participation, the results shows that 92% of the respondents says they mobilise resource through community contributions as opposed to 8% for donations. This is an indication that almost each member of the community participates in raising resources for maintaining a common facility. It's not very surprising to see from table 4 that majority (77%) of participating gender in maintenance works are females. The deducible justification stems from the perpetuating historical and cultural gender segregation of labour which "ties" women to the rice growing ecologies (mainly lowlands) and men to the groundnut growing ecologies (mainly uplands). This situation unable men to render adequate and timely assistance to women in the rice fields since they would as well be busy with their upland field activities. Therefore the mere availability of labour resources as indicated in the table under review may not directly translate to the sustainability of the constructed dikes and spillways since the available labour is that of the women only. Men labour is an important necessary factor for enhancing sustainability of the constructed dikes and spillways. The low (17%) participation of youths within the age brackets of 12 to 25 years in maintenance works of the constructed dikes and spillways can also exacerbate the community labour requirement stress for maintaining the dikes and spillways. 83% of the respondents in the study area affirmed that only the elders (between 26 to 50 years) participate in maintenance works of the constructed dikes and spillways.

Table 4: Community Participation, Social Capital and Management of the Constructed Dikes and Spillways

Variable	Frequency	Percent
Ownership of the constructed dikes and spillways		
Government	10	11.5
Community	64	73.6
GALDEP	13	14.9
Availability of labor resources		
Yes	81	93.1
No	6	6.9
Availability of financial resources		
Yes	30	34.5
No	57	65.5
Membership of Farmer association		
Yes	87	100
Availability of management committee for constructed dikes and spillways		
Yes	70	80.5
No	17	19.5
Who forms the committee (n=70)		
Government	2	2.9
Community	68	97.1

Committee formation process		
Election	5	7.1
Selection	48	68.6
Voluntary	12	17.1
Inheritance	5	7.1
Availability of knowledge and skills of repair works of the constructed dikes and spillways		
Yes	48	55.2
No	39	44.8
Mode of resource mobilisation		
Community contribution	80	92.0
Donations	7	8.0
Availability of rules/ bylaws governing the upkeep of the dikes and spillways		
Yes	46	52.9
No	41	47.1
Group networking		
Yes	85	97.7
No	2	2.3
Gender participation in maintenance works		
Males	20	23.0
Females	67	77.0
Age group participation in maintenance works		
Youth group (12-25yrs)	15	17.2
Adults (26-50yrs)	72	82.8

4.1.3 Rice Production Status in the Study Area

Table 5 below looks at the rice production status in the study area since the primary purpose of the constructed dikes and spill ways is to boost rice production and productivity. It is worth noting that 94 % of the respondents said that they own the land they grow the rice and the remaining 6% hire land for production. This is consistent with the main land tenure system in rice production communities of The Gambia known as customarily owned household land holding (Carney, 2004). In this tenure system (locally called *maruo*), ownership rights are extended to all married women within a given household which lasts as long as the marriage lasts, correspondingly 94% of the respondents in the study area as shown in table 1 are married. However, this ownership rights within a particular household also entails the collective labour capital of all workable members of the said household for consumptive purposes. Males usually do *maruo* cropping on the uplands (millet or groundnuts) and females on the lowlands (rice) and the produce are entirely managed by male household heads. Such patrilineal hegemony countered by the boom in women vegetable gardening as agued by Schroeder (1996) gave rise to many intra-household politics which serves as a disincentive for many males to render assistance to women in the rice fields.

Soil fertility as shown in table 5 is responded to be average (87% of respondents), meaning that with even minimal fertilizer application an average output can be realized. Area put under cultivation as well as paddy output, according to respondents, has increased after dike and spillway construction. Even though majority of the respondents still cultivate under 1.0 ha both for before and after dike construction, 61% and 53% respectively, the cultivation of more than 1.0 ha has also significantly increased representing 47% of the respondents for after dike and spillway construction against 39% for before dike and spillway construction. Furthermore paddy output has also dramatically increased after dike and spill way construction since 69% of the respondents were in the output bracket of 500kg to 1000kg per ha compared to only 31% of respondents in the same output bracket before and after. In the other way round the results shows that 43% of the respondents score within paddy output bracket of 1000kg to 1500kg per ha after dike and spill way construction while only 17% of them could have that much before. This trend shows that the constructed dikes and spillways are serving their water retention and anti-salt intrusion capabilities in a bid to enhance paddy production and productivity in the study area. This trend is an indication that farmers in the study area have an incentive in terms of paddy output for sustaining the constructed dikes and spillways.

