

**RICE PRODUCTION AND MARKETING: A COMPARATIVE
STUDY OF WETA (AFIFE) AND AVATIME TRADITIONAL AREAS**

BY

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,
LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT
FOR THE AWARD OF MPhil DEGREE IN AFRICAN STUDIES.**

JUNE, 2012

DECLARATION

I hereby declare that this submission is my own work towards the award of MPhil in African Studies and that to the best of my knowledge, no materials, previously published by other persons or works which have been accepted for the award of any other degree of the University are contained in this study except where due acknowledgement has been made.

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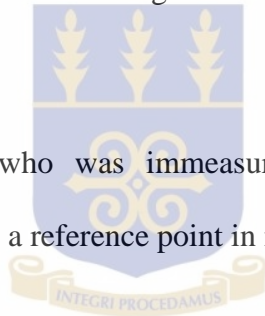
ACKNOWLEDGEMENTS

I am most grateful to my supervisors, Prof. Kojo Sebastian Amanor and Doc. Kojo Opoku Aidoo whose guidance and recommendations helped produce this thesis. To Prof. Amanor who developed a special interest in this work and believed in my ability to research into a topic which is rooted in Rural Development, I am forever indebted to you. I am most grateful to Doc. Opoku Aidoo for his commitment to ensuring that this work becomes a success.

I am thankful to Future Agricultures Consortium for the Bursary for Graduate Studies of which I am a beneficiary. The funding for the research has been particularly significant in taking care of its financial needs, leading to a successful completion of this thesis.

To my mother, Juliana A. Adorsi who gave her all right from my infancy to give me a future, I say thank you!

To Mr. Samuel K. Denu who was immeasurably supportive throughout my Mphil programme, your name remains a reference point in my life. God richly bless you.



To all rice cultivators at Weta and Avatime especially Mama Charity Kwadam at Avatime and Papa Halm Annas at Weta, Pastor Samuel Boakye - the IDA Manager at Weta, and all IDA staff at Weta, I am thankful for your numerous assistance, accommodation and time.

My colleagues especially Kofi Semanu Adzei who was part of my first and second visits to Avatime, Afrakoma Boakye-Ansah, Berlinda Bulley, Maame Kyerewaa Brobey who stayed closest to me, encouraged and made me laugh when the times were most difficult, and to all other colleagues, I am forever grateful and will ever cherish your time, care and friendship.

To all other persons who in diverse ways have immensely contributed to the success of this work but have gone unstated, thank you and God richly bless you.

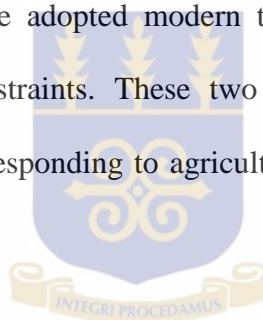
DEDICATION

To the Unseen God.



ABSTRACT

This study focuses on rice production in two areas, Weta/Afife and Avatime in the Volta region of Ghana. It compares rice production under two distinct farming systems: one using indigenous seeds under rain-fed agriculture (Avatime); and the other improved seeds under modern irrigation system (Weta/Afife). At Avatime farms are not mechanized, farm sizes are small, farmers do not use modern farm inputs and cultivate indigenous *glaberrima* rice varieties in addition to some modern rice varieties. Rice is primarily cultivated for domestic use. In contrast, at Weta/Afife rice is cultivated under a modern irrigation system with modern farm machinery and inputs. Farmers cultivate aromatic Asiatic varieties as a cash crop. However they do not purchase certified seed but multiply modern open pollinated varieties. Although they have adopted modern technology they have adapted it to their conditions and existing constraints. These two farming styles show distinct strategies developed by farmers, both responding to agricultural intensification by adopting strategies based on:



- Investment in labour and labour saving technologies (Avatime)
- Investment in high inputs and seeds for increased productivity (Weta)

However agricultural policy in Ghana does not recognise the autonomous attempts of farmers to modernise their agriculture or the significance of investments in labour but seeks to promote a single production system driven by high external input usage that may not fit into the farming system and farmers' objectives, including the play-off between investment in labour and labour-saving technologies, new seed and inputs, or in other ways of raising fertility and productivity. Agricultural policy in Ghana does not assist farmers to develop their distinct farming systems but promotes use and dependence on commercial inputs.

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ACRONYMS

AAGDS	Accelerated Agricultural Growth and Development Strategy
CARD	Coalition for African Rice Development
CIMMYT	International Centre for Wheat and Maize Improvement
CRVs	Chemically Responsive Varieties
FAO	Food and Agricultural Organisation of the United Nations
FASDEP	Food and Agriculture Sector Development Policy
GDP	Gross Domestic Products
GFSR	Global Food Security Response
GIDA	Ghana Irrigation Development Authority
GIHOC	Ghana Industrial Holding Corporation
GNA	Ghana News Agency
GPRS	Ghana Poverty Reduction Strategy
GPRS II	Growth and Poverty Reduction Strategy
GRIB	Ghana Rice Inter- Professional Body
GSSP	Ghana Strategy Support Program
HYVs	High-Yielding Varieties
ICRISAT	International Crop Research Institute for the Semi Arid Tropics
IDA	Irrigation Development Authority

IMF	International Monetary Fund
IITA	International Institute of Tropical Agriculture
IRRI	International Rice Research Institute
JICA	Japan International Cooperation Agency
MOFA	Ministry of Food and Agriculture
MTADP	Medium - Term Agricultural Development Programme
NAMSECO	National Association of Agricultural Mechanical Service Centre Operators
NERICA	New Rice for Africa
NGOs	Non-Governmental Organisations
NRDS	National Rice Development Strategy
SAP	Structural Adjustment Programmes
SSA	Sub-Saharan Africa
TNCs	Trans-National Corporations
UNDP	United Nations Development Programme
WARDA	West Africa Rice Development Association (Africa Rice Centre)

CHAPTER ONE

SCOPE OF THE STUDY

Background of the Study

Rice consumption has been escalating in recent times all over the world. In Sub-Saharan Africa (SSA), the importance of rice is rapidly growing (Otsuka and Kijima, 2010). Though rice consumption is on the increase, domestic production is disproportionate to consumption demands. There is therefore the need to improve its production in terms of quality and quantity in order to make up for the deficit in supply.

Sub-Saharan Africa is said to account for a third of global rice imports at an alarming cost of more than US\$4.3 billion per year, an amount which otherwise could be used in other areas of development (Nakano et al, 2011). In Ghana, annual per capita rice consumption on the average increased from 17.5 kg during 1999-2001, to 22.6 kg during 2002-2004. By estimation, per capita rice consumption would increase to 63.0 kg in 2015 if the trend remains the same (MOFA-NRDS, 2009). Ghana presently spends US\$450 million on rice imports to make up for the shortfall in supply. The country's self-sufficiency in rice production stands at about 30 per cent, leaving a deficit of 70 per cent (GNA, Monday, August 9, 2010). Thus, national focus is on how to increase rice production as key component of the strategies on food security.

Specific policy documents on the rice sector reveal strategies which seek to promote rice production to address food security and poverty reduction. FASDEP II, which is the current Agricultural Sector Development Policy guideline (2008 – 2010) records rice as one important crop/commodity whose production must be given extra attention to ensure increased food security and import substitution. In line with the general agricultural expansion policy, (increasing agricultural growth through acreage expansion as well as developing and

disseminating better technologies and using higher input intensities), the rice sector intends to increase production through improved mechanization, increased cultivation of inland valleys and efficient utilization of existing irrigation systems, varietal improvement, as well as increased seed production utilization (FASDEP II 2009; NRDS 2009). This approach to increase rice production aims to involve all rice farmers under the different production systems in the country.

Two groups of farmers are engaged in rice farming worldwide: large-scale commercial farmers and small-scale farmers, who produce rice for consumption and also for commercial purposes. Distinct farming approaches are employed by the two groups of rice producers. While large-scale farmers employ scientific methods and use synthetic inputs on their farms, small-scale (local) farmers are basically engaged in the use of indigenous knowledge which they acquired over time through a process of continuous adaptation of the crop to varied environments, and also through experimentation (Buckland, 2004; Amanor et al, 1993).

Large commercial rice farms in Ghana have declined in recent years but a significant number of smallholders who also depend upon inputs and scientific prescriptions exists. Two distinct ways of cultivating rice – indigenous and improved methods continue to exist. In the Volta Region, cultivation of many different varieties of rice occurs. These include indigenous upland and swamp *glaberrima* varieties, and improved *sativa* varieties. At Avatime, no farmers use synthetic inputs, and rice cultivation is bound with a complex cycle of rituals. On the irrigation project at Weta on the other hand, the majority of farmers use improved varieties and synthetic inputs. Thus by comparing these two as Weberian ideal types of rice cultivation, we can contrast the impact of different farming styles in order to understand what effects they have in the relative position of farmers in the food value chain – the extent to which they can exercise choice or how dependent they can be.

Indigenous rice production in Ghana over the years has not significantly attracted national support. Since Ghana's independence in 1957 when efforts were made to modernize agriculture, government's agricultural budgets largely sustained the state sector (state farms, large-scale estate agriculture) at the expense of food production which for the most part, was based on smallholder production of which indigenous rice production is part (Konings, 1986). Attempts were however made in the 1970s to integrate smallholder farmers "into government-sponsored projects in which they could receive land (including irrigated land), inputs and seeds, and agricultural services (such as ploughing and water). In return farmers were contractually obliged to cultivate particular prescribed varieties of crops with cultural practices outlined by project extension staff, and to sell their produce to parastatal marketing organisations" Amanor, (2011: 50). The Weta rice irrigation project is one result of those government efforts.

Farmers working on the Weta project benefited from government by receiving subsidies on inputs such as fertilizer, improved varieties and pesticides. However, following the downturn of Ghana's economy which resulted in the intervention of the Structural Adjustment Programme and its socio-economic implications for the nation in the 1980s, subsidies on inputs for the agricultural sector were removed and rice cultivation was also affected (Wayo, 2002). Consequently, farmers have to depend upon their own resources without any financial backing from the government or other development agencies.

Rice farmers at Avatime on the other hand have not been integrated into the government modernization project. Farmers cultivate distinct indigenous varieties alongside modern varieties. While some of the rice varieties are purchased for cultivation, others, particularly the local ones are distributed among farmers through farmer-networks.

The differences between these two groups of farmers are captured by van der Ploeg (1990) in his theory of intensive and extensive (I- and E- Calculi) farming styles. Under the E-Calculus,

farmers use modern farming technology – irrigation, certified modern varieties, chemical fertilizers, herbicides and pesticides, and engage the services of paid labourers. Productivity is maximized through technology use and expansion of cultivated area (scale enlargement). The structure of the process of productivity disengages from the ‘autonomous historically guaranteed’ approach to that of a ‘market-dependent’ productivity. Production largely depends on the markets for farm supplies (incorporation) and tasks which used to be performed by farmers are externally prescribed (institutionalised) by technical administrators. Income is highly dependent on scale enlargement (van der Ploeg, 1990). The E-Calculus approach mostly understands development on the farms as the taking up of externally-developed innovations which are consistently affected by changing trends in the market. Productivity is affected by changing market prices for farm supplies.

The I-Calculus or the intensive farming style on the other hand is one in which farmers’ display of indigenous knowledge and high technical efficiency comes to the fore. This knowledge is acquired over the years through adaptation and experimentation. The I-Calculus is independent of the market for farm supplies and institutional arrangements for technical advice. Farmers act as technical officers on their own farms. Care for crops and other farm inputs are provided by farmers with help from family members. Under this agricultural practice, high production per object of labour relates to income. Unlike the E-Calculus, maximizing productivity comes through the use of increased labour and not scale enlargement.

In this era of technological advancement, most theories of agricultural development uphold intensification through the use of external inputs. However, there are divergent opinions in the literature concerning scientific approaches and synthetic input use in food crop production. While some view it as means to achieving high yield in production (Nakano et al, 2011), others regard it as a “technological treadmill”, drawing farmers away from more innovative

and participatory paradigm (Amanor, 2011; Buckland, 2004) leading to a situation in which agriculture has been restructured to equal market and price relations (van der Ploeg, 1990).

The aim of this research is to compare the two methods of rice cultivation under the two styles of farming – the E- and the I- Calculi. The study shall focus on the extent to which farmers are able to exercise choice in their own localities and how they are able to develop their own strategies, gain access to support services, and the extent to which they become indebted and dependent upon various types of loans and how this affects the productivity, welfare, wellbeing, and sense of entitlements, without making any assumptions about which technology is more progressive or backward as has characterized modernization period. There would be efforts to understand the socio-cultural context within which local agricultural knowledge concerning rice production, especially the cultivation and preservation of distinct local varieties, is generated.

Statement of the Problem

Different farming styles are employed in rice cultivation – improved and indigenous methods, any of which is practised by farmers based on its effectiveness and convenience. Policy documents for increased rice production have however specified scientific agricultural practices as ones that could duly propel the nation into achieving self-sufficiency in rice production. Although farmers' knowledge is hybrid (combines modern knowledge with their own), this is not recognized by agricultural modernization. This seeks to replace farmers' technologies with commercial technologies and direct farmers to produce specific varieties of crops with specific cultivation techniques rather than enable them to exercise choice. This study examines the impact of agricultural modernization strategies and policies on farmers' own attempts to modernize and adapt agriculture and how it affects the farmer's welfare, wellbeing and sense of entitlements. The study would also investigate the diversity in farming and to establish that rice production can be structured in different ways.

Study Objectives

The study examines how access to policy support among smallholder farmers using modern varieties and inputs and those using indigenous varieties and low inputs affect agricultural practices and the main constituent in smallholder agriculture. The general objective shall be achieved through other specific ones as follow: To

- Investigate rice production in two communities in the Volta region of Ghana.
- Compare and contrast an area using indigenous seeds under rain-fed agriculture with an area that uses improved seeds under modern irrigation system.
- Examine farmers' access to policy support and agricultural support services.
- Find out how responsive agricultural policy is to the changing needs of farmers and their ability to influence policy and exercise choice.

Research Questions

- Investigate the basis on which farmers develop their own strategies in rice cultivation.
- Examine the autonomy or dependence of farmers on support services and externally generated technology and access to credit, and their impact on farmers and productivity.
- Examine the diversity and rationale of smallholders' farming systems and how they incorporate modern inputs differently into their farming systems.
- Discuss the relationship between rice production and marketing, the implication of these factors for policy, and how this affects farmers' choices, their welfare, wellbeing, sense of entitlements and productivity.

Significance of the Study

This research compares two methods of rice cultivation under the two styles of farming – the intensive and the extensive.

The study shall contribute to the literature on local agricultural knowledge and the diversity in food crop production under different farming systems using different styles of farming. While enhancing the knowledge and understanding of indigenous methods of rice production, especially in the area of cultivation and preservation of distinct rice varieties, the study will also help understand smallholders' systems and the way they integrate modern inputs differently.

STUDY METHODOLOGY

The methodology for this study comprises the research design, research methodology, population and sampling techniques, methods of data collection, and data collection techniques. These assisted the researcher in achieving her objectives by answering her research questions. The study methodology reveals how this study was carried out.

Research Design clarification

The study was exploratory and by design, its focus was to look into issues in areas where there are few studies to refer to. This design helped me gain insights into the definite situations in the environments in which they occur. Qualitative and approaches such as informal discussions with rice farmers (both in Weta and Avatime), and project staffs (on the irrigation project at Weta), as well as formal processes such as in-depth interviews, focus group discussions and case studies were used to accumulate relevant information about this study.

Research Methodology

The methodology for this study is both quantitative and qualitative. This enabled the researcher to acquire first hand information from the people who are truly engaged in rice farming in the environment where the farming directly takes place. The qualitative method helped the researcher to observe activities and practices that are carried out on the various

farms during the process of rice cultivation. Thus, the information captured in this study is reliable since the in-depth interviews have been supported with participant observation. The open-ended questions enabled respondents to answer questions in their own words and to give true picture of situations. They also helped the researcher to ask follow-up questions in order to gain more understanding from explanations given by respondents. Since the study is exploratory, it allowed the researcher to observe how rice farmers exploit their environment to their benefit.

Population and Sampling

The target population for this study was all rice farmers from the two study communities – Avatime and Weta traditional areas. A sample of 50 respondents from the two communities was used with the aim of obtaining detailed information on the study. Even though the two study communities are apart, they are both found in the Volta Region. The choice of the two communities was also informed by their differing characteristics which fit into the researcher's study objectives. Purposive and stratified samplings were used by the researcher in her choice of respondents. The purposive sampling technique helped in the choice of respondents who can answer research questions. It also made it possible to choose cases which are representative of general views of the sample. Again, the purposive sampling informed the selection of the two study communities considering the fact that there are closely connected rice production communities which would not have fulfilled the research objectives. For instance, though the Aveyime rice project is closer to the Weta/Afife project, and Hohoe rice farmers are closer to Avatime, any of the above pairs could not have helped the researcher achieve her objectives since the pairs produce under similar farming systems. The stratified technique also enabled the researcher to group respondents, a clear indication of gender bias prevention. Three IDA officials were also interviewed to enable the researcher assess farmer/management relationship at Weta/Afife.

Methods of Data Collection

Primary and secondary data collection methods were used to access information on the study. Under the primary method, focus group discussions, structured interviews and field observations were used by the researcher. These enabled to obtain qualitative information that helped achieve objectives for this study. Structured interviews for instance made it possible to obtain farmers' views about the type of farming systems and strategies they engage in and to ascertain whether farmers are fulfilled with the various systems. Since the interviews were structured, they prevented respondents from providing irrelevant information. As a researcher, the structured interviews also guided me to absolutely reframe a question or ask a follow-up question. These interviews facilitated the assessment of farmers' willingness or otherwise to maintain their farming systems and strategies. In addition, the interviews also reveal some alternatives which could improve upon farmers' lots. Focus group discussions were also held to enable me deal with some significant issues which were not addressed during the interview sections. It also helped me gain insights into some observations made during field visits. Apart from writing down notes, most of the interviews and focus group discussions were recorded. These were later transcribed by the researcher.

Secondary data was collected from written materials which are relevant for the study. They include published and unpublished books, newsletters, articles, internet downloads, working papers from Ministries, Departments, Organizations and District Assemblies. The secondary data largely helped me assess other people's opinion about the research.

Focus Group Discussions

Two focus group discussions were held in each of the two study communities. At Avatime, the discussions took place on a Sunday afternoon when the majority of the farmers were available. The significance of this day and time was that farms are far away from the town

(about 4 km walk) and farmers leave home at dawn (about 4:00am) and return in the evening. Saturdays are used for other social gatherings and Sunday mornings for church services, while the afternoons are usually free. The discussions were recorded and latter transcribed. The Ewe language was used as a medium of communication in both study communities. Since the researcher and all the farmers are Ewes, there was no need for a translator. In case of the IDA staff at Weta, the English language was used since the respondents neither speak nor understand the Ewe language.

Though men and women were involved in the discussions, at Avatime where rice production has gradually become the exclusive occupation for women, only 4 out of the 20 respondents were men. At Weta where gender relations presumably do not affect cultivation, only 10 out of the 30 respondents were women. The disparity in relation to the number of respondents chosen from the study communities is informed not only by the size of the farming community, but also by the number of farmers involved in cultivating rice. Whereas over a thousand farmers are engaged in the rice fields at Weta, the number of rice farmers at Avatime presently has drastically reduced. The sample is based on the common nature of farm practices, problems and general opinion on alternatives. The discussions were first based on the nature of the farming system and how it affects the choices and ingenuity of the farmer. The second discussion focused on effectiveness of the farming system and strategies, how they affect livelihood of the farm families, and whether there is the need for other alternatives. At the end of the discussions, the various groups always arrived at a consensus, a reflection of general opinion among farmers in relation to various research questions.

In-depth Interviews

The focus of the in-depth interviews was to discuss issues obtained from the literature, as well as those raised by the focus group discussions. In all, a total of 53 respondents were interviewed from the two study communities. These included 20 farmers from Avatime, 30

farmers from Weta and 3 IDA staff from Weta. Though there were informal interactions with a number of other farm workers on the field, they do not form part of the sample since the focus of this study is to assess farmers' opinion on the farming systems and strategies they engage in and how those practices influence farmers' choice and livelihood. Characteristics of respondents which were captured by the researcher included age, sex, marital status, and educational background, represented in tables 1, 2, 3 and 4. These features enabled me to assess the relevance and potential of rice cultivation.

Table 1: Age of Respondents

Age/Location	Avatime	Weta/Afife	Total	Percentage (%)
20 -30	0	6	6	11.3
31 – 40	5	6	11	20.8
41 – 50	5	10	15	28.3
51 – 60	6	7	13	24.5
61 and above	4	4	8	15.1
Total	20	33	53	100

The dominant age group as represented above in both study communities are rice farmers between the ages of 41 – 50, followed by farmers between the ages of 51 – 60. These two groups are not the most active according to the diagram therefore productivity is likely to be affected by their dominance.

Table 2: Sex of Respondents

Sex/Location	Avatime	Weta/Afife	Total	Percentage (%)
Female	16	10	26	49.1
Male	4	23	27	50.9
Total	20	33	53	100

A total of 53 respondents from the two study communities were interviewed out of which 49.1% was women and 50.9%, men. Even though this almost equal representation of the sexes was not a deliberate effort by the researcher, it is an indication that gender is not an issue in

rice farming. It also shows the significant roles women play in farming. The number of female respondents in Avatime to a large extent indicates that the majority of females are involved in rice farming and are dependent on it as their only source of livelihood. As a result, decrease in their income levels will affect them, leading to high poverty rates among women. The general representation also signifies that either low or high income from rice production will affect households and farm families regardless of who takes care of the home. However, since women are mostly involved in household activities, household needs and provisions will be most affected if income levels for women reduce.

Table 3: Marital Status of Respondents

Marital Status/Location	Avatime		Weta/Afife		Total	Percentage (%)
	No.	%	No.	%		
Single	0	0	6	18.2	6	11.3
Married	15	75	27	81.8	42	79.3
Others	5	25	0	0	5	9.4
Total	20	100	33	100	53	100

The table above shows that 79.3% of the respondents were married, 11.3% single, and the remaining 9.4% was widowed, separated or divorced. Focus on the married group was significant since family plays significant role in labour provision in the indigenous farming system. Therefore, the married were expected to own bigger rice farms with increased productivity, as well as higher income based on the assumption that labour cost shall be replaced by family labour. The majority of the singles live on their own even though they are not married. They however agreed that they are in relationship with people they intend to marry. There were no recorded divorce cases, an indication of strict adherence to societal norms which frown on divorce particularly in the rural areas of the Volta Region of Ghana.

Table 4: Educational Background of Respondents

Education/Location	Avatime	Weta/Afife	Total	Percentage (%)
Primary	7	14	21	39.6
Secondary	5	3	8	15.1
Vocational	2	2	4	7.6
Tertiary	2	4	6	11.3
Other	4	10	14	26.4
Total	20	33	53	100

Generally in Ghana, literacy rates are low in rural areas as opposed to high rates in the urban centres. This table is a proof of the above assertion. Most significantly is the corroboration that farming is a preserve of the uneducated since most of the educated continue to search for jobs which would send them away from farm work. Those who choose agriculture continue to limit themselves to areas which do not directly bring them into contact with the soil. From table 4, the majority of the farmers are those who had primary education (39.6%), followed by others who either dropped out of school or never had a taste of formal education (26.4%). The 11.3% respondents was made up of the 3 IDA officials from the Weta/Afife irrigation project, 1 farmer who also doubles as private farm machinery owner, and 2 retired teachers from Avatime. It is also obvious that the presence of a tertiary institution in the Avatime traditional area is a contributing factor to the number of respondents who received tertiary education. Even so, there were no active highly educated persons who were involved in rice farming.

Participant Observation

Participant observation was necessary for the researcher to ascertain first-hand information about the nature of the different farming systems, practices and strategies which are employed on the farms. In addition, the researcher went round the fields in the case Weta/ Afife project to find out if farmers adhere to the cropping calendar which is prepared for them by the IDA

management. And if not, to find out what informed changes and how those changes impact crop yield, farmers' income and livelihood. It was observed during this observation trip that a large labour force is dependent on rice farming. This includes bird scarers, winnowers, rice carters, dryers and baggers, and a lot more.

Techniques of Data Analysis

Responses from the respondents during the interviews and focus group discussions were transcribed since the discussions were mostly done in the Ewe language. Data analysis was done by comparing responses from all the respondents. These were juxtaposed with what the literature says and the practical nature of what was observed on the field. The conclusion of this study was done based on the outcome of the data analysis.

Conceptual Framework

This study was situated in the 'farming styles' conceptual framework of van der Ploeg (1990). Ploeg presents a farming style approach which conceives diversity as benefit in the farming enterprise. Heterogeneity is seen as the foundation of indigenous agriculture. Distinctively, the choice of how to farm and which strategies to use is fundamentally a decision of the actor involved in the field. Diversity in Ploeg's model becomes a reflection of divergent growth blueprints, each of which emerges from a related farming style. Farmers do not only aim at profit maximisation. That is why they have different strategies that respond to other needs such as risk prevention, maintenance of biodiversity and environmental conservation. A specific farming style then becomes a resultant tactical conduct of the actor involved in the production. In relation to the market, farmers always have specific needs which are purchased from the market since they cannot be directly gotten from the farm. Structuring of the production process regarding modern technology must concern itself with farmers' specific choice of farm technology that is relevant to their diverse needs.

The relevance of Ploeg's farming style concept to this study cannot be over-emphasized. Diversity exists in rice production in relation to ecology, variety, socio-cultural norms, resources availability (external and internal), market proximity, and many more. Based on this heterogeneity, it will be unwarranted to approve of wholesale technology transfer and by inference think of agricultural production as a textbook enterprise. External and internal farm factors can be combined to improve upon production only if those externalities are found to be locally beneficial. Otherwise, they are bound to add up to the cost burden of the poorest cultivators. Local knowledge should in no way be considered primitive - it unquestionably forms the basis of what today is regarded as scientific and technological. What needs to be done is to ensure that technology is developed in relation to societal needs, in this case, particular groups of rice farmers. Even so, such science-based technologies should be built on the existing knowledge of farmers to help address their societal needs.

Rice farmers at Weta and Avatime use different farming methods - improved and indigenous. The relevance of Ploeg's diversity concept helped this study to investigate how production methods consolidate farmers' ingenuity and how they impact farmers' livelihood and the choices they make in relation to what they produce on the farms and how they do it.

Organisation of the Work

This work is organised into five (5) chapters:

The next chapter reviews literature generally on agriculture and specifically on rice production and marketing. Concepts such as indigenous and improved agricultural methods, intensive and extensive farming styles are reviewed. The chapter discusses strategies in rice production, available support services for rice production, financing rice production and how it affects productivity. The chapter also looks at the extent to which farmers are able to exercise preference in their own localities in relation to what they do, and how they develop their own

strategies, access support services, and the level to which they become indebted and reliant upon various types of loans and how this affects the productivity, welfare, wellbeing, and their sense of entitlements.

Chapter three discusses the overview of rice production and marketing in the context of agricultural reforms in Ghana. This includes modernization of rice production, the selection of the beneficiary communities for the government project and its implications for the communities.

Chapter four presents findings and analysis of the research based on the data collected during field work. This is based on qualitative interpretation of findings, interviews, focus group discussions, case studies and field observations.

The final chapter accounts for the conclusion and recommendations for the study in the framework of promoting diversity in rice production methods in Ghana.

CHAPTER TWO

LITERATURE REVIEW

Introduction:

Several works abound on rice production and yet many do not connect production with farming systems and styles, and the degree to which a particular style of farming influences a farmer's choice, welfare, wellbeing and sense of entitlements. Farmers have become receptacles, implementers and the media to achieve policy, project aims, and decisions they are not party to. In this chapter, literature on diverse concepts and arguments in the context of agriculture production and marketing such as farming systems, styles and strategies are reviewed. The concepts and arguments are not only related to how farmers are able to exercise choice in their localities, and how they are able to actively participate in policy decisions affecting a field of their livelihood under a particular farming style. It focuses on the correlation of policy to inputs and outputs of the farm system, especially to the peasant farmer.

The Concept of Farming Systems

The neo-classical literature on agriculture over the years, rather than projecting the significance of the diversity in farming systems, concentrated on cropping systems by producing a great deal of quantitative information which gives detailed description of such systems and their major socio-economic production constraints (Norman, 2002). Studies conducted at the time usually concluded with standardised recommendations which were assumed to be applicable to all farming environments. "The one fits all syndrome" (Norman, 2002: 3) which characterised the neo-classical period drove researchers into thinking less of environmental diversity which typify agricultural production, the need to look at farmers' challenges and desires for technical change from within. Researchers at the time were also dismissive of farmers' innovative abilities and capabilities (Norman, 2002; Roling, 2008). The

remarkable influence of the Green Revolution on agricultural production in parts of Asia and Latin America by the mid-1960s derives from the introduction, use and availability of fertilizer-responsive, high-yielding varieties of rice, wheat, and maize in favourable and comparatively homogeneous production environments where there was guaranteed soil moisture, good soils, ready access to inexpensive fertilizer, and relatively well-organized output markets. In Sub-Saharan Africa, and parts of Latin America and Asia where the conditions for the success of the Green Revolution technology were, and are still not available, 'the reductionist approach' to agriculture failed to develop technologies suitable for the 'resource-poor farmers in less favourable heterogeneous production environments or agricultural areas' (Norman, 2002:1). The persistent focus on technology diffusion (especially from the global North) to unfavourable and less conducive farming environments has led to the negligence of the remarkable diversity that characterise farming systems and the credible roles farmers play by maintaining large reserves of such diversities of crop varieties particularly in Sub-Saharan Africa.

Local crop development which has been defined from the perspectives of plant breeding and seed supply by many authors (Berg et al., 1991; Groosman et al., 1991; Cromwell et al., 1992, in Hardon and de Boef, 1993) is, under the indigenous farming system, a dynamic combined farming strategy among farmers. The concept of local crop development is the continuous and dynamic process that maintains crop varieties and adapts landraces to diverse environments and specific needs of different household. The maintenance of crop diversity and adaptation becomes a very useful strategy against risks, a strategy which is absent in modern agricultural technology (Hardon and de Boef, 1993).

Whereas 'modern' agricultural technologies are basically concerned with standardization and efforts at homogenising the environment to achieve most favourable production conditions through the adaptation of the environment to homogenous crops (mono cultures, and hybrid or single line modern varieties) by using technologies based on external inputs such as irrigation,

fertilizers and pesticides (Amanor et al, 1993:2), resource-poor farmers in many parts of the Third World are still maintaining and developing diversity where farmers' resourcefulness has not been weakened by the dissemination of modern varieties (Richards, 1995; Amanor *et. al*, 1993). There is the need to comprehend farming as a complex system which is best understood and managed best by farmers through their own innovations which are acquired through experience, experimentation, adaptation, and practice over a period of time. This is evident in farmers' exceptional management of agro-biodiversity in the face of challenges posed by erratic and uncertain environments. Understanding farming systems then becomes imperative because it serves as a tool for appreciating farmers' knowledge and their relation to the environment, and why they carry out certain cultural practices. The farming system is also useful in determining which technical change best suits a specific farming environment rather than imposing the one fits all approach on farmers.