Table 5: Rice Production Status in the Study Area

Variable	Frequency	Percentage
Land ownership		
Yes	82	94.3
No	5	5.7
Land acquisition (n=5)		
Hired	5	100.0
Soil fertility		
Very fertile	8	9.2
Average	72	82.8
Infertile	7	8.0
Ecology used for production		
Upland	8	9.2
Lowland	57	65.5
Both	22	25.3
Reasons for chosen rice ecology		
Lowland is more productive	32	36.8
Because of easy Access	32	36.8
Risk averse(Diversification)	23	26.4

No. of hectares cultivated before dike construction		
Less than 1 Hectare	53	60.9
1 to 2 Hectares	32	36.8
Above 2 Hectares	2	2.3
No. of Hectares cultivated after dike construction		
Less than 1 Hectare	46	52.9
1 to 2 Hectares	38	43.7
Above 2 Hectares	3	3.4
Rice Output before dike construction		
Less 500 kgs	9	10.3
500 to 1000 kgs	60	69.0
1000 to 1500 kgs	15	17.2
Above 1500 kgs	3	3.4
Rice Output after dike construction		
Less 500 kgs	6	6.9
500 to 1000 kgs	27	31.0
1000 to 1500 kgs	37	42.5
Above 1500 kgs	17	19.5

4.2. Logistic Regression

A logistic regression model is used to determine the socio-economic factors influencing sustainability of the constructed dikes and spillways using STATA software. First socio-economic factors including socio demography, community participation and social capital factors were all imputed in one model, while only community participation and social capital factors were imputed in the second model.

4.2.1 Socio- Economic Factors Influencing Sustainability of Constructed Dikes and Spill Ways

The model consists of socio demographic variables of the farmers as well as community participation and social capital variables. The variables in the model are gender, marital status, age, household size, educational status, farm size, access to credit , access to extension services, gender participation in the community, age group participation, committee formation process, mode of resource mobilization, perception on dike ownership, availability of labor resources within the community, availability of financial resources in the community, required skills and knowledge of the farmers in the maintenance works of constructed dikes and spillways, the ability of the community to network with other groups, and availability of set rules/bylaws governing the upkeep of the constructed dikes and spillways in the community.

A multi-collinearity test was done to establish correlation among the variables. The variables that show high correlations were removed to improve the model. The correlation matrix is shown in the appendix.

The results of the logistic model showing the factors that influence sustainability of dikes and spillways are presented in table 6 below. Running the model for the first time, farming experience and primary occupation were omitted because of multi collinearity. This initial result is presented as follows:

Iteration 0: log likelihood = - **48.262844**
Iteration 1: log likelihood = - **35.273005**
Iteration 2: log likelihood = - **34.864468**
Iteration 3: log likelihood = - **34.853267**
Iteration 4: log likelihood = - **34.853256**
Iteration 5: log likelihood = - **34.853256**

Logistic regression N L P

umber of obs = **70**
R chi2(**18**) = **26.82**
rob > chi2 = **0.0825**
Pseudo R2 = **0.2778**

Log likelihood = **-34.853256**

Sustainability	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Gender	2.291432	1.547964	1.48	0.139	-.7425225	5.325386
Maritalstatus	-.3473605	1.60389	-0.22	0.829	-3.490927	2.796206
age	.0091049	.0467531	0.19	0.846	-.0825296	.1007393
Hhsize	-.1285402	.0687167	-1.87	0.061	-.2632225	.0061422
edu	.0362697	1.12944	0.03	0.974	-2.177393	2.249932
Farmsze	.7208392	.7288513	0.99	0.323	-.7076832	2.149362
Credit	.2653906	.7591116	0.35	0.727	-1.222441	1.753222
Extension	-1.94705	2.233747	-0.87	0.383	-6.325114	2.431013
Genderpart	-2.596826	.9981661	-2.60	0.009	-4.553196	-.6404568
Agepart	-1.425963	.8793741	-1.62	0.105	-3.149505	.2975786
Cmmteform	.0585378	.8549692	0.07	0.945	-1.617171	1.734247
Resoumobls	.9156675	1.376482	0.67	0.506	-1.782188	3.613523
Dikeownership	1.296279	.8587198	1.51	0.131	-.3867809	2.979339
Labresources	.7324744	1.654732	0.44	0.658	-2.51074	3.975689
Finresources	.4233706	.7861052	0.54	0.590	-1.117367	1.964108
Skillskno	.6846483	.710397	0.96	0.335	-.7077042	2.077001
Networking	-.8393034	2.191209	-0.38	0.702	-5.133995	3.455388
Rulesbylaws	.5099521	.8664372	0.59	0.556	-1.188234	2.208138
_cons	.7669905	4.852552	0.16	0.874	-8.743837	10.27782

Note

- Farming experience!= 1 predicts success perfectly farming experience dropped and 1 obs not used
- Primary occupation!= 1 predicts success perfectly primary occupation dropped and 1 obs not used

From this model, it is noted that the overall model is not significant given the prob >chi2 = 0.0825 and two variables that is education status and committee formation process having highest p > [z] of 0. 974 and 0.945 respectively. These variables were dropped from the model to yield table 6 below.

Table 6: Socio- Economic Factors Influencing Sustainability of Constructed Dikes and Spill Ways

Iteration 0: log likelihood = - **59.837454**
Iteration 1: log likelihood = - **41.010431**
Iteration 2: log likelihood = - **40.521624**
Iteration 3: log likelihood = - **40.512294**
Iteration 4: log likelihood = - **40.512284**
Iteration 5: log likelihood = - **40.512284**

Logistic regression N L P — Number of obs = **87**
R chi2(**16**) = **38.65**
rob > chi2 = **0.0012**
Log likelihood = **-40.512284** — Pseudo R2 = **0.3230**

Sustainability	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Gender	2.386756	1.378725	1.73	0.083*	-.3154945	5.089007
Maritalstatus	-.0498285	1.318958	-0.04	0.970	-2.634939	2.535282
Age	-.0234404	.0380817	-0.62	0.538	-.0980792	.0511985
Hhsize	-.1108233	.057459	-1.93	0.054*	-.2234408	.0017942
Farmsze	.8430948	.669509	1.26	0.208	-.4691187	2.155308
Credit	-.2212632	.640896	-0.35	0.730	-1.477396	1.03487
Extension	-1.72133	2.035794	-0.85	0.398	-5.711413	2.268754
Genderpart	-2.258947	.834723	-2.71	0.007*****	-3.894974	-.6229198
Agepart	-1.022883	.7638981	-1.34	0.181	-2.520096	.4743295
Resoumobls	.7895335	1.284687	0.61	0.539	-1.728406	3.307473
Dikeownership	1.593822	.7782024	2.05	0.041***	.0685733	3.119071
Labresources	-.8810885	1.129312	-0.78	0.435	-3.0945	1.332323
Finresources	1.415842	.6810585	2.08	0.038**	.0809915	2.750692
Skillskno	.4871634	.6596856	0.74	0.460	-.8057967	1.780123
Networking	-.0662459	2.024141	-0.03	0.974	-4.03349	3.900998
Rulesbylaws	1.532346	.7362317	2.08	0.037***	.0893587	2.975334
_cons	1.057647	4.08133	0.26	0.796	-6.941613	9.056906

***, ** and * means statistically significant at 1%, 5% and 10% respectively

The results shown above show that at 5% significant level, four socio economic factors are statistically significant in influencing the sustainability of constructed dikes and spillways in the GALDEP intervention areas. The factors are gender participation, perception on dike ownership, availability of financial resources and the availability of set rules/bylaws governing the upkeep of the constructed dikes and spillways. Three factors (perception on dike ownership, financial resources and rules/bylaws) have positive influence on the sustainability given the coefficient values 1.594, 1.416, and 1.532 respectively. In other words, this can be interpreted as the more the communities take ownership of the constructed dikes and spillway will inevitably increase the likelihood of sustaining the technology. The same positive influence is observed for financial resources and set rules governing the upkeep of the dikes and spillways. That is, the availability of required financial resources and setting of the bylaws that are to be strictly followed will contribute immensely in sustaining the constructed dikes and spillways in the communities.

In contrast, gender participation shows a negative coefficient (-2. 259) on sustainability of the constructed dikes and spillways. This is clearly an indication that female participation in maintenance works is more prominent than the male participation. So as a result, their participation might not necessary translate into sustainability. The results show that gender participation is very crucial for sustaining the constructed dikes and spillways however this should not be felt in the hands of female folks alone. The absence or inadequate participation of men in rice growing probably due to their concentration in the upland cash crop production as seen in most communities tend to put the constructed dikes and spillways vulnerable. This is true because the availability of labor resources in the model equally has negative influence on the sustainability though not statistically significant (p>z =0435). This is interesting and unexpected results because labor resources within the communities should influence sustainability positively. However, this can be justified that labor available in these communities are predominantly women and this might not be an effective labor required for upkeep of the dikes and spillways.