The word system is a connotation of collection of objects which are bound by some form of regular interaction or interdependence, and it can be explained as a structured unitary whole which comprises two or more interdependent and interacting parts or components or sub-systems which are demarcated by identifiable boundary or its environmental system. Farming distinctively refers to crop-combination or enterprise-mix in which the products and/or the by-products of one enterprise serve as the input for the production of other enterprises. It is an active, natural and open system with human and social participation (Maji, 1991).

Farming is an enterprise that thrives on participation and changing ideas. It is a system with inputs, processes and outputs. The inputs are things that are invested into the farm leading to maximum productivity. They are materials and infrastructure used on farms to facilitate crop production (Bloom *et. al*, 2009). Activities (ploughing, seeding, fertilizer application, harvesting, etc.) on the farm that translate inputs into outputs are referred to as processes. Outputs are the products or yields from the farm. In order to maximise profit, it is normally expected that the value of farm outputs turns out higher than that of the inputs.

Krantz (1974) considers the farming system as a complete farm development process which includes resources allocation, decisions and other farm activities which are carried out within a defined area or a combination of those areas of agricultural production, leading to the processing and marketing of outputs. Tezwani (1974) explains farming system as a whole complicated farm process involving the preparation of farm resources, allocations, decisions and activities that are carried out within an operational area or a combination of such areas resulting in agricultural production. Okigbo (1979) defines farming system as a venture or commerce in which sets of inputs or resources are exclusively organized by the farmer in such a way as to satisfy needs and to achieve desired objectives in a given environmental setting. The Food and Agricultural Organisation of the United Nations (U. N.) also sees farming system as a “population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a few dozen or many millions of households” (FAO and World Bank, 2001:9). Drawing from the foregoing definitions and explanations, a farming system can be seen as an entire farm business within which resources, decisions and all other farm activities interact with, and are interdependent upon one another. However, for the purposes of this study I shall concentrate on Okigbo’s (1979) definition which clearly focuses on the uniqueness of a farm and the role of the farmer as the central actor regarding decisions concerning the farm which are primarily targeted towards the satisfaction of the needs of the farm family in a specific environment.

The farming system is multifaceted. It is a field where interconnected resources (physical and natural) are somewhat controlled by farm families. To a considerable degree however, the farming system is influenced by political, economic and social factors that are functional at different levels. The operation of such factors predominantly turns to relegate the farmer’s

choices and decisions. To achieve an efficient and goal-oriented farming system, the individual farmer must be able to exercise choice and control over the complex components within the farming system. Allocation of resources and all other factors that influence the farming system must, to a large extent, satisfy the needs and priorities of the farm family.

Selection, production/cultivation and /or rearing activities within a farm determine the nature of farming system which is practised in any circumstance – exclusively crop or animal component or a homestead farming involving other additional activities taken up within the home. The kind of activities (crop or animals) however included under each component depends on their suitability, adaptability, marketability and or their capacity to satisfy the needs of a farm family. Mostly, the experience of the farmer and his/her predecessors over the years enable them to select the activities under each system. For instance, a farmer's experimentation with crops and crop varieties or species and animal types or breeds knowingly or unknowingly over the years enables him/her to finally incorporate them into the farm plan. Such interfaces between farmers and their environments have given rise to farmers' competence to further develop crops through a process of continuous adaptation and experimentation. Once a system is discovered, its adoption first and foremost, depends on the availability of different types of limited resources at the disposal of the farmer (Amanor et al, 1993; Bhowmick *et al*, 1999).

A farm under the indigenous farming system usually combines different components, depending on the farmer's preference. Farms sometimes comprise some field crops grown in different crop seasons, few animals, some vegetable crops grown either in the main crop field commercially or on small scale in the kitchen garden, some fruits and plantation crops beside activities like bee keeping and weaving etc. taken up in the homestead. While it is characteristically a case of mixed farming in an indigenous environment, it is not the same

under every farming system. Farming system differs from farm to farm, place to place and land situation to land situation and agro-climatic zone to agro-climatic zone.

Farming under a particular farming system depends on a farmer's resource endowment, environmental condition, economic and other socio-cultural and, sometimes, religious beliefs. In spite of these disparities, there are some common characteristics in the systems involved in different agro-climatic zones. To distinguish the understanding needed (including operation of the system, repair and improvement of the system, and construction of new systems), it is best to analyse a farming system as a complex whole based on structural changes since it is the totality of relations within a locality. Structural changes within a farming system among others include changes in land use pattern, production relations, land tenures, size of holding and their distribution, irrigation, marketing including transport and storage, credit institutions and financial markets, and research and education (Bhowmick et al, 1999).

There is a broad classification of farming systems based on farm size, methods and practices which are used in the cultivation of farm products or outputs, and many more. The similarities in farm characteristics put them under the same type of farming system. For instance, small and large scale farms are farm types based on the farm size. Farms are classified either as intensive or extensive based on the proportion of land, labour and capital. In relation to water supply, they are called rain-fed or irrigated farms. In connection with the extent of commercialisation, farms are said to be commercial, partly commercial or subsistence. Further classifications are based on the intensity and type of rotation, value of income, the nomadic nature, and many more (AgriInfo.in, 2011)¹. Other classifications are based on types of crops produced or animals reared (arable, pastoral, mixed, organic), farm size (subsistence or commercial), intensity of inputs, capital, labour and technology (intensive and extensive), and whether farms are sedentary or nomadic (Barcelona Field Studies Centre S.L., 2012).

¹AgriInfo.in (2011) "Farming Systems & Sustainable Agriculture"
<http://agriinfo.in/default.aspx?page=topic&superid=1&topicid=646> Accessed Feb. 19, 2012

Different categories and models of farming result from differences in inputs which can be physical, cultural, economic, and behavioural factors. This notwithstanding, the farmer, who is the major actor, should be able to select a suitable farm type that can satisfy her/his priorities and enable her/him to exercise control and choice in a field of her/his livelihood.

Types of Farming Systems

For the purposes of this study, farming systems shall be put under two major categories: Indigenous farming system and modern/improved farming system.

The Indigenous Farming System

Several decades ago, agricultural production was carried out at the local and community level. Crop yields mainly depended on rainfall patterns and other natural resources – soil nutrient and organic manure to fertilize homestead farms (mostly mixed cropping). Yields were constant and enough to sustain the farm family. This type of agriculture is referred to as indigenous agriculture.

Indigenous agriculture is a composite, heterogeneous and locally adjusted system which was developed by ‘farmers and herders’ thousands of years ago. It is a sustainable agricultural system that has stood the test of time based on resourceful combinations of strategies and practices that promote ‘community food security and the conservation of natural resources and biodiversity’ (Altieri and Koohafkan, 2008:12). With farmers’ ingenuity, they have been able to meet their survival needs regardless of environmental diversity without much use of modern agricultural inputs (Denevan 1995; in Altieri and Koohafkan, 2008).

All over the world, the indigenous agricultural legacy still exists and is estimated to be covering some five (5) million hectares (Altieri and Koohafkan, 2008). Indigenous agriculture has been significant in contributing to ecological and socio-cultural needs through the maintenance and conservation of technical local knowledge, indigenous crop and animal

diversity and other forms of socio-cultural organizations. Indigenous agricultural system is participatory – allowing farmers to interact with their environment using their ingenuity, experiences and available local resources which have accrued over time (Altieri and Koohafkan, 2008; Amanor, 2011).

Cultivation under the indigenous system of agriculture thrives on local specificity, enabling diverse crops and varieties to adapt under definite ecological conditions (Hardon and de Boef, 1993). Crop diversity and varietal differences play vital roles in risk prevention and contribute to increased harvest security in uncertain and marginal environments, under low levels of technology and with limited environmental impact (Altieri and Koohafkan, 2008).

Indigenous agricultural system promotes biodiversity. By planting several species and varieties of crops, environmental and climatic risks are minimized, undesirable effects of pests and diseases are reduced, long-term yield stability is ensured, diet variety is promoted and at the same time, proceeds are maximized although under low levels of technology and limited resources (Mushita, 1993; Altieri and Koohafkan, 2008).

Land as a resource under the traditional farming system is communally owned and in most cases, the distribution to individual families is done by the chieftain while allocation of family lands to individual family members for is done mostly by family heads. In preparing the land for cultivation, the bush is cleared by cutting down trees, followed by burning. After cultivating a piece or a plot of land for a number of years, it is laid fallow to recoup its lost nutrient. The fallow system varies from farm environments to another depending on the population density. While the previous land undergoes the fallow period, a different farm land is then prepared and cropped awaiting the regeneration of the lost nutrient of the previous farm land. There is limited input use under the subsistence farming system (Ruthenberg, 1980; Kuhnen, 1982; FAO, 1982).

Labour under the indigenous farming system is carried out by the farm family. Division of labour is culturally specific. While men are mostly in charge of clearing the land, women and children have the responsibilities of planting and harvesting. Marketing is mostly done by women. Subsistence farming is practised by small groups and families where population increase is not an issue to deal with (Richards, 1985; Kuhnen, 1982).

Though the evolution of indigenous agriculture is time and geography specific, certain structural and functional features are common in all situations. They include but are not limited to the following:

- They combine species and structural diversity in time and space through both vertical and horizontal organization of crops.
- The higher biodiversity of plants, microbes, and animals inherent to these systems supports production of crops and stock and mediates a reasonable degree of biological recycling of nutrients.
- They exploit the full range of micro-environments, which differ in soil, water, temperature, altitude, slope, and fertility within a field or region.
- They maintain cycles of materials and wastes through effective recycling practices.
- They rely on biological interdependencies that provide some level of biological pest suppression.
- They use local resources, human and animal energy, with less modern technology.
- They rely on local varieties of crops and incorporate wild plants and animals.
- Production is usually for local consumption.
- They focus on risk minimization.
- They enhance year round vegetative cover of soils.

The system diversity based on mixed cropping with varietal and other genetic variability ensures food security in times of natural disasters such as drought and flooding (Altieri, 1987; in Kazimirski 1998; Beets 1990, Marten 1986; in Altieri and Koohafkan, 2008; Altieri and Koohafkan, 2008).

Although farmers are mostly smallholders with relatively small land size under the indigenous agricultural system, they have immensely contributed to consumption needs of human beings all over the world. In Asia for instance, “China alone accounts for almost half the world’s small farms (193 million hectares), followed by India with 23 percent, and Indonesia, Bangladesh, and Viet Nam. In Asia where there are more than 200 million rice farmers, most of whom grow their crops on small 2-hectare pieces of land, there are probably 75 million rice farmers in China alone who still practise farming methods similar to those used more than 1,000 years ago. Local cultivars, grown mostly on upland ecosystems and/or under rain-fed conditions, make up the bulk of the rice produced by Asian small farmers” (Uphoff 2002; in Altieri and Koohafkan, 2008, p.18).

In Africa where 33 million small farms approximately represent 80 percent of all farms in the region, two-thirds of all farms are below 2 hectares and 90 percent of farms are below 10 hectares. The majority of the farmers, mostly women, are smallholders and the practice of low-resource agriculture which is fundamentally based on ‘the use of local resources’ is prevalent, although it makes ‘modest use of external inputs’ (Altieri and Koohafkan, 2008). Even though farm holdings are small, the majority of grains, roots, tubers and plantain crops, and the majority of legumes are produced from low-resource agriculture. With little or no use of agro-chemicals and improved seeds, smallholder farmers are able to produce most basic food crops (Richards, 1995).

The last two decades have nevertheless witnessed a dramatic overturn of the trend leading to huge reductions of food production per capita. The situation derives from agricultural

modernisation based on technology development, using external inputs. While attempts have been made to disseminate these technologies globally, conditions prevalent in Africa's agricultural environment are incompatible with the innovations which were built without Africa's production environment in mind. The situation has culminated in large imports of food from the North where conditions necessary for the success of the novel technologies are available. The situation has so much declined in Africa that the one time self-sufficient continent in cereals now has to import millions of tons to meet the supply deficit. In spite of the increase in imports, smallholders still produce most of Africa's food (Beets 1990; Altieri and Koohafkan, 2008).

Types of Indigenous Agricultural Systems

Indigenous agricultural farming systems are diverse, serving different and specific purposes in relation to farmer and environmental needs. Ruthenberg (1980) identifies three of the types: shifting cultivation, fallowing system and permanent cultivation.

Shifting Cultivation

Shifting cultivation is a type of farming in which the land under cultivation is at regular intervals shifted so that fields that were cropped in the past are left fallow to regain the lost fertility. The system is the agricultural practice in much of the humid part of West Africa. The main humid area where shifting cultivation remains the dominant form of farming is the middle belt of West Africa, between the coastal tree belt and the more permanently farmed northern plains (Ruthenberg, 1980; Kuhnen, 1982; FAO, 1984, p.9, in FAO, 1985).

Shifting cultivation is based on the natural soil fertility and the input of manual labour only. There is no input of capital, technology, manure, or fertilizers. It is characterized by short periods of cultivation (usually one to three years), alternating with long fallow periods which serve to restore the lost fertility of the soil. In a FAO convention, the term shifting cultivation

has been referred to as "a system in which relatively short periods of continuous cultivation are followed by relatively long periods of fallow". In a narrower understanding, shifting cultivation involves shifting both the land under cultivation and the settlement. More recently, however, the tendency has been to shift only the land that is cropped while the settlement remains permanent due to the increasing population density and influence of the state (Ruthenberg, 1980; Kuhnen, 1982; FAO/University of Ibadan, 1982, in FAO, 1985). The natural fertility of the soil under this system is of optimal significance for farm productivity.

In a shifting cultivation system, a farmer clears a piece of land from bush fallow, using indigenous methods of slash and burn. The land is then cultivated. When its soil fertility is exhausted, he/she abandons that land and moves to another piece of land. The abandoned plot is left to bush fallow for two to three years. Bush fallowing is a type of agriculture in which land is cultivated for a period of time and then left uncultivated for several years so that its fertility will be restored (Richards 1995; McGraw-Hill, 2003).

The Fallowing System

Shifting cultivation is being substituted with the fallow farming system where the period of fallow is shorter than that under shifting cultivation. Generally however, the time in fallow still exceeds the time during which the land is cultivated (Ruthenberg 1980). Under increasing population pressure and expanding cash production, the fallow system becomes a replacement for bush fallowing under shifting cultivation. Among the Krobos of Ghana, fallow periods usually last for two to three years after which the farmer returns to it. However, if the land is not well regenerated, the Krobos hire land whilst they wait for the land to regain its lost nutrient (Amanor, 1993). Fallow farming is usually characterized by clearly defined farms with largely permanent field divisions and more or less permanent farm yards. Land occupied by fallow cultivators is substantially modified by man's efforts to maintain and improve his living. The most common staple crops cultivated in this way are rice, roots and tubers such as

cassava, yam, sweet potato, and mixed grains such as maize, sorghum, millet (Ruthenberg 1980; Richards 1987; Amanor, 1993).

Permanent Farming Systems

Further shortening of the fallow period eventually leads to its disappearance, and is eventually replaced by a more permanent farming system. Farming becomes permanent particularly in densely populated areas like the Mossi Plateau (Burkina Faso), Kano (north Nigeria), and among the Ibo of Nigeria (Windmeijer and Andriessse, 1993), where the individual farmer has no substitute land to move to. The available land has over the generations been fragmented among the growing family members and there is just one plot (or a piece in some cases) of land for the farm family to grow all their food crop needs. This intensive land use is necessitated by the fast-growing population. The farmer is forced to cultivate permanently in one location using indigenous methods. Many of these systems have faded away in several parts of the world yet “the stubborn persistence of millions of hectares under traditional farming is living proof of a successful indigenous agricultural strategy and constitutes a tribute to the creativity of small farmers throughout the developing world” (Altieri and Koohafkan, 2008:2). To date, the existence of millions of smallholders, farm families and local people engaged in resource-conserving farming all over the world, contributing significantly to food security at local, regional and national levels is a corroboration of the incredible sustainability of agro-ecosystems regardless of constant environmental and economic change (Altieri and Koohafkan, 2008).