4.2.2 Social Capital and Community Participation Factors Influencing Sustainability of Constructed Dikes and Spillways.

This section also used logit model to determine only social capital and community participation variables that influence sustainability of constructed dikes and spillways. These variables include gender participation, age group participation, committee formation process, resource mobilization, dike ownership, labor resources, financial resources, skills and knowledge of farmers in maintenance works, networking and availability of rules/bylaws governing the upkeep of the dikes and spillways. All these variables were used in the model for the determination of social capital and community participation factors which have an influence on the sustainability of constructed dikes and spillways.

The initial model was run including all these variables. However, some variables were omitted due to multi-colleanerity and the initial results are presented as follows:

Iteration 0: log likelihood = - **48.262844**
Iteration 1: log likelihood = - **39.767711**
Iteration 2: log likelihood = - **39.726634**
Iteration 3: log likelihood = - **39.726574**
Iteration 4: log likelihood = - **39.726574**

Logistic regression	N L P	Number of obs =	**70**
		R chi2(**10**) =	**17.07**
		Prob > chi2 =	**0.0728**
Log likelihood = **-39.726574**		Pseudo R2 =	**0.1769**

Sustainability	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
Genderpart	-1.949535	.7792115	-2.50	0.012	-3.476761	-.4223083
Agepart	-.9283159	.7434925	-1.25	0.212	-2.385534	.5289026
Cmmteform	.0381337	.6347787	0.06	0.952	-1.20601	1.282277
Resoumobls	.6388905	1.119467	0.57	0.568	-1.555224	2.833005
Dikeownership	1.438509	.7415791	1.94	0.052	-.0149593	2.891978
Labresources	-.0026109	1.232871	-0.00	0.998	-2.418993	2.413772
Finresources	.9729963	.6348202	1.53	0.125	-.2712284	2.217221
Skillskno	.8517939	.5977436	1.43	0.154	-.319762	2.02335
Networking	.4402193	2.200256	0.20	0.841	-3.872204	4.752642
Rulesbylaws	-.0471019	.679649	-0.07	0.945	-1.379189	1.284986
_cons	-2.218908	2.413417	-0.92	0.358	-6.949119	2.511302

From the table above, it is noted that the overall logit model is not significant given that Prob>chi2 = 0.0728 and the availability of labour resources and committee formation process variables having the highest (i.e. p > [z] = 0.998 and 0.952 respectively) in the model were dropped, to give the following results as shown in table 7 below.

Table 7: Social Capital and Community Participation Factors Influencing Sustainability of Constructed Dikes and Spillways

Iteration 0: log likelihood = - **59.837454**
Iteration 1: log likelihood = **-46.71325**
Iteration 2: log likelihood = - **46.614664**
Iteration 3: log likelihood = - **46.614491**
Iteration 4: log likelihood = - **46.614491**

Logistic regression		Number of obs =	**87**
		LR chi2(**8**) =	**26.45**
		Prob > chi2 =	**0.0009**
Log likelihood =	**-46.614491**	Pseudo R2 =	**0.2210**

Sustainability	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
Genderpart	-1.676891	.6827132	-2.46	0.014**	-3.014984	-.3387973
Agepart	-.7507147	.6863641	-1.09	0.274	-2.095964	.5945343
Resoumobls	.532318	1.140376	0.47	0.641	-1.702778	2.767414
Dikeownership	1.407095	.6707092	2.10	0.036**	.0925286	2.72166
Finresources	1.670338	.5910011	2.83	0.005***	.5119971	2.828679
Skillskno	.6570663	.5357498	1.23	0.220	-.392984	1.707117
Networking	.1168913	1.964221	0.06	0.953	-3.732911	3.966694
Rulesbylaws	.9181234	.5857264	1.57	0.117	-.2298792	2.066126
_cons	-2.833679	2.09117	-1.36	0.175	-6.932298	1.264939

***, ** and * means statistically significant at 1%, 5% and 10% respectively

The model shown in the above table is a logistic regression model showing social capital and community participation variables influencing sustainability of the constructed dikes and spillways. The model is statistically significant since prob >chi2 = 0.0009 and three factors are found to be statistically significant at 95% confidence interval. These factors are gender participation in the community, perception on dike ownership as well as availability of financial resources within the communities. All these statistically significant factors positively influence sustainability of the constructed dikes and spillways except gender participation which indirectly impact on the sustainability of the technology. The same explanations can be deduced as presented in the discussion on the preceding table (i.e. table 6). However, the fact that these three factors maintain their statistical significance trend in both logit models depicts their outstanding relevance when devising strategies to foster sustainability of the constructed dikes and spillways.