Indigenous Agricultural Practices

Farming practices associated with indigenous agriculture are in response to specific ecological and farmer needs. Mixed farming, crop rotation, intercropping, soil and water conservation, and organic farming practices yield immense benefits. They serve as major checks against pests, diseases, and climatic failures, stable yields, risk minimization, improved

soil fertility. Mixed cropping (combination of different food crops on a farm) for instance provides diverse nutritional needs, different maturity periods ensuring constant food availability, serves as a check against fluctuating climatic and environmental conditions. Intercropping and divergent crop practices provide protection against total crop failure by helping to stabilize income and food supply. There are specific strategies which are employed by farmers for various reasons. For example, panicle harvesting of rice ensures the maintenance of rice diversity in a stable traditional gene bank (Mushita, 1993; Altieri, 1995; Longley and Richards, 1993; Altieri and Koohafkan, 2008). Obviously, no specialized off-farm services or equipment are used. The ecology is not endangered, and the farmer exercises optimal control and choice in the production enterprise.

Modern/Improved System of Agriculture

History and Development of Improved Agricultural Systems

The concept of agricultural modernization is basically built upon scientific advances and new technologies. This concept supports large farm size, specialized production, crop monocultures, mechanization (the use of modern farm machinery such as tractors, harvesters, threshers, etc.), development and use of improved seeds (high yielding varieties - HYVs), the use of pesticides and chemical fertilizers, and the construction of large irrigation systems (Altieri, 1995; Macmillan Reference, 2001-2006).

The development of modern agricultural systems seeks to achieve two related aims: to obtain the utmost yields and to get the maximum economic profit possible. The striking increase in yields of primary crops such as rice and wheat through the use of new agricultural technology for instance, is intended to lower the price of food in order that food production keeps pace with the growing population. Six basic practices developed by agronomists became the spine of production. These are intensive tillage, monoculture, application of inorganic fertilizer,

irrigation, use of agro-chemicals, and genetic manipulation of crop plants. Each practice is connected to the others, reinforcing the need to use them (Macmillan Reference, 2001-2006).

Evidence according to Buckland (2004), Altieri (1995) and Macmillan Reference (2001-2006) shows that agricultural modernization is believed to reduce farm labour constraints and increase yields with the introduction of agricultural mechanization, machinery and synthetic inputs. Invention of farm machinery for tilling, planting, reaping and threshing of crops is supposed to immeasurably increase farm efficiency, farm labour constraints are lessened by agricultural mechanization and synthetic fertilizers are believed to provide crops with readily obtainable and uniform amounts of vital plant nutrients resulting in high yields. Irrigation technologies become replacements to rain-fed farm productions, especially by using them to supply water to crops during times of dry weather or at places where natural rainfall is insufficient for growing crops, resulting in increased yields and contributing to the expansion of cultivated farm land. Synthetic chemicals such as pesticides are used to prevent pest and diseases that attack crops and slow down the growth of crops. When there are pest outbreaks, chemical sprays quickly counter their attack while weeds that obstruct crop growth are equally treated using chemical sprays. Genetic engineering under modern agriculture encourages manipulation of crops resulting in new breeds or seeds called high yielding varieties (HYVs) which are sold to farmers at the commencement of every farming season since these cultivars cannot be selected and replanted in a new planting season as characteristic of indigenous cultivars (Buckland, 2004; Altieri, 1995; Macmillan Reference, 2001-2006).

In spite of the modernization discourse that agriculture will now be transformed to produce high yields to address global food security, the conditions for modernizing agriculture do not exist in the environments where, according to Altieri and Koohafkan (2008), they are most needed such as in Sub-Saharan Africa. Beyond that is the issue of cost which most smallholders battle with to have their farms modernized since farm modernization costs are far

beyond what they can afford. The invention of new agricultural technology has been the cause of key changes in agriculture. New farm technology since the 1950s, as noted by Buckland (2004) was developed and promoted by hierarchical institutions - led first by the state, and then by the corporations. Though technologies may play significant roles in developing agriculture, they are also reflections of the interests of the corporations and their supporting institutions which either depart or correspond with farmers' interests. The use of commercial seeds in agriculture for instance is said to boost production levels yet their use has added to the cost burden of smallholders. These seeds need to be regularly replaced since by design, seeds from their harvested crops cannot be reused (Bloom et al, 2009). Corporations perpetuate and consolidate their interests and wealth through poorer farmers using technology.

Diffusion and Adoption of Novel Technologies in Farming

Diffusion is key to social change and modernization which explains the spread of every new technology. It is an ad hoc social process that reproduces discoveries made through research and extension (Roeling, 2008). The success of any diffused new technology mainly depends on its adoption by the target clients but some conditions without which the new technologies are not able to achieve the desired results need to be in existence or made available. For instance, the dissemination of hybrid maize in Iowa in the early 1940s as noted by Ryan and Gross (1943) and Roeling (2008) was made possible by specific available conditions in the Mid-West corn belt of the United States. The conditions are outlined by Roeling (2008:3):

- A large number of farms or firms which all produce the same commodity for the same market.
- Each of them is too small to affect the price of the commodity. Hence they all produce against the going price (price takers) and therefore seek to improve their situation by producing more of the commodity against lower costs.
- Given the inelasticity of the demand for most agricultural products, all these farmers trying to produce more, more efficiently, exert a constant downward pressure on the prices of farm products.
- All the farms have access to credit, fertilizers, extension, farm journals, agribusiness, and are members of farmers' organisations, be it in different degrees.

The above outlined conditions may be applicable in some agricultural production environments, particularly in the more advanced nations but the same cannot be said about most Southern nations specifically in Africa where poor-resource smallholders are in the majority of food crop production. Adoption of new technology enables users to produce more and efficiently. Meanwhile, absence of the needed conditions among all target groups in all production environment results in early adoption of the new technology by few people who have the means to purchase the resources. Such waves of innovation deny some producers who lack the necessary basic needs for adopting the novel technology, leading to a situation referred to as the technological treadmill.

The Technology Treadmill

Benefits of new technologies are reaped by those who adopt it early since it enables them to produce in abundance and efficiently. Outputs of the new technology are still sold at existing prices which are still determined by the old method of production. This makes few producers who adopt the new production method early to make “windfall profit” which then becomes motivation for more producers to also adopt the novel technology. Nevertheless, as more and more people migrate to use the new technology to enable them produce efficiently in abundance, output prices begin to fall, leading to reduction of income, especially for those who still use the old method of production, regardless of their hard work. Such producers, with compulsion from the ‘price squeeze’, also begin to adopt the new technology, which is mostly driven and directed by market forces. This is what is referred to as the technological treadmill. In agriculture, “farmers who are too small, too old, too sick, or too stupid to keep up”, eventually drop out. Their resources (such as land) are taken over by wealthy farmers (Roeling, 2008:4; Buckland, 2004). Those who survive this scale enlargement process mostly “have large enterprises, a good education, an enormous working capital (tractors, buildings,

livestock, etc.), they are highly organised, and they are embedded in a network of supporting institutions and organisations, including input service cooperatives, farmers' unions, truckers, processors, retailers (e.g., supermarkets), vets, and so on." This network of institutions serves as integral component of the technology treadmill (Ronald Havelock, 1973 and 1986; cited in Roeling, 2008:4).

Success of the market-led agricultural technology treadmill largely has effects not only among producers, but also at the international level. First, it leads to labour migration, compelling most resource-poor farmers to seek employment elsewhere, especially in the industries. Second, the constant decline of global food prices as a result of productivity increase has significantly denied resource-poor farmers any remarkable benefits of technological innovations. The situation has led to escalating poverty rates among resource-poor farmers. Third, it has led to competition among countries in the international market as their agricultural production sector becomes more efficient. Four, voices of poor-resource farmers are silenced since major positions in farmers' organisations are occupied and controlled by early adopters of the new technologies who have made huge profits from the treadmill (Roeling, 2008; Buckland, 2004).

There are huge internal returns which come with investment in agricultural research and extension based on the explanations offered by the multiplication effect of the diffusion process, and also the macro profits from the market-driven treadmill. As observed by Roeling (2008:4), the treadmill becomes the overriding principle of promoting the novel technology. He notes that the diffusion of new technologies is based on research works which look into existing knowledge. However, perceptions concerning large gains of the treadmill by economists lead to transforming the research into a 'policy model' which emphasizes 'technology transfer (technology supply push)' and 'free markets' as panaceas for agricultural development.

In most parts of Africa, the innovation transfer has been dominant in the agricultural sector to the extent that “most policy makers, ministry officials, research administrators and managers, economists, and agricultural researchers cannot imagine any other theory of innovation than the linear model and continue to adhere to it, even after years of failure in situations where it does not apply” (Roeling, 2008:4). Agricultural institutions in most of Africa fail to realise that the success of research technologies at experiment stations does not actually warrant their diffusion and successful adoption in environments which lack the necessary conditions for the technologies to work.

Effects of the Technology Treadmill

Goulet (1989: 6) defines technology as a “systematic application of collective human rationality to the solution of problems by asserting control over nature and over human processes”. This suggests that technical change in agriculture should reflect increased labour, land productivity and enhance farm size expansion. In spite of the positives of agricultural technology, the impact of new technologies on smallholders becomes devastating in view of the unlevelled playing fields which are created by the technology treadmill.

The technology treadmill increases farmers’ total cost and adds up to the debt load of smallholders. Increased supply of farm outputs is associated with downward pressure on prices. This diminishes farm income and compels the farmer to increase investment in the farm in order to increase productivity (Gabre-Madhin et al, 2003; Buckland, 2004). Technology in agriculture can also create power imbalance between regions and people, based on who controls the power associated with technology. For example, the gap between the global North and South in consumption and productivity can be traced to the control of agricultural technology. Poorer Southern nations are faced with the challenge of high cost of adopting new technologies and yet, they remain the world’s largest exporters of agricultural commodities. In the North where export subsidies still exist, agricultural surpluses have filled

world markets at cheaper prices. With this keen market competition between the North and South in the face of liberal markets, the North is favoured while the inequality gap continues to widen (Buckland, 2004).

The subject of who largely benefits from technology adoption is of no substance but one thing is clear: that large commercial farmers have better access to credit resources and so are able to take risks such as investing in agricultural technology early. Eventually, the technology treadmill strategically pushes out smallholders from production because by the time they adopt the technology, market output expands leading to reduced prices and profits.

Implications of the Agricultural Treadmill Policy Model for Africa

In Africa where farming thrives on ecological diversity (which requires location specific external technologies) there are issues of political and social differences which do not support diffusion and adoption of a uniform agricultural technology. Beyond these factors is the obvious fact that the majority of African farmers do not participate in well-developed commodity markets due to lack of credits, access to information, and high costs of inputs, which would have equipped them to benefit from externally introduced new technologies. Most of Africa's resource-poor farmers lack credits and agricultural subsidies which are mostly enjoyed by farmers in the advanced nations. Presently, most Sub-Saharan African small farmers are being driven out of occupation, compelling them to move to urban centres or supplement their livelihood with off-farm income, resulting in the reduction of farm population shares (Buckland, 2004). In Africa where there are no strong institutions to deal with biodiversity and environmental destruction, poor-resource farmers who are affected by the technology treadmill resort to 'externalise social and environmental costs' through pollution of groundwater, natural resource and biodiversity damage, and human health contamination from the use of pesticides, etc (Roeling, 2008:4-5). The technology treadmill is based on farmers having access to credits to buy new technology to enable them

participate on the treadmill. However, in Africa where resource poor farmers do not have access to credits, they are limited or denied from participating on the treadmill. This implies that in competing with their counterparts from the global North in the face of a liberal economy, it is clear that poor resource farmers from Africa do not stand the least opportunity to gain from the market competition, resulting from the several years of agricultural efficiency benefits by those from the advanced nations (Roeling, 2008; Buckland, 2004). For instance, imported maize into Kenya is sold at 20% below the cost price of the best Kenyan farmers' maize (Cyrus Ndiritu, pers. com., 2002; cited in Roeling, 2008). Roeling also claimed that even though food imports into Africa have long term negative consequences for poor-resource farmers, "some governments (e.g.,Ghana) love the cheap imported food because it keeps their urban electorates happy" (Roeling, 2008:5).

In a world and a future characterised with food insecurity resulting from climate change, population growth, political instability and many more, it is difficult to say with certainty if Africa (having been largely affected by the global treadmill) will be able to contribute its quota to global food security or will ever be able to attain her own food sovereignty.

Modern Agriculture and Market Competition

Agriculture is progressively more interlaced with the market through connection with the other sectors of the economy such as industries which are extensively influenced by scientists and merchants under modern agriculture. The development of fertilizers and pesticides, new high yielding varieties, techniques, implements, and irrigation methods – the new technologies which came with modernizing the agricultural enterprise are intended to achieve lasting increase in agricultural production. Since the innovations are labour-efficient, farmers have to use other externally purchased inputs to achieve the maximum and standard yield which enable them to stay in the competitive market (Kuhnen, 1982; Buckland, 2004).

Modern agriculture is characterized by intense market competition. Under this survival environment, most smallholders are faced with the choice of externalizing their production system to meet market demands or face the consequences of being ejected from the market by the same demand forces. In this market-led agricultural model, prices have become the incentive and orientation for farmers, as well as how much they can produce (Kuhnen, 1982; Buckland, 2004). The effects of the competitive market are enormous on smallholder farmers who, per their land holdings and lack of all the needed factors for adopting new technologies, easily get thrown out of the market with constant reduction of their income. When this happens, the gap between the rural poor and the urban rich continue to widen. This is due to the fact that, large rural families are tied to agricultural production to sustain their lives. Thus, impacts on one farmer affect whole families, often times, resulting in migration to urban centres in search of non-existent jobs.

The cause of agricultural technology change can be viewed generally from two perspectives – supply and demand. Supply factors include farm population size, resource availability (genetic, land, water), cultivation practices, tools and implements. Demand factors can be seen through food consumption indirectly based on population increase, and growing non-agricultural population (Tansey and Worsley, 1995). While demand factors may seem a justification to technology adoption, the questions of who adopts it, how quickly and at which cost remain obscure (Kherallah, et al, 2000). Many who think of agricultural technology as a panacea to food insecurity have lost sight of the fact that technology change comes with cost in an enterprise highly dominated by majority of the world's poor who cannot cope with the increasing cost of modernized farm production, and are susceptible to being thrown out of a venture that belongs to them. Buckland (2004) maintains that technology can be a tool to advance a society only if that society decides the need for it. He further argues that technology involves costs and benefits and therefore changes to dominant ones must be carefully made

and rooted in the needs of the specific society. This implies the technology push force which is being applied by African policymakers “blindly” is unjustifiable since most Africa’s agricultural production environments do not have the necessary conditions to take up those technologies, and farmers do not have the means to adopt the technologies even if the conditions exist. What is important is for the inventors to learn from African farmers and their peculiar production environments to enable them develop specific technologies targeted at specific groups to reflect specific needs.

Agriculture Modernization and Neoliberalism

The neoliberal period involves expansion of the market in farm technology research and development. With the rise of the market, intellectual property rights and biotechnology, government role in agricultural development was terminated. After independence for instance, Southern states became central actors in agriculture inputs and outputs by establishing public research and extension services, as well as state-run agencies to provide inputs such as fertilizers and to market farm outputs. Production focused on both local and international markets and farmers were encouraged to adopt, save and multiply publicly developed seeds. However, a homogenous agricultural policy which expanded the role of the market became a replacement for governments’ role in agriculture. Dominant control of agricultural technology generation and provision shifted to trans-national corporations (TNCs). One area this is clearly demonstrated is in the generation of commercial seeds. Ownership of these seeds is now controlled by intellectual property rights system which controls the right to use and sell products. This way, only farmers who can afford to buy these seeds can meet the market demand (Bukland, 2004).

The neoliberal period projected markets as key and more efficient compared to state and community-led production processes. Farms worldwide during this period became

incorporated into diverse markets both at national and at the international levels. Increasingly, the role of the markets assume much significance in connecting consumers, the larger society and the farm, with prices being key elements in the relationship. With the increasing role of the market came drastic decline in states involvement in agriculture - provision of governments' social and production-related services. One assumption of the neoliberal concept according to Buckland (2004) was increased prices for agricultural produce under 'market-led models' compared to state-led development approaches. Proponents argue that competition and specialisation which are primary constituents of markets result in increased productivity. First, Specialisation would permit producers to specialise in producing one type of commodity and to sell the surplus in the market. Second, competition would allow no single individual, consumer or producer to manipulate prices in the market. Commodity prices come from consumers as signals to producers, asking them to either increase or decrease prices, or whether to produce more or halt production. Once the market becomes competitive, non-competitive producers are pushed out of the market. Buckland (2004) contends that this development has dire consequences for producers as prices now determine not only what to produce but also how to do it. For instance, a competitive market ensures that producers adopt a newly-developed technology (e.g. tractor) which alters labour constraints and increases efficiency. The first producers to adopt the tractor experience increase in profit, compelling others to adopt the new technology. As most of them begin to use the new production method, market production rises resulting in lower commodity prices. Eventually, those who are not able to acquire the new technique are either compelled to do so or are forced out of the market. Late technology adoption also leads to loss of profits.

Agriculture and the Green Revolution

The Green Revolution originated from modern plant breeding which began with wheat in the 1940s in Mexico with the objective of developing a chemical fertilizer responsive dwarf wheat

variety. Early attempts were championed by Norman Borlaug and funded partly by the Rockefeller Foundation. This was the root for the International Centre for Wheat and Maize Improvement (CIMMYT), resulting in productivity increase in Mexican wheat production, and was used as the foundation for official wheat breeding in India. Drawing on national rice breeding programmes in China, Taiwan and Japan, the International Rice Research Institute (IRRI) was established in the 1960s in the Philippines (Richards, 1985; Buckland, 2004).

The Green Revolution is an agriculture development approach, focused largely in Asia and Latin America, involving chemically responsive seed along with chemical inputs, driven by the public sector. The Green Revolution necessitated agricultural mechanisation since it increased labour. Most Southern nations have engaged in promoting the Green Revolution after independence in the 1950s and the 1960s. While Asia still counts the benefits of the Green Revolution, Sub-Saharan Africa is yet to tell her own success story (Buckland, 2004).

According to Buckland (2004:156) “the green revolution could counter peasant support for radical change by introducing technologies that would boost production and income without the need for land redistribution”. A technological parcel which came with the Green Revolution contained seed that was particularly responsive to chemical fertilizers, and necessitated irrigation during the early stages. At high rates of fertilization, the chemically responsive varieties (CRVs) could often out-yield indigenous varieties. CRVs have been widely adopted especially in well-watered and irrigated regions. In spite of this, the Green Revolution had diverging effects for small and large farmers, and for men and women.

Since the new seeds required irrigation, small farmers did not benefit as much as large farmers. First, with less capital and poorer access to credit, smallholders delayed in adopting new technologies due to the mandatory marketed inputs. Second, reliance on unofficial credit markets also meant that smallholders faced higher cost of borrowing with higher interest rates which increased their cost of adopting the Green Revolution.

The Green Revolution was equally problematic for gender relations and worsened gender division of labour in most cases. In parts of India for instance where women are responsible for weeding and other post-harvesting activities, and men in charge of marketing, women's workload increased while they gained nothing from marketing the output. Since CRVs are often not as robust as indigenous varieties, they require careful weeding. This task is reduced with the introduction of herbicides but in poorer communities, their use is not common. Again, since men are mostly in charge of mechanical technology, gender roles shifted with the introduction of mechanical threshers and huskers. In South Asia for example, even though women are traditionally responsible for post-harvest activities, men quickly took charge once mechanised technology was introduced, depriving women of their livelihood. Since women are always in the fields weeding, they are exposed to health hazards from inhaling the chemical inputs such as herbicides. Regardless of all these challenges, the Green Revolution was widely adopted in Asia but not in rain-fed Africa and is believed by some to have contributed to solving the global food crisis (Buckland, 2004).

Lipton and Longhurst (1989:9) estimate that the Green Revolution has resulted in an increase of between 30 to 60 million tons for grain output globally. They argue that but for that boost in grain production "many of world's poor would today be poorer still, and millions now alive would have died" (Lipton and Longhurst, 1989:9). However, they fail to appreciate the lasting cost which is borne by the world's poorest. That cannot be disputed. The introduction of CRVs for example, created large-farm bias by neglecting smallholders. At places such as Northwest Mexico and India, sharecroppers and renters were thrown out of farming by landholders. Since large landholders could easily access better land and capital, they were the first to adopt CRVs. By the time rain-fed CRVs became available, output prices had shrank leading to reduced benefits for late adopters. This had ingrained inequality between the rich and poor (Dixon, 1990). The adoption of mechanical technologies which came with the CRVs also engendered another problem. The endorsement of large farms which demanded the use of

tractors instead of human labour kicked out most poor landless labourers whose livelihood depended on agriculture. The consolidation of large farms with mechanised farm equipment such as tractors, threshers, huskers and combine-harvesters resulted in high productivity with poor job creation which deprived the poorest people from benefiting from the Green Revolution. This led to urban migration, culminating in the reduction of farm-labour availability. Eventually, farmers are forced to adopt labour saving techniques by joining the technology treadmill. As more farmers move join the treadmill, commodity prices decline, compelling farmers to increase farm size either by expanding land size or investing more capital into production, or combine both. In developing countries, agricultural modernisation (introduction of huskers, threshers, combine harvesters, tractors, etc) meant increased productivity but also prejudice against the poorest labour force that has been neglected (Lipton and Longhurst, 1989; Bukland, 2004; Roeling, 2008).

The focus on rice, wheat, and maize by the Green Revolution contributed to the neglect of remote smallholders whose livelihood depend on the cultivation of lower-yielding traditional coarse grains such as millet and sorghum (Lipton and Longhurst, 1989). With increasing competition and falling grain prices, the poor farmers struggle to survive.

Conceptualizing Farming Styles

Agriculture has been undergoing lots of transformations all over the world. In Western countries such as the United States and the United Kingdom, smallholder farming is gradually being phased out. Global and national policies are directed towards changing agriculture to a more advanced level in order that enough food is produced to address world food insecurity. These policies seek to endorse commercial farming over subsistence agriculture by consciously engendering necessary environments which require peasant cultivators to adopt new ways of production. It is also understood that these policies aim at improving farmers' livelihood through increased earnings from their farm outputs. (Makhura *et al*, 1996;,

Department of Agriculture, 2001:8; Backeberg, 2003:165; in van Averbeké and Mohamed, 2006; Buckland 2004).

While these efforts may be impressive, it must be admitted that smallholder farmers have been drawn, by dictates of those same policies, into a circle where prices have become determinants of what is produced and how it is produced. Science and technology have mostly become the driving force of agricultural production and are gradually replacing indigenous methods, thereby eroding farmers' autonomy (Buckland, 2004; Amanor, 2011). Buckland (2004) argues that smallholders are the worst affected, and the most likely to be caught up in the technology treadmill. Almost all farm tasks are being externalised.

Indigenously, ways of farming are based on knowledge and experiences that are handed down to generations. These farming styles result from careful study of ecological, cultural, socio-economic, and farmers' continuous interaction with their environment. With the drastic transformations in the agricultural sector which come with new prescriptions, one would like to find out if farmers are able to exercise choice and are able to control their autonomous production and livelihood. The next section of the study intends to review literature on farming styles, their characteristics, as well as strategies involved in the different farming styles. The review shall also be concerned with the extent to which farmers are able to exercise choice and control under a particular farming style around which their livelihood revolves.

The Concept of Farming Styles Defined

“Farming styles” is a sociological concept propounded by the Dutch rural sociologist Jan Douwe van der Ploeg. This concept has for the most part been used to study, distinguish and give details about diversity in farming within particular sub-sectors of agricultural production in Europe (Van der Ploeg, 1990; van Averbeké and Mohamed, 2006). As an integrating concept, a farming style depicts a particular way of practising agriculture. It is an expression

of how farmers combine and order elements that are used in the process of agricultural production (Van der Ploeg, 2003:101; in van Averbeke and Mohamed, 2006).

Drawing from the Dutch rural sociologist Jan Douwe van der Ploeg's 'actor-centred approach' as opposed to standardised agronomic models of agricultural development, Langthaler (2010:1) refers to farming style as "a socio-technical network linking elements of the natural and social world". This social network enables farmers to create new farm tasks through interaction with the farm during their daily farm activities. The interaction enables farmers to organise their farm in specific but flexible ways that help them achieve their goals which normally are not only directed towards economic benefits. Langthaler categorises this network in three levels: symbolic (the way farming is individually and collectively conceived), social (the way farming is negotiated between actors at household, local, regional and supra-regional levels), and material (the way farming is carried out as an everyday practice).

In their study on smallholder farming styles and development policy in the Dzindi Irrigation Scheme in South Africa, van Averbeke and Mohamed (2006:1) define farming style concept as "specific farming strategies, which are conscious responses of farmers to the prevailing ecological and socio-economic conditions".

The human or social connection to farming makes it divergent. In this regard the active participant is able to transform the system through continuous interaction with the farm. All three definitions of farming concept above convey the importance of the farmer as the central actor in deciding the appropriate farming style to be employed on a particular farm. Though Langthaler (2010) refers to actors without a specific mention of the farmer as the most important actor, one cannot do away with the fact that in every enterprise, the most important actor is the owner of the business who decides how to run his venture. So it is with the farmer and a particular type of farming style. In this regard, this study considers Paredes' (2010) proposition on farming style most apt when she points out that farming styles, in the context of heterogeneity, allows seeing farmers as citizens, who are permanently engaged in the

transformation of policy and geographies through everyday interaction with their environment. By implication, farming is not a homogenous art and therefore a common farming method cannot be applicable in all production instances. Without doubt, policy decisions, national and international, which aim at improving agricultural need to incorporate into such policies farmers' perspectives on what to do and how to do them. Above all, such decisions should target the farmer as the most important actor in the network whose needs must be satisfied.

Van der Ploeg (2003:111; in van Averbeke and Mohamed (2006)) asserts that farming styles arise from and can be studied in diverse interconnected spheres. These include strategic, structural, social and cultural domains. In the strategic domain, farming styles signify different decision-making models, and in each style, this model is the foundation of consistent set of strategic ideas held by farmers about how agricultural production should be done. Strategic notions are responses to cost-benefit correlations which are established by farmers based on practical evidence. A farming style in the structural domain is characteristic of consistent in-house and agreeable 'application of specific production practices, techniques and resources'. A particular farming style results from selecting and executing a preferred farm project aimed at generating income. In the social domain, a farming style is a reflection of a farmer's connection and relationship with other actors outside the farm who perform in the farming enterprise. These include 'other farmers, suppliers of services and goods, traders, government and society at large'. As production becomes more market-led, developing and maintaining these connections become more demanding. A farming style in the cultural domain 'represents a repertoire'. A specific agricultural practice becomes an adaptation to indigenous agro-ecology, technology and markets and market availability. A cultural repertoire, according to van der Ploeg (2003:89,111; in van Averbeke and Mohamed (2006:138) "is a store of indigenous knowledge that is shared and reproduced among farmers, and that acts as a normative framework guiding the handling of land and the objects of farming. It is an open knowledge system that is continuously subjected to feedback, resulting in its affirmation or

triggering its modification” (van der Ploeg, 2003:89,111; in van Averbek and Mohamed, 2006:138).

The different models from which a preferred farming style arises as discussed above convey the understanding of the genesis of a particular farming style – the farmer, being the central actor in making choices. Such choices eventually lead to innovations which are only applicable in specific farm or farm community based on the diversities in strategic, structural and social-cultural differences. Thus, a particular farming style which works perfectly under a peculiar farming condition is unlikely to yield good results in another system based on socio-economic, technical and agro-ecological diversities. What constitutes a good farm management practice may be a bad one in another farm. This brings into question the notion of homogenous modern technologies which are presumed to be applicable under all farming systems. In building new technologies, diversities in farming system and practice must be considered.

Different Types of Farming Styles

Farming styles are social constructs that result from practice and experience. The broad understanding of the farming style concept is a farmer’s perception of what constitutes good or bad farm practice or farm management. This means variations exist between different groups of farmers, even within a so-called homogenous group of farmers as pointed out by van der Ploeg (1990), diversities exist. So to assume that a specific farming style is universally applicable is to presume agriculture as an art of homogeneity.

Van der Ploeg’s farming styles concept offers the explanation to diversities which occur within a farming community in terms of historic farming strategies which are available to farmers. Through the active process of choices and decisions, farmers derive a specific farming style which becomes an outline for the management of their farms. Farming styles are created from strategic, socio-cultural and structural forces and they basically offer

explanations to agricultural diversity which further account for the continuous existence of indigenous agriculture in the face of the globalisation agenda.

Van der Ploeg (1990) identifies two major types of farming styles: intensification and extensification. In order to understand the extent to which farmers consciously decide on which farming style to apply on their farm, van der Ploeg presented two hypothetical examples of farm management to his respondents who are dairy farmers in Emilia Romagna (Italy) as follows:

Farm 1	Farm 2
20 cows	30 cows
50 ql/cow	40 ql/cow
1,000 ql	1,200 ql

Farm 1 represents an intensive farm with fewer cows (20) while Farm 2 is an example of an extensive farm with more cows (30). Two reasons account for the above exercise. The first is to find out whether farmers make conscious choice for both intensification or for scale enlargement and extensification. The second is to determine how farmers would defend their choice for a particular option or the other, what is the rationale for their choice, what means would be thought necessary for implementing a specific choice, and in which terms would the respondents justify their choices.. Van der Ploeg (1990) argues that there are structural forces responsible for diversities in agriculture culminating in the choice of a specific farming style by a farmer. He demonstrates the different market orientations which exist for different farming styles and shows that farmers do not just have a choice either for intensification or extensification but a choice to combine both options. This finding was based on his study among dairy farmers in Emilia Romagna (Italy), when van der Ploeg shows that there are various farming strategies available to farmers leading to resourceful blend of both extensification and intensification.

Diversity in farming explains a wide range of practices. While some of these practices solely depend on in-house forces, others rely on external drives, and yet some practices are combinations of both factors. Each farm development can be said to be appropriate depending on the needs and aspirations of the farmer who stands at the centre of decision-making. As a result, the current assumption made by policy formulators and trans-national corporations based on technology change leading to competition in the market cannot be justified with specific reference to the rural poor whose livelihood solely depend on agriculture. While admitting that external factors largely influence agricultural production, Ploeg's self-identity scheme with specific farming style acknowledges the significant position of the farmer as being in control and exercising choice over what to do and how to do it.