4.2.3 Dynamics of Paddy Production within the Study Area

The results in table 8 below show a comparison of production output before and after the construction of dikes and spillways by GALDEP project as well as the land put to cultivation during the two phases. It is shown that farmers gain more production after the construction of the dikes and spillways in their rice ecologies. The average output realized by farmers is 1198 kg as compared to 913.79kg before the construction of the dikes and spillways. This difference between the two phases is statistically significantly at 1 % significant level. The purpose of dike construction was purposely geared towards increasing production in the rice farming communities which is evident as indicated in the table 5.

A similar result is shown for the number of hectares cultivated for rice production. The results indicated a significant difference at 5% significant level for cultivated area before (1.12ha) and after (1.30ha) dike construction. Farmers in these communities are encouraged to utilize more land into cultivation since they are assured of barriers of salt intrusion and availability of required quantity of water for their croplands.

Table 8: Comparison of Paddy Production and Cultivated Area Before and After Dike Construction

Variables	Before construction of dikes and spillways	After construction of dikes and spillways	Paired difference mean	T statistic	p- value(2 tailed test)
Production output (kg)	913.79 (352)	1198.56(436)	-284.77(486)	-5.464	0.000
Cultivated area(ha)	1.12(0.48)	1.30 (0.74)	-0.16(0.61)	-2.387	0.019

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Generally four socio-economic factors are statistically significant in influencing the sustainability of the constructed dikes and spillways and these are perception on dike ownership, availability of financial resources, and availability of set rules/bylaws governing the upkeep of the constructed dikes and spillways as well as gender participation. The first three factors having positive influence on sustainability given the coefficient values of 1.594, 1.416, and 1.532 respectively is an indication that the more these factors are further strengthened within the communities the more likely the dikes and spillways are sustained. In contrast gender participation showed a negative coefficient (-2. 259) on sustainability of the constructed dikes and spillways. This is clearly an indication that female participation in maintenance works is more prominent than the male participation. So as a result, their participation alone without male support might not necessary translate into sustainability of the structures.

It is interesting to note that perception on dike ownership, availability of financial resources and gender participation repeated their respective significances in both logit regression models (tables 6 and 7). It can therefore be concluded that these three community participation and social capital factors stood prominent even amongst socio-demographic variables as in the first logit model, hence they require special attention when devising strategies to foster sustainability of the constructed dikes and spillways.

In summary, the major conclusions from the study was that the outstanding socioeconomic factors influencing sustainability of the constructed dikes and spillways are perception on dike ownership, availability of financial resources, and availability of set rules/bylaws governing the upkeep of the constructed dikes and spillways as well as gender participation. The production dynamics of the study area also showed an increase in both area put to rice cultivation and paddy output. Therefore the constructed dikes and spillways in the study area are productive and can be sustained if the four socioeconomic factors outlined above are further enhanced and strengthened.

5.2 Recommendations

Relative to the findings of the study it's generally recommended that local institutions at community levels be strengthened both technically and financially so that their full ownership of the dikes and spillways is further enhanced to foster greater sustainability. Gender mainstreaming is also important so that both genders participate in the management of the constructed dikes and spillways. Some specific recommendations are as follows:

- Government to sensitise communities to take full ownership of the constructed dikes and spillways and avoid any further direct intervention but channel all future assistance through local institutions on a demand-driven bases.
- Government to facilitate devolution of power by training local institutions on governance and management as well as training of community members on numeracy and literacy.
- Government to facilitate the proliferation of micro finance institutions at community levels to foster timely access to credit facilities. This can involve NGOs, multilateral and bilateral donor agencies.
- Gender should be mainstreamed through sensitisation and advocacy in all rice production and development activities so that the crop is less gendered but seen as a staple food crop to be grown by all able-bodied family members regardless of your gender.
- Agronomic follow ups should be boosted through the extension services to improve on paddy output within the study area so that the attractiveness of the crop is further enhanced.

5.3 Areas for Further Study

Areas of further studies may include the following:

- Studies on the technical factors influencing sustainability of the constructed dikes and spillways needs to be investigated.
- Economic valuation of paddy production within the constructed dikes and spillways should be carried out to determine the profitability level of the venture.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE

The information collected will be used for research purpose only and will be treated in confidence.