Farming Strategies

Farmers are good planners. They have strategies rooted in their values, perceptions and experiences which enhance their work to realise high productivity and benefits. Agricultural modernisation models do not recognize this ingenuity and therefore they plan and carry out productive projects outside community values and farmer perceptives which fail to achieve intended objectives. This section discusses farmers' strategies in relation to labour, economic, social and ecological considerations.

Indigenous peasant farmers combine a wide range of economic strategies which help them sustain livelihood. In his work among farmers on the irrigation development project at Weija in Ghana, Botchway (1993) identifies such strategies to include labour arrangements (use of pooled family labour), multiple resource management – maintenance of rain-fed bush plots, carpentry, fishing, hunting, in addition to working on the irrigation development project. All these primary economic activities significantly contribute to the “household budget of peasant farmers, providing an extra source of income for minimal capital outlays” (Botchway, 1993). Even though the multiple resource management strategies distracted labour from the irrigation

project, culminating into seasonal labour constrictions, they were necessary means to sustain livelihood. Collapse of the irrigation project followed from project officers' failure to give recognition to the significance of local knowledge, community values, farmers' strategies and perceptions.

Farmers' strategies also respond to ecological needs. Among the Krobo peasant farmers in Ghana, Amanor (1993) asserts that a two to three years fallow system is observed by farmers to allow the land to recoup its lost nutrient. In situations where the land is insufficiently regenerated, farmers engage in land hiring to continue with their production. Amanor maintains that rather than engage in permanent cultivation (which further degrades the land) in times of land shortage, farmers resort to "outmigration". He identifies that farmers who engage in shorter fallow periods and permanent cultivation experience drastic fall in yields. These practices have helped retain the natural fertility of the soil – "equilibrium of over 50 per cent of the inherent fertility" (Amanor, 1993:37). Other strategies include intercropping systems and fallow management practices. For instance, long-duration crops such as cocoyam, which can survive opposition from the rejuvenating field are intercropped with short-duration ones such as maize.

The indigenous ecological management strategies among the Krobos contrast with formal modern agricultural models which promote permanent cultivation of mono-cropping systems accompanied with heavy agrochemicals application yet the indigenous systems are striking in terms of preserving the natural environment. Though modern agricultural prescriptions are appreciable in terms of yield increase, they damage natural agro-ecology, destroy biodiversity, while they pose damaging health threats to humanity. Mera-Orcés (2000; cited in Paredes, 2010) identifies pesticide poison for instance, as the second most regular source of death among adult peasant farmers, in his study in the Ecuadorian Highlands. Consequently, both knowledge systems are needed to address the growing agricultural needs in the face of modernization.

Elsewhere among Mendes and Kukuna of Sierra Leone, traditional rice farmers' strategies include exploitation of the changing moisture levels of the soil as a way of sustaining their environmental conditions. Historical accounts as captured in Longley and Richards (1993) show how Mende and Susu rice farmers plant up and down the slope, "carefully matching rice varieties of different duration to soil moisture conditions at different points on the slope as the rainy season advanced". While this technique provides solutions to labour bottlenecks because all rice fields are not cultivated at the same time, it also ensures rice availability all year round. A traditional technique of this kind can be an ideal substitution for modern irrigation technology, yet it can only survive in rice fields with similar landscape. This explains the difficulty in providing a consistent interpretation to the significance of local knowledge in scientific terms without careful prior analysis of the ecological and social-cultural context.

Panicle harvesting, a rice harvesting technique among Mende farmers enables them to select and group rice seeds based on water and drought resistance capacities. With this indigenous knowledge and technique, farmers have come up with diverse varieties of rice which are planted at different times of the year in different soil locations. While this tactics evidently would ensure rice availability throughout the year, it has also resulted in the generation of three distinct Mende rice germplasm. Today, the seed selection strategy has led to social classification in the "ownership and control" of rice species among the Mendes. Among the Kukuna, a resilient, weed-resistant, drought-tolerant rice variety known as *disi kono* for instance is planted "at the top of the farm catena where the soil is typically gravely dry", while *samban konko*, "a much higher-yielding *O. sativa* variety" is planted in the valley where it can gain enough water to enable it yield much. A unique technique which developed out of the two planting strategies is the combination of the two rice varieties, planted on a level ground where they "both grow to the same height and mature at the same time". However, this local technique is known and adopted by only a few successful wealthy male farmers in and around Kukuna (Longley and Richards, 1993:51-57). To understand why this knowledge is known

among a few farmers in the same community over the years, one needs to first understand the cultural and the socio-economic context within which the strategy is generated.

Drawing from the above cases and illustrations, one gets a clearer picture of the diversity of technical local knowledge even within homogenous group of cultivators. The human factor in the selection and preservation of seeds (rice, in this case) whether consciously or as a result of ecological adjustments, is significant to preserving biodiversity. The value of indigenous knowledge in farming cannot be neglected and it is important that agricultural science knowledge finds a common ground to integrate local knowledge with the formal one. Local technical knowledge does not constitute an obstacle to scientific agricultural knowledge. Instead, we need to understand not only what farmers do but why they do it and how they understand what they know and do (Thrupp, 1991; Longley and Richards, 1993). The cultural and social nuances of strategies used by farmers in producing their crops need to be understood and incorporated into new development strategies. Indigenous and scientific knowledge need to complement each other in improving agriculture.

A Case of Combined Knowledge Systems, not Standards?

Standard application of science-based technologies connected to the Green Revolution is considered agricultural modernization theorists as a prime means of increased productivity for the market. They assume that the extent to which modern technology is used corresponds to the level of farm development. Studies, at variance with this thinking have shown that farmers do not adhere to standardized forms of application of modern technologies. What is more, use of modern technology does not necessarily result in development; harmful outcomes are bound to occur (Paredes, 2010). This section is devoted to discussing the significance and resilience of local knowledge in the presence of mounting pressures of agricultural modernization. Paredes (2010) looks at different practices and styles adopted by four groups of peasant potato farmers in Carchi, a farming community in Ecuador. What is important is

how farmers are able to merge practice and experience with standard to achieve their goals. Carchi is a heterogeneous farm community where lives thrive on potato production. Farmers in this community apply different combinations of strategies on their farms to sustain what they do and their livelihood. Though they apply modern technology in their production, they combine such technology with their own local knowledge which they have gathered through practice over time. These strategies are in response to their ecological and socio-economic needs.

The first group of farmers in Carchi are referred to as the “*Tradicionales*” (traditional group) who engage in intensive farming style requiring a great deal of labour but produces high yields and earnings. The traditional farmers use old methods such as “wachu rozado”, a cropping system which decreases soil erosion and serves as a source of green manure (Paredes, 2010). Though this practice is resourceful, it involves more labour than ‘full tillage’ therefore farmers employ the services of organized labourers who are specialized in the practice to reduce cost. This group also regularly use uncultivated land including wetlands. This method often involves use of agrochemicals (Paredes, 2010).

The second group is the ‘*Seguros*’ (friends are more valuable than money) whose farming style is extensive and emphasizes use of large amount of seed. This compensates for the low yields they gain from the exhausted land. Strategies for this group of farmers involve monetary risk prevention (bank loans and other unofficial credit resources). Cultivation is limited to the use of available resources which made others tag them “poor”. However, they regard themselves as “independent” farmers who are not susceptible to market instability. When their fields lose nutrient, they resort to using fertilizers and agrochemicals. Strategies to enhance other production factors include labour exchange, sharecropping arrangements with families and community members. These tactics provide farmers access to land, seed and machinery ‘with little or no monetary exchange’ an explanation of the saying among farmers that “friends are more valuable than money” (Paredes, 2010:3).

The third group comprises risk takers who invest all their money in farming. They are called '*Arriesgados*' or those who bet all their money on potato production (full-time farmers). Their style is extensive and involves high levels of mechanization and intense fertilizer use. Following from decades of mechanization, the land becomes poor and yields are low, attracting poor income. To sustain themselves, they largely rely on bank loans and use modern production methods. Their style is associated with capital build up. Farmers in this group are inspired by earlier members who were successful – bought vehicles, educated their children in the city, built magnificent houses, and many more. The system is now under threat since 2004 due to ever-reducing yields when majority realised negative net profits (Paredes, 2010:3-4).

The last group is known as "*Experimentadores*" (finding the way through experimentation) or experimental farmers. This group combines foliar fertilizer with the use of cheap, highly toxic pesticides which are meant to compensate for the more expensive soil fertilizers and pesticides. This helps them achieve high yields and income. Their style is extensive and they are part-time farmers who aim at producing for the market on small pieces of land, using little. They engage in sharecropping with other smallholders from the extended families, granting them access to "seed, oxen, and agrochemicals". This helps them meet most of their labour needs. Farmers in this group believe that families attach more 'care' in performing farm tasks such as "soil preparation, seed selection, planting and hilling up" compared to paid labour. "Experimentadores" consider family labour as 'capital for the poor' (Paredes, 2010:4).

From the Carchi example, it is clear that in the face of mounting degrees of agricultural commoditization which calls for homogenous modern farming techniques, peasant farmers still employ diverse strategies in response to labour, technology and market relations. Because of these varied economic strategies (involving a combination of commoditized and non-commoditized resources), they are able to sustain production and are mostly not held back by market forces. Paredes (2010) maintains that farmers integrate production activities, social relations and decisions regarding their environment in largely unpredictable ways – often at

odds with modernization theories which view development in “linear” and “evolutionary stages”. This helps farmers to achieve their set goals. Merging indigenous farming strategies with new ideas can flourish in the face of economic challenges as demonstrated by Carchi potato farmers. It is a clear case of combining external factors with internal ideas to achieve the farmer’s (central actor) goal. What is important is to recognise the value of indigenous agricultural knowledge at levels that it diverges with modern agricultural knowledge rather than treat it as poor agronomic practice. In attempting to reorganize agriculture through new technologies, conscious efforts should be made to build them on specific existing peasant ideas. Farming strategies are reflections of divergent responses to labour, ecological and market needs. Therefore wholesale modern technologies should not be promoted since they do not respond to specific needs of the different agricultural environments. What is more, these strategies must positively act in response to the multifaceted social considerations of the community, which are characterised by family values, as well as the differing views about what constitutes good farming methods and economic priorities to the farmer.

Agriculture and Seed Systems

Seeds are fundamental to the continued existence of agriculture. Accordingly, every effort at ensuring availability and accessibility of abundant existence of healthy productive seeds to farmers must be supported by all actors to guarantee food insecurity. This section of the literature is devoted to discussing seed systems and their relevance to food production. In this discussion, I propose that none of the dual seed system in agriculture is a threat to the accomplishments of the other, and that by finding a common ground to exchange relevant ideas about quality seed production, multiplication and conservation processes, interconnected seed problems among farmers, especially peasant farmers can be addressed.

Around the African continent, indigenous farmers have their own seed system which enables them to carry on with their agricultural activities. Being location specific in nature,

these seeds are known as local seeds, and the system referred to as local seed system. The most important seed source for food crop production among small farmers includes saved seeds from previous harvests, local seed markets and seed exchange among farmers. This informal system is sustained based on technical knowledge on seed selection, storage and distribution which ensure not only seed availability and access throughout a farming season, but also the preservation of landraces and biodiversity. However, modern agriculturists have failed to appreciate local farmers' technical knowledge concerning the evolution of landraces although the informal seed sector undeniably has been the foundation of all hybrid and genetically modified seeds. Longley and Richards (1993) for instance, observed how Kukuna rice farmers are able to combine two local varieties (with different duration capacities which yield at their full capability only when planted at specific location in the field) to generate another unique landrace which thrives on a levelled field. What the academic agricultural researchers have consistently done is to 'steal' local knowledge, repackage it, appropriate it, and resell it to the original owners. Meanwhile, they continue to openly despise the informal system and any activity which deviates from formal recommendations is tagged poor and backward. A case in point is the World Food Prize award given to Dr Monty Jones during his tenure as the Director General for WARDA for the development of NERICA, New Rice for Africa. The award was based on the originality of the discovery that *Riza sativa* (Asian rice) and *Riza glaberrima* (African rice) could, after all, be hybridised, which allowed the development of crops with the advantages of each. The award was given with assumption that WARDA had developed this cutting-edge hybrid rice variety. The truth however is that Sierra Leone local farmers had discovered natural hybridisation in their fields which was in turn discovered by a Sierra Leonean researcher, the late Malcolm Yusu, whose discovery which eventually led to WARDA getting the prize and the recognition (Barry *et.al.*, 2007; Monde *et. al.*, 1992; Roeling, 2008).

The informal seed system has not, over the years, received any recognised attention and support from governments and institutions despite the ever-increasing population growth rate and its accompanying escalating food consumption demand. As a result, the system has been stagnant and over the years deteriorated to a point where small farmers can no longer access enough seeds to cultivate. The effect of this inaction has culminated in low productivity, extinction of landraces, and reduced income for poor and marginalized farmers.

Not only do some thoughts regard local seeds as unhealthy and low yielding, they have also said that seeds from the informal sector are “untreated and thus a potential carrier of various diseases”², thus discouraging local seed cultivation. What these schools of thought fail to realise is poor resource farmers dependence on local seed cultivation. Again, the argument that local seeds are low-yielding and therefore reproducing them cannot solve the needs of the growing population is questionable. What has continuously eluded such schools of thought is the major role local farmers play in crop development using local seeds. Additionally, given the volume of attention received by seeds bred in the formal system, local seeds can stand the test of time. As Hardon and de Boef (1993:64-65) argue:

The comparative advantage of modern varieties over local landraces tends to depend on simultaneous manipulation of the environment, through adapting growing conditions to the requirements of the new varieties in order to achieve higher yields. Where opportunities for the use of external inputs do not exist, the comparative advantage in yield of modern varieties over landraces tends to be reduced.

Smallholders rely on seeds from local seed markets. Though unorganized, farmers in this system are able to distribute seeds over comparatively wide areas and their activities account for majority of seed needs in most developing countries. Two thirds of all bean seeds used by farmers in Malawi for instance come from neighbours, relatives and other local sources (Cromwell *et. al.*, 1992). In Ethiopia, between 25 to 50 per cent of smallholders engage in borrowing or purchasing seeds annually but the transactions predominantly take place between

²Maria Charlotte Arup Busch (2010) “Seed Systems in Developing Countries”, for Danish Seed Health <http://www.dshc.life.ku.dk/Seed/Seed-systems.aspx>. Accessed Mar. 18, 2012.

neighbours and relatives. Farmers are said to prefer the arrangement because they see the crop stands from which seeds are taken (Cromwell, *et.al.*, 1992). The seeds may not be high-yielding but farmers who have no regular seed source alternative, and lack credits to purchase them if they exist, the informal seed system will remain their ultimate source of supply.

Local farmers have been responsible for seed improvement, multiplication, storage and distribution for several centuries ago until by the 19th century when a systematic crop improvement that emerged in Europe and North America began to spread to the rest of the world. The formal system is a modern structured seed production activity. It began in 1883 in the United States and later spread among the more developed countries such as Holland, Australia and Canada over the last 75 years. It refers to a group of institutions linked together by their involvement in or influence on the multiplication, processing and distribution of improved seed (Cromwell *et. al.*, 1992). These institutions are governed by appropriate legislation and they include not only those who are directly engaged in the multiplication, processing, distribution and quality control of seed but include also a collection of interconnected institutions at national and sectoral levels, which though do not form a central composition of the seed sector, are able to significantly influence the sector's performance. Activities and decisions taken by every component of the seed sector vigorously affect the performance and success of all the other members (Cromwell *et al*, 1992:6).

Narrowly delineated in terms of those who are directly engaged in the multiplication, processing and distribution of seeds are public seed sector organisations (government ministries and parastatal enterprises), private sector commercial seed companies and community-oriented seed organisations. Government control and investment fluctuates between countries and adjusted with time in response to changes in economic policy and external pressures. Seed prices are usually affected by policy even though profit-making is typically not their key purpose. Making all kinds of seeds available and accessible to all seed users, particularly those who cannot afford seeds from the commercial markets is a mandate of

public sector seed organisations. Private sector commercial seed companies include Multi-National Companies (MNCs) and indigenous small- and medium-scale seed enterprises operate with profit-making as their fundamental goal. Consequently, their market targets are mainly large commercial farms, state farms where available (due to their high purchasing power) and small-scale commercial farmers.

One principal challenge of the formal seed system is its inability to reach out to small-scale semi-commercial farmers (mostly found in the developing countries) although they form the leading single group of seed users in parts of the developing world. In Africa, for instance, farmers in this category are estimated to form 50 per cent of the total farming population (Mellor, 1988). Community-oriented seed organisations cover a wide range of local organizations including co-operatives, community organisations and church groups occupied with seed provision for specific farm communities. Their objectives are largely developmental rather than commercial and they are often aided by foreign or local Non-Governmental Organisations (NGOs) (Cromwell et al 1992).

Based on the operational aims and organisational structures of the formal seed sector, tends to satisfy the needs of their interest groups and largely denying specific needs of other seed users in the diverse farming systems. Semi-commercial farmers are the worst affected of this limitation and it often exacerbates their plight. The gap created by the formal seed sector is often bridged by the informal seed sector even though admittedly, it might not sufficiently satisfy seed needs of all farmers. From their on-farm seed reserves from previous harvests and farmer-to-farmer-exchange obligations, local farmers are able to distribute seeds among themselves for cultivation.

Development of the Formal Seed Sector

In the 1970s, recognition for high-yielding quality seeds led most African governments to establish the formal seed sector through parastatal enterprises with the aim of satisfying seed

needs of farmers. Governments supported the system by subsidizing seed prices (Rubyongo et al, 2007). Due to high government subsidies, the government seed enterprises were met with financial challenges and by the 1980 Sub-Saharan Africa public seed production research systems were compelled to privatise and the state was forced into the back seat with a regulatory responsibility, acting as a channel for the materialization of seed markets (Amanor, 2011). With profit maximization as the sole objective of private commercial seed companies, they are limited in their operations by targeting high potential areas with high purchasing characteristics. Commercial seed companies turn to specialise in producing a few high-yielding popular varieties rather than catering for the diversity of varieties planted by farmers. Consequently NGOs, rural development/relief organizations emerged in the 1990s with the objective of transforming farmers' on-farm produced seeds into formal certified seeds (Rubyogo *et. al*, 2007) with focus on improving seed accessibility through the establishment of sub-regional organizations to promote seed business regulations and to support the private seed sector. However, there are indications that the seed companies still largely focus on profitable crops such as hybrid maize and cash vegetables rather than investing in the numerous varieties of crops which can address the devastating food security needs of the poor resource farmers (Rubyogo *et. al.*, 2007). This also reflects the formal sector's economic constraint which confines their scope of breeding programmes to major crops and comparatively broad environmental spheres (Hardon and de Boef, 1993:67). Despite efforts to promote activities of the sector, the fact still remains that there are gaps which need to be filled and that confirms the need for integrating the formal sector with the informal to address seed problems.

Integration as the Way Forward

Undoubtedly, the formal sector is beset with numerous challenges despite some successes it has chalked by increasing food productivity through its technological applications. However, it

is unable to address the diverse needs of the majority of farmers regarding their varietal landraces, environmental adaptations, socio-cultural needs among many. According to Hardon and de Boef, 1993, the focus on developing new varieties is only a fulfilment of a limited objective. They argue that local crop development focuses on gradual processes of adaptation and change believed to aid maintenance rather than improvement. For instance, specific adaptation of crops is a reasonable component of the selection process, while maintaining a degree of diversity among landraces is essential for socio-cultural purposes which are still relevant among local people (Richards, 1985; Brush et al., 1981; Boster, 1985; Cromwell, 1990; in Hardon and de Boef, 1993).

Lessons from specific seed selection processes such as sorghum seeds among farmers in Southern Sudan and Tigray of Ethiopia (Berg, 1993), crop diversity preservation strategies among farmers in Ethiopia (Mekbib and Worede, 1993), strategies of classification and selection of sorghum seeds among small-scale farmers in Zimbabwe (Van Oosterhout, 1993), and the selection and cultivation of small grains in communal areas in Zimbabwe (Mushita, 1993) have demonstrated economic and socio-cultural embeddings in those processes. They have also shown the peculiarities of local crop development and the objective of maintaining diversity in landraces while satisfying economic and socio-cultural needs of poor resource farmers. Hence the need to combine knowledge systems – formal and informal, to address peculiar needs of smallholders without compromising and undermining specific practices, drawing on diverse ecological, economic and socio-cultural considerations of small-scale farmers.

Conclusion

Agriculture has all over the world been the foundation of development. Its role in contributing to development over the years through the supply of cheap agricultural products, transfer of surplus to other sectors of the economy, foreign exchange, strengthening domestic

markets by investing in consumable outputs, etc., has been acknowledged by the proponents of the neo-classical theory (Stevens and Jabava, 1988). The remarkable contributions of agriculture largely derive from ingenuity, innovations and commitment of indigenous smallholders whose contributions are rarely appreciated in modern agricultural policy framework. On the contrary, development paradigms have distinguished agricultural modernisation as the sure means to promote social and economic advancement especially in the poorer regions. Emphasis has specifically been on increased crop yield through external input usage which always comes with costs (Buckland, 2004) which is always beyond what poor-resource farmers can afford, resulting in ever-increasing issues of low-income, depopulation, disease, unbendable production processes, unfavourable policies, and many more.

Diversities exist in agriculture. Any departure, especially from the modern concept of farming does not present a structural case for inadequacy and therefore must not be wiped out in attempt to concentrate on modern agriculture as the ideal method. It is imperative rather to look at ways of devising technologies that are specific to answering the divergent needs of poor-resource farmers, which can be achieved only by learning directly from the local farmer in the indigenous system. By this proposition, the current agricultural research focus on top-down approach must be revised to give allowance for researchers to listen to and learn from farmers. This will provide researchers the understanding of what and why farmers do, and what they consider relevant to their specific needs – ecological and socio-economic. Farmers are innovate, and are willing to introduce new ways into farming but not when those innovations are not compatible to their environment and do not respond to their specific needs. African farmers themselves are exceptionally good in managing agro-biodiversity as a means of coping with a variable and risky environment (Roeling, 2008). This is a situation which researchers must find answers to by building technologies to fit African ecologies.

CHAPTER THREE

OVERVIEW OF RICE PRODUCTION IN GHANA

Introduction

Rice cultivation in Ghana was smallholder-driven in specific environments under indigenous production system. This system became subject to change and transformation resulting from state interventions over time which have as their agricultural modernisation policy focus, the promotion of large-scale commercial rice farms. In attempts to acquire large stretches of land in fulfilment of this policy-driven production agenda, smallholders were displaced – lands, homes and indigenous staples were destroyed – leading to the creation of settler communities. In spite of promoting all these large-scale commercial farms which received huge financial support from the state, the system collapsed, resulting largely from the commercial farmers' failure to pay off their loans owed the banks (Konings, 1986; Amanor, 2011). This led to a shift in paradigm, focussing on smallholders' incorporation into the national agricultural modernisation programme premised on monocultural food crop production system in which high crop yields are synonymous with external input use. To achieve this agenda, smallholders' control over their indigenous production system was expropriated. The new technology-led knowledge system which is the overriding focus of the national agricultural agenda resulted in the relegation of diverse indigenous staples' production, making smallholders dependent on the market for both personal and production needs. The situation is exacerbated with policymakers' failure to allow participation of smallholders in decisions affecting smallholders' field of livelihood and insurance. This chapter looks at the trajectory of rice production in Ghana, state interventions in relation to international policies, and the impact of these interventions on smallholders.

Rice Production in Ghana

In Ghana, rice is a major food crop grown in most communities. It is cultivated both as food crop and cash crop. The crop accounts for nearly 13% of total cereal consumption and it is increasingly replacing indigenous staples of both rural and urban dwellers. Small scale farmers are the major producers of rice in Ghana. They grow rice over a wide range of different yields under different agro-ecological and environmental conditions (MoFA, Inland Valleys Rice Development Project 2005). Rice production presently in Ghana is estimated from “200,000 to 300,000 MT of paddy or roughly 120,000 to 180,000 MT of milled rice, the bulk of which comes from the Upper East, Northern and Volta Regions” (Global Food Security Response, 2009: 2). The discrepancy in production has been attributed to rainfall which remains the foundation of rice production. Between 1994 and 2004, production increased from the expansion of land area under cultivation. The GFSR (2009:2) noted:

By the end of 2008, rice production in Ghana was estimated at 301,921 MT of paddy, yielding roughly 181,000 MT of milled rice, produced on 132,921 hectares, resulting in an average yield of 2.27 MT/Ha of paddy for upland and lowland rice aggregated. It is generally agreed that current domestic production accounts for between 30 to 40 percent of domestic consumption (approximately 600,000 MT of milled rice), leaving almost 70% supply deficit to be filled by domestic supply.

Table 5: Categorization of Paddy Fields in Ghana

	Lowland rain-fed	Upland Rain-fed	Irrigated	Total
Planted Area (Ha)	93,750 ha	18,750 ha	10,200 ha	122,700 ha
Paddy (MT/Ha)	2.4 ton/ha	1.0 ton/ha	4.5 ton/ha	2.4 ton/ha
Paddy Production (MT)	224,700 ton	18,750 ton	45,900 ton	289,650 ton
% in Area	77 %	15 %	8 %	100 %
% in Production	78 %	6 %	16 %	100 %

Source: “The study on the Promotion of Domestic Rice in the Republic of Ghana,” *MoFA and JICA*, (Final Report, March 2008: S- 4).

Rice Ecologies in Ghana

Rice is extensively cultivated in Ghana, covering all the major ecological-climatic zones in all the ten regions under three main production systems namely rain fed upland, rain fed

lowland and irrigation. On the whole, the lowland rain fed system covers 78% of the arable area, the irrigated system covers 16% while the upland system covers 6% (MoFA, JICA and CARD, 2009; JICA, 2008).

Upland rice is grown on free draining soils where the water table is permanently below the root zone of the rice plant. The crop depends entirely on sufficient and continuous rainfall. Under these conditions, the rice crop can be grown only once a year during a single rainy season (Kranjac-Berisavljevic et al, 2003). There are problems of weed competition with the crop as the soil environment is suitable for most upland weeds. Other constraints include low soil fertility, pest damage, and low level of technological use which are said to account for poor rice yield. Rice varieties suitable for the ecology are short duration and drought tolerant types. Cultivation of the traditional local varieties of *Oryza glaberrima* dominates this agro-ecological zone even though the yield is said to be poor. Some desirable attributes that justify the continued cultivation of the local varieties include tallness and ability to compete effectively with weeds. Upland rice is also tolerant of some adverse soil conditions such as drought, poor fertility and acidity, some diseases, insects and pests. It is noted that upland rice possesses sweet aroma when cooked. Major pests in the upland ecology are rodents and birds (Oteng 1997; MOFA, JICA and CARD, 2009).

Rainfed lowlands or inland valleys are considered to be the most important areas for rice production. It entirely depends on continuous rainfall. Water is retained in the soil due to its hydromorphic nature and the topography. Farmers under this system level the rice fields and make bunds around the fields which create aquatic conditions in order to conserve water coming from rain, river flooding or other sources. Rain fed lowland ecology has water management problems as a result of frequent flooding from ground water and precipitation even though it has a more favourable crop-water environment than the rain fed uplands. Weed control, water management, unavailability of suitable varieties and adverse soil conditions are some of the major constraints in this ecology. (Oteng, 1997).

The irrigated ecology is recorded to have the highest rice yields because of the levels of technology utilization (improved land preparation, improved varieties, fertilizer application and weed control through water management) which are higher than found in cultural practices in both rain fed lowland and upland ecologies (MOFA, JICA and CARD, 2009). Water is distributed by means of a system of irrigation canals in the rice fields. In some areas, basin flooding allows water to flow from one terrace to another. In some parts of West Africa, two to three rice crops can be grown annually under irrigated conditions, and in some cases, five crops are cultivated over a period of two years. Presently in Ghana, the government owns 22 irrigation sites that cover 8,700 hectares. Studies have shown that the maximum potential is in the expansion of irrigated structures along the Volta and its tributaries, where a number of Small and Medium Enterprise (SME) rice producers are operating and a larger facility has been developed by an American company called Prairie Volta Ltd. (formerly Quality Grain Rice Company). In addition, a Millennium Challenge Corporation funded program is seeking to develop new irrigation sites and rehabilitate others, totalling an additional 5,200 hectares of irrigated area (GFSR, 2009). The problem with irrigation schemes however is the high cost of agricultural technology which smallholders are not able to afford, resulting in increased poverty levels among them.

Agriculture Modernization and Rice Production in Ghana

Ghana has since independence been dedicated to modernizing agriculture involving the establishment of an agricultural service infrastructure to advance mechanised agriculture, the use of synthetic inputs, scientifically improved varieties of certified seeds bred on research stations, and cultural commendations worked out on trial stations. The modernization took diverse forms under different governments relative to their ideological commitments, political associations, and changes in the ideas of global development. Under the Nkrumah-led government for instance, agricultural modernization took the form of state investment in

agricultural production through the establishment of State Farms, Worker's Brigades and Co-operative farms (Amanor, 2011:4). This was an agricultural development policy aimed at import substitution of which rice was an essential component as cash crop for urban consumers (Konings, 1986; Shepherd and Onumah, 1997). The import substitution agenda was also intended to open up new commercial agricultural boundaries in the Northern Region and within the transitional zone of Brong-Ahafo and the Ashanti Regions of the country but more importantly to conserve foreign exchange which would finance agricultural modernisation in the South. By largely focussing on the state sector with government funding, no considerable attention was given to food production which was still mostly done by smallholders at the peasant level (Konings 1986; Amanor, 2011).

After the overthrow of Nkrumah, agricultural policies turned towards promoting large-scale private estate agriculture. This followed from the Green Revolution approaches of the UN Food and Agriculture Organisation (FAO) and United Nations Development Programme (UNDP) initiatives of the time. Owners of these large-scale private farms became beneficiaries of subsidized agricultural inputs and low-interest loans. As noted by Ti (1993; in Kranjac-Berisavljevic et al 2003), there was a substantial reduction in the number of state farms in order to make way for private sector participation. These policies according to Amanor (2011), continued through various political transitions in the 1970s "with government facilitating agricultural investment for fractions of the political, bureaucratic and military elite" (Amanor, 2011:5). Between 1971 and 1976, fertiliser subsidies increased from 50% to 81% (Shepherd and Onumah 1997), resulting in the emergence of considerable estate capitalist farmers in rice production in northern Ghana and in maize production in the transition zone of Brong-Ahafo and northern Ashanti by the 1970s. Peasant-led food crop production in the North as noted by Konings (1986) was relegated while large fertile lands were appropriated by large private commercial farmers most of whom were migrant farmers, who also benefited from the region's cheap labour. What was more, these private capitalist substantially enjoyed

government incentives (farm subsidies) and bank loans while smallholders production received no government support. The development resulted in the loss of control over labour power within the communities and most of the young men and women who could contribute peasant labour were now employed by the private capitalist, resulting in reduction in peasant productivity. Though wages from labour could be invested in farming, the labourers were paid meagre wages which could rarely be useful for any major economic activity.