Date of interview………………………………… Form Number…………………………

(A) Socio-Demographic Profile

no	Variables	Codes for option	Response
1	Region		
2	District		
3	Village		
4	Age of respondent (years)		
5	Ethnicity	1=Madinka, 2=Fula, 3=Wolof, 4 = Jola 5= Others, specify----------------------	
6	Gender	1=Male, 2= Female	
7	Marital status	1= Married, 2= Single, 3= Widowed, 4= Divorced 5 = Separated	
8	Household status	1= Head, 2= Spouse	
9	Household size	Male ………… Female ……...	Total…………
10	Education	1= Yes, 2= No	
11	If yes, what level?	1= Pre-school, 2=Primary school, 3= Secondary school, 4= Post-secondary school, 5=Diploma, 6= Bachelor's Degree, 7= Madarassa	
12	Production experience (Years)	1= less than 10, 2 = 10-20, 3 =21- 30, 4 = 31-40, 5 = Above 40 years	
13	Primary occupation	1= Farming, 2= Civil service, 3= Trader, 4=Others, specify	

B. Production Details

	Variables	Codes for option	Response
1	how many hectares is your cultivatable land before and after dike construction	Before…………….. After………………..	
2	Do you own the land you currently growing the rice?	1= Yes 2= No	
3	If no how do you acquire the land?	1= hired, 2=leased, 3= borrowed, 4= others(specify ------------)	
4	How fertile is your land?	1= very fertile,2= average, 3= infertile	
5	Which ecology do you cultivate rice?	1= upland 2= lowland 3= both	
6	Why do you prefer the chosen ecology?		
7	How do you acquire farm production labor during the following activities?	A. Land preparation B. Sowing/planting C. Fertilizer application D. Weeding E. Harvesting F. Threshing G. Milling **Codes** 1= own labor only, 2 = family labor, 3= hired labor, 4 = reciprocal labor, 5= others (specify)…….	__________ __________ __________ __________ __________ __________ __________ __________
8	What power source do you use in the following production operations?	H. Land preparation I. Sowing/planting J. Fertilizer application K. Weeding L. Harvesting M. Threshing N. Milling **Codes** 1= manual 2= draught animal 3= mechanical	__________ __________ __________ __________ __________ __________ __________
9	Do you receive regular access to credit from any financial institutions?	1= Yes, 2= No	
10	If yes, which institution, and the purpose for which the credit was used for		
11	How often do you receive extension services	1= At least once in three months, 2= Once in 6 months 3= Once a year, 4= Never	

12	What is your average output before and after (2014 season specifically) the construction of dikes and spillways in a cropping season?	Before (kgs/ha) After (kgs/ha)	------------- ---------------
13	What is your estimated cost of production on the following activities/ inputs in 2014 production season?	A. Land preparation (for 0.5 ha) B. Seeds C. Pesticides D. herbicides E. Sowing/planting F. Fertilizers - NPK - UREA G. Weeding H. Harvesting I. Threshing J. Milling K. transportation	____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________
14	what do you do with your produce	1= home consumption, 2= sale, 3= both	
15	If both what proportion of your produce is sold?		
16	if you sell, at what level of market to you do so	1=farm gate, 2= local market, 3=cooperatives 4= others specify	
17	Why did you prefer that level of market?		
18	What are your production limiting factors now		

C. Community Participation, Social Capital and Management of the Constructed Dikes and Spillways

no	Variables	Codes for option	Response
1	Who owns the constructed dikes and spillways	1= Government, 2= NGOs 3= community, 4= GALDEP 5= Others (specify)………………..	
2	Do you belong to any farmer association	1= Yes, 2= No	
3	If yes, which one?		
4	Are you aware of any management committee(s) for the constructed dikes and spillways	1= Yes, 2= No	
5	If yes who form the committee	1= Government, 2= NGOs 3= community, 4= projects 5= Others (specify)………………..	
6	How is the formation process like?	1=election, 2= selection, 3=voluntary, 4= inheritance 5= other (specify)---------	
7	Do you have knowledge and skills in repair work of the constructed structures?	1= Yes, 2= No	
8	If yes, who trained you	1=Government, 2= NGOs 3=Farmers' association 4=. Neighbors 5= Other (specify)	
9	Do you have the required labor resources in the community for the management of the constructed dikes and spillways?	1= Yes, 2= No	
10	Do you have the required financial resources within the community for the maintenance of dikes and spillways	1= Yes, 2= No	
11	How do you mobilize resources for maintenance works	1 = community contributions, 2= donations , 3 = others (specify)---	
12	Are you aware of any written rules/bylaws governing the upkeep of the dikes and spillways ***(if no skip to 19)***	1= Yes, 2= No	
13	If yes, who formulated them	1= Government, 2= NGOs 3= community, 4= projects 5= Others (specify)………………..	
14	Are the rules being fairly administered	1= Yes, 2= No	
15	If no, why not?		
16	Do your group network with others	1= Yes, 2= No	
17	Which gender group participates more in maintenance works	1=males, 2= females	
18	Which age group participate more in maintenance works?	1= youth group (12-25yrs) , 2= Adults(26-50yrs), 3= elderly (above 50yrs)	

D. Sustainability Indicators

Sustainability will be assessed using 7 likert scale on the following indicators. Please choose the item that describes your opinion best

1	2	3	4	5	6	7
Not at all	**Relatively low**	**Low**	**medium**	**Relatively high**	**High**	**Very high**

No	Statement	Score
1.	Are there any funds available to sustain the constructed dikes and spillways	
2.	Is there any functional management committee in place for the management of constructed dikes and spillways?	
3.	What is the level of community participation in the management of constructed dikes and spillways	
4.	Are there varied skilled and unskilled labor within the community to sustain the constructed dikes and spillways	
5.	What is the level of governance (democracy) within the community	
6.	What is the level of social cohesion within management committee as well as the community	

APPENDIX 2: FOCUS GROUP DISCUSSION (FGD) CHECKLIST

Name of the village:
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Number of participants: Males...……………………Females………………………..
Name of the facilitator: ……………………………………………………………………

1. How is the current performance of the constructed dikes and spillways?

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2. Compare crop yields of before and after the construction of the dikes and spillway

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3. How do you upkeep the constructed dikes and spillways? (what are the sustainability plans)

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4. Explain the major challenges faced in rice production within the constructed dikes and spillways

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5. Explain the major challenges faced in the maintenance of the constructed dikes and spillways

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What suggestions do you have as a way forward?

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APPENDIX 3: LIST OF PLATES

Plate 1 Anti-salt dike

Plate 2 Water retention dike

Plate 3 Spillway

(Source, GALDEP)

APPENDIX 4: CORRELATION MATRIX

	gender	age	marita~s	hhsize	hhstatus	pryoccup	edu	expe	farmsze	produc~n	credit	extens~n
gender	1.0000											
age	0.1274	1.0000										
maritalsta~s	0.0754	-0.1413	1.0000									
hhsize	0.0095	-0.0597	0.1043	1.0000								
hhstatus	0.3194	0.2404	-0.1591	0.0807	1.0000							
pryoccup	-0.2538	0.1357	-0.0422	-0.0556	-0.1109	1.0000						
edu	0.0348	-0.2326	-0.0893	0.2297	0.1975	-0.4465	1.0000					
expe	0.0369	0.2697	-0.0296	-0.0814	0.0655	0.7020	-0.3134	1.0000				
farmsze	0.0067	-0.0811	0.0972	0.0732	0.2488	0.0141	-0.0849	0.0475	1.0000			
production	0.0724	-0.0034	-0.1245	0.1146	0.0041	0.0710	-0.1222	0.0465	0.3752	1.0000		
credit	0.1118	0.1346	0.0412	0.0128	-0.1635	0.1200	-0.0870	0.0842	-0.1906	0.2317	1.0000	
extension	-0.1445	-0.1001	-0.0606	-0.0907	-0.4523	-0.0422	0.0946	-0.0296	-0.2799	-0.1520	0.0412	1.0000
dikeowners~p	0.1599	0.2270	-0.1286	0.0696	-0.0474	0.1194	-0.2155	0.2305	-0.0942	0.2095	0.1430	0.0214
labresources	0.0754	-0.2030	-0.0606	0.0501	-0.3057	-0.0422	-0.0893	-0.0296	0.0664	0.2941	0.0412	0.2045
finresources	-0.0329	0.1514	-0.3107	-0.2233	-0.0120	-0.0403	0.0463	0.0954	0.2835	0.0686	0.0080	-0.0578
skillskno	0.0589	0.0000	0.1599	0.0900	0.0589	-0.1485	-0.0123	-0.1043	0.0459	0.0320	0.1756	0.0355
networking	0.0525	-0.0841	-0.0422	-0.0556	0.0934	-0.0294	0.0659	-0.0206	-0.1467	-0.0772	0.1200	-0.0422
rulesbylaws	0.1137	-0.0691	0.0815	0.2000	-0.1802	0.2374	0.0077	0.1667	-0.3490	0.0491	0.4412	0.0815
genderpart	0.1021	0.1019	-0.1846	-0.1772	0.1531	-0.1286	0.0213	0.0602	-0.0880	-0.0080	-0.1217	-0.0308
agepart	0.1021	0.0422	-0.0308	-0.0704	-0.1021	-0.1286	0.0213	0.0602	-0.0188	0.0677	0.0304	0.1231
cmmteform	0.0974	0.1893	-0.1667	0.0241	0.0021	0.0686	-0.1996	-0.0815	-0.2330	-0.2103	-0.1816	-0.0341
resoumobls	0.1021	-0.3094	-0.0821	0.0679	-0.1588	-0.0572	-0.0142	-0.0401	0.0274	0.0438	0.1318	0.1231

	dikeow~p	labres~s	finres~s	skills~o	networ~g	rulesb~s	gender~t	agepart	cmmtef~m	resoum~s
dikeowners~p	1.0000									
labresources	0.0214	1.0000								
finresources	-0.0153	0.0686	1.0000							
skillskno	-0.0302	-0.0888	-0.0254	1.0000						
networking	-0.0896	0.3272	-0.2164	0.0248	1.0000					
rulesbylaws	0.2829	0.0815	-0.2932	0.1651	0.2374	1.0000				
genderpart	0.2611	-0.0308	0.0440	0.0722	-0.1286	-0.0903	1.0000			
agepart	-0.0000	0.1231	-0.1761	0.0722	0.0857	0.0602	0.0179	1.0000		
cmmteform	0.0214	-0.0341	0.0307	-0.1510	-0.1161	-0.1000	-0.1231	-0.2770	1.0000	
resoumobls	0.0580	0.1231	0.0685	0.1925	0.2287	0.0602	-0.0714	-0.0714	-0.2257	1.0000

APPENDIX 5: SUMMARY TABLE OF GALDEP COMPLETED WORKS

No.	INTERVENTION SITE	ACHIEVEMENTS				REMARKS
		AREA (Ha.)	Dike Length (m)	Spillway Length (m)	De- silting (m^3)	
1	LAMIN	40	891	4		Completed
2	BANJULUNDING	45	Not applicable (NA)	NA	90,000	504m long and 6m wide drainage canal, with 364m long, 2m high reinforced concrete/cement walls for protection of Rice fields against siltation. COMPLETED
3	FARABA BANTANG	325	4300	170 with 15m x 6m Irish Crossing cum spillway on bund road	NA	Completed
4	SOHM	100	2125	130 with 17m x 5m concrete ramp	NA	Completed
5	BULOCK/SUTUSINJAN	6	NA	NA	30,000	Completed
6	SUTUSINJAN/BAJANA	60	NA	2	NA	Completed
7	BEREFET	55	2628	92	NA	Completed
8	Gifanga/Kayanga	25	NA	NA	125,000	Completed
9	Ndemban Jola	71	NA	NA	25,000	COMPLETED
10	Kandong	15.3	1760	100	NA	Completed
11	Bintang	11.2	2492	40	NA	Completed
12.	Sibanorr	10.8	1220	80	NA	Completed
13	Sita	7.1	718	30	NA	Completed
14	Bagiran for Batabut	5.4	525	20	NA	Completed
15	Bajagarr	33	1026	60	NA	Completed
16	Arangallen	16.5	416	20	NA	Completed
17	Buginga	5	400	NA	25,000	Completed Sedimentation traps also constructed
18	Bwiam	70	3073	50	50,000	Completed
19	Tintiba	45	1553	60	NA	Completed

20	Sangajorr	36	858	115	15,000	Completed
21	Bantanjang	8.3	1060	65	NA	Completed
22	Kayaborr	33.9	895	40	NA	Completed
23	Mayork	23	404	50	NA	Completed
24	Bullenghat	5	NA	NA	25,000	Completed
25	Kanwally	48.7	949	75	NA	Completed
26	Bondali Jola	42.1	1197	90	NA	Completed
27	Bondali Tenda	33.6	1036	110	NA	Completed
28	JARROL	98.5	2631	100 and two pipe outlets	50,000	Completed
29	Chabai	4	NA	NA	20,000	Completed
30	Wassadu	7	NA	NA	35,000	Completed
31	MANKANA CLUSTER includes Kanmamudu, kansambou, Kanpassa and others	71	1135	125	25,000	Completed
TOTAL		1,357.4	33,392	1,660	515,000 m^3	
PLANNED TARGET		1500 (including the 147 ha of purely liming reclamation by GALDEP PMU)	27544	1480	425,000 m^3	
% ACHIEVEMENT		100%	121.2	109.6	121.2%	