The national policy which was intended to enhance import substitution and also to facilitate the country's food self-sufficiency especially in rice production was done at the detriment of smallholders. For instance, the agricultural policy that saw to the development of the flood plains of the Volta and Oti Rivers into large mechanized rice farms in the 1970s displaced resource-poor smallholders, resulting in a progressive swing of major rice production from the Volta and Western Regions of the nation to the flood plains of the Volta River in the northern part of Ghana (Bozza, et al., 1990; in Kranjac-Berisavljevic et al, 2003). The impact of national focus on large estate and private commercial farms on smallholder production was outlined by Kranjac-Berisavljevic et al (2003:7) in the following lines:

Firstly, the development of large-scale commercial farms had no impact on the local rural populations, since the crops cultivated on them were largely intended for urban markets and not as staples for local inhabitants. Secondly, modern techniques, which emphasised cash crops and financial gain, were expected to push traditional farmers aside. The development of animal traction technology for small-scale farmers, for instance, was discouraged at that time through the creation of subsidies for the purchase of tractors, while animal traction implements and animals were not subsidised.

The high cost of adopting new technologies for agriculture then began to neglect smallholders who could not afford machinery cost and as a result could also not efficiently produce for the market, deepening the already existing societal poverty gap.

Even though rice was already cultivated by smallholders in the northern parts of Ghana, it was not a traditional staple and among the Builsa in the Northern Region for instance, it was only eaten during festive occasions (Konings, 1986). The diversion to growing rice rather than promoting the cultivation of indigenous staples is not only a reflection of denying smallholder

communities the opportunity to improve upon and expand the cultivation of their own staples but also an indication of disregard for smallholders' capability of increased production using indigenous knowledge. Large investment in 'capital intensive' large commercial farms by successive administrations for example, was not only a denial of investment in peasant-led cultivation (Konings, 1986:167) but also an evidence that smallholders can only increase productivity by using modern agricultural technology which was the focus of successive state agricultural policies. The taking away of large tracks of uncultivated lands from the communities by governments, coupled with the state's failure to invest in smallholder production also accounted for limited, low output, peasant-led diverse food crop production. Again, focus of modernisation policies on the farming elite (mostly politicians, army officers, businessmen and civil servants) continued to deepen the already existing socio-economic differences between the wealthy citizens and the poor smallholders through appropriation of peasant farmers' resources and government's reluctance to invest in smallholder agriculture. Modernisation policies also negatively impacted the environment by destroying rich biodiversity that is protected by smallholders' cultivation of different food crops.

In spite of all the huge national investment in large estate and private commercial farms, the system could not endure. The failure of large commercial farmers (mostly politicians, army officers, businessmen and civil servants) to repay bank loans resulted in credit failure, leading to the collapse of large commercial rice farms in the northern part of the state. This resulted in a policy shift which now focussed on the incorporation of smallholders into the national agricultural modernisation policy which according to Konings (1986) emerged later in the late 1970s after large-scale rice commercial production failed to meet urban needs and commercial farmers diverted supplies to neighbouring countries. Government, through the policy of "*encadrement*" (Konings, 1986) sought to incorporate smallholders into government assisted projects. Amanor (2011: 50) contends that:

Peasant farmers became integrated into government-sponsored projects in which they could receive land (including irrigated land), inputs and seeds, and agricultural services (such as ploughing and water). In return farmers were contractually obliged to cultivate particular prescribed varieties of crops with cultural practices outlined by project extension staff, and to sell their produce to parastatal marketing organisations.

Not only did the policy of *encadrement* suggest the rising deficiency of economically viable large estate agriculture; it also explains the growing national financial crisis resulting from defaults in payment of bank loans received by the large commercial farmers intended to improve their farms. In addition, the policy of *encadrement* was an indication of donors' interests to commercialize small-scale agriculture and contract farming (Konings, 1986; Shepherd and Onumah 1997; Amanor, 2011).

Underpinning the commercialisation policy was the desire to avert smallholders' sovereignty over production means (land, input and technology), processes and marketing which smallholders still largely retained during the period of growing large-scale commercial farms (Konings, 1986). *Encadrement* came with attractive packages (loans, inputs, mechanised technology, and available irrigation water) which easily captured smallholders' attention and resulted in damaging their autonomy over their labour and knowledge of what they do and how they do it. By moving smallholders away from their original communities to settler environments where monocropping cultivation is dominant, cultivation of traditional staples became limited and downgraded. This was more conspicuous in environments where peasant farms were taken over and developed for the national agenda and farmers now became dependent on government authorities to acquire limited parcels of land for cultivating only prescribed crops which fit only into the national programme. Since high yields of these monocrops are synonymous with external input use which can only be purchased from the market, smallholders were even more trapped to relying on the state for credits of which lending terms in the banks have become high, drawing from the lessons from large-scale commercial farming. The cases of Veve and Tono irrigation schemes in the Northern Region of Ghana demonstrated the displacement of smallholders when their homes were pulled down,

indigenous food crops destroyed and lands taken over for the national ‘development’ programme. Displaced peasants were forced by the situation to sell their livestock and remaining indigenous crops which were their livelihood insurance and to resettle in strange environments. Consequently, these settlers became dependent on the market for their food supply. In addition, while some settlers could not access land on the irrigation projects, those who did were not entitled to the same parcels of land as the indigenous people, a situation which led to growing impoverishment among displaced smallholders.

Specific modernisation programmes such as outgrowers’ schemes undermine smallholders’ autonomy. Apart from high costs of production under such schemes, marketing of produce is overseen by the farm management. Konings (1986) pointed out how a crate of outgrowers’ tomatoes cheaply sold at ¢15 to GIHOC, which was management and supervisory body of the scheme, against the open market price of ¢45. Crafty means through which credits, external inputs and technology use have become threats to the sustainability of smallholders’ permanence on ‘development’ projects have the propensity to weaken smallholders’ interests. Smallholders are prone to losing their small parcel of land on project in situations they do not have the means to afford inputs and services resulting from high credit terms, to those who have the means to produce for the sake of profit maximisation. This will result in the re-creation of emerging large-scale commercial private cultivators who will then employ the original land owners as labourers on their farms. Where smallholders do not lose their land, they will resort to combining indigenous strategies with low input use to sustain their cultivation. What is significant is to note that under these ‘development’ schemes, agricultural strategies are conditioned by political and economic interests and these often weaken interests of smallholder farmers. In spite of all these state interventions remains resilient communities of smallholders whose lands were not taken and were not attracted by the new schemes’ ‘incentives’ and methods. This section of smallholders still carries on production of indigenous staples using indigenous strategies to sustain their livelihood and biodiversity.

Meanwhile, the bankruptcy of the banks due to large-scale commercial farmers' failure to repay their debts compelled the government to seek financial support from the International Monetary Fund (IMF) leading to the implementation of the Structural Adjustment Programmes during the 1980s and 1990s. Ghana consequently disengaged from interventions in the agricultural sector under pressure from the IMF and World Bank, and major agriculture infrastructural elements were sold to the private sector (Amanor 2011; Konings, 1981).

Structural Adjustments and Agricultural Production

The structural adjustment programme (SAP) has two main components – privatization and deregulation. It involves, according to Bozza, (1994 in Kranjac-Berisavljevic et al, 2003), the steady liberalization of both in-house and external commerce, a partial elimination of controlled prices, privatisation of certain state monopolies, and the steady removal of government financial supports. Within the agricultural sector, reforms took the form of reduced government control, withdrawal of subsidies on agricultural inputs such as chemical inputs and fertilizers, reduction of export taxation and trade restrictions, divestiture of state owned-farms and fertilizer plants. In 1989, the government ceased procuring, dispensing and funding fertiliser while parastatals in charge of certified seed and fertilizer distribution were privatized that same year (Amanor, 2011). This led to drastic increase in fertilizer prices as well as high interest rates on agricultural credits. Removal of fertilizer subsidies resulted in striking reduction in fertilizer utilization, especially among small farmers who could not afford the high costs, resulting in drastic decline in fertilizer imports from 59,000 tons in 1979 to 20,000 tons in 1986. This figure was undulating between 35,000 to 55,000 tons annually during the 1990s (Shephard and Onumah 1997; Amanor, 2011). Amanor (2011) pointed out that Ghana's seed industry which was developed with the competence to produce certified seeds was hampered by macro-economic reforms through the introduction of the structural adjustments. The high price of fertilizer and its consequential reduced usage on farms

significantly affected the quantity of new seeds purchased by farmers since their prospective higher yields were connected to required fertiliser application.

The structural adjustment programme had devastating effects the rice industry in particular. They include high influx of foreign rice into the Ghanaian market resulting from the liberalization policy leading to the collapse of large rice mills nationwide. In addition to partial abolition of controlled prices, the structural adjustment programme also led to the privatization of state-owned enterprises and machinery, as well as the withdrawal of government financial support on farm inputs and very high interest rates on agricultural credits (36 – 46%) from the nation's financial institutions. There was also the issue of steady removal of institutional assistance in terms of machinery, equipment, and input delivery. Mechanized and irrigated schemes are constrained with efficient land management and conservation practices. Institutional arrangements for the development and maintenance of seed multiplication and also parastatals for variety improvement collapsed. Owing to poor remuneration of extension officers and inadequate logistics supply for both research and extension staff, there was a breakdown of the connection between extension staff, researchers and commercial farmers (Kranjac-Berisavljevic *et. al.*, 2003).

Liberalization and Rice Production in Ghana

The implementation of the liberalization policy generally has consequences for agriculture and for smallholders in rice production in particular. Reduction of applied tariffs led to increase in the imports of agricultural outputs which can be locally produced, import subsidization by government resulted in cheaper prices of imported agricultural produce compared to locally produced ones, and the removal of government subsidies on agricultural inputs by the Ghana government largely contributed to unequal market competition between local agricultural produce and farm produce from developed countries which are heavily subsidized. As part of the liberalization process, applied tariffs on agricultural produce were

also reduced and in some cases, completely removed while prices of agricultural inputs increased. This largely contributed to increased imports of agricultural commodities resulting from demand and supply deficit since smallholders lack the means to access credits whose interest rates have sharply increased since the failure of large-scale commercial farmers to repay their debt. The few commercial rice farmers who remained faced keen market competition from imported rice which sold cheaply on the market resulting from heavy subsidies received from their home governments, plus the cut down on tariffs which applied to imported agricultural commodities. Not only did the imported polished rice diverted consumers away from the local rice, but the urban consumer is attracted to it partly due to its ease of cooking since it is free from stones and chaff as compared to local rice. Even though the market for local rice still exists, it is used for preparing local dishes such 'Waakye' and others that depend upon the specific qualities of local rice.

The liberalization policy had devastating effects on small farmers. A study conducted by Christian Aid (Khor and Hormeku, 2006) in the Katanga Valley of the Northern region of Ghana revealed massive migration to the nation's cities by small farmers affected by the liberalisation policies. Farms have been abandoned and children dropped out of school since parents could no longer afford fees. Children who used to work in rice fields for fees after school have also migrated which largely affected households who were once supported with income from those children. Farmers who are left behind have very little to do owing to lack of capital, resulting from harsh agricultural loan schemes with very expensive interest rates ranging between 36% to 46%. The high interest rates resulted from the failure of commercial rice farmers to pay off their loans leading to a reluctance of the banks to lend to the agricultural sector. Outputs from their small fields are also underpriced due to competition from imported rice which has flooded the country's markets.

The Current Agricultural Sector Policy

The current Food and Agriculture Sector Development Policy (FASDEP II) is clear on its focus to promote agricultural modernisation programme in which external input usage becomes a universal remedy for higher crop yield (FASDEP II, 2009). However, provision and supply of these inputs (seed, fertilisers, herbicides, etc.) remain a challenge in farm environments where smallholders whose farming systems require external input usage are dominant. While healthy practices such as combination of on-farm and external inputs persist among farmers, modernisation policies give no room to explore such opportunities that have the potential to reduce the cost burden unleashed on smallholders by modernisation packages.

The sector's document identifies the need to promote smallholder agriculture by stating the sector's willingness to 'support' them 'to improve their productivity' (FASDEP II, 2009:10) without clearly stating the type of assistance smallholders will receive from the government. This reinforces the invisibility of smallholders' major contributions to food crop production by maintaining that 'grassroots farmer-based organisation (FBOs) will be encouraged to network with a central authority through local, district and regional groups (FASDEP II, 2009:10). Leaders of these organisations are mostly large-scale commercial farmers whose goals and production orientations are different from smallholders' and therefore do not advance the course of smallholders. It is important that policymakers understand the diversity embedded in agricultural production so that they can cater for the different needs of the different farm systems through policy designs and resources allocation. This can only be realised when smallholders are given space to participate in decisions that affect their production systems.

Constraints to Rice Production in Ghana

Land Tenure

Land tenure is a challenge to the rice production industry regarding access and security. Although large stretches of land abound in the country especially in the lowland rain-fed

ecology, holdings and investments towards land improvement are limited by the tenure system. Often times, there is prejudice against women in land allocation, posing greater challenges in areas where rice production is mostly done by women. Consequently, though large hectares of lowland suitable for rice cultivation can be found all over the nation, they remain unexploited (NRDS, 2009). Land tenure under rain-fed ecologies varies. They include family land, hired land, share-cropping, and or personal land.

Under irrigated schemes, land is acquired under the State Lands Act, 1962 (Act 125) which states that “any land—stool, family, private—may be compulsorily acquired where the government considers it in the public interest, an executive instrument being required to specify the site, land dimensions, and time of acquisition” (Boakye 2008: 3). By The Act, all initial interests and impediments concerning the land are halted and the initial holder(s) is paid compensations which presently are determined by the Land Valuation Board. All lands under Ghana’s Irrigation scheme are compulsorily acquired for ‘public good’ (Boakye 2008:3) under the Act. However, land disputes still largely remain issues of concern to stakeholders, often times escalating into violence. Sometimes, even though initial land owners are prioritised in land allocation on irrigation schemes, what they receive does not compensate their losses – land, traditional staples and livestock, homes. The situation is aggravated by their introduction to cultivating new cash crops using new methods dependent on external inputs. In addition to high debts resulting from high costs of inputs and mechanisation, farmers’ livelihood is affected by purchasing food crop from the market since they now produce cash crops. The new land tenure arrangements under irrigation schemes intercept smallholders’ autonomy over what to produce, how to produce it, and how much to produce. As pointed out by Konings (1986) smallholders who have been incorporated into government’s irrigation schemes lost their sovereignty over means of production and processes – land, labour, technology and indigenous staples – and have become dependent on the state for what, how, and how much of what to produce in addition to how much to market the produce. Sometimes, the situation

degenerates into conflicts between smallholders and project management. In the northern parts of Ghana for instance, original landholders occasionally seize or take back their rice fields which have been occupied by wealthy farmers who have employed original landowners as labourers. There are attestations suggesting distorted history of land tenure arrangements that escalate in community strife and dislocation of vulnerable poor farmers. It also provokes the damage of valuable investments, particularly in agriculture. New land tenure arrangements under irrigation schemes where smallholders depend on the management of the project to receive small parcels of land for cultivation have been apart with smallholders' interests. Field evidence (this study) suggests that smallholders are limited by those arrangements in relation to what and how much to produce. Such arrangements tend to affect the extent to which smallholders are able to exercise choice and control over their production.

Financial Constraints

Financing agriculture in Ghana has been a major constraint to the sector. While farmers require capital to cover their investment needs, credit facilities are unavailable and even when they are, terms are expensive. Farmers, especially smallholders have limited access to formal financial services for want of non-existent collaterals demanded by the banks (GSSP Working Paper, 2011). Large commercial farmers have been given preference since they have what it takes to acquire the loans. In cases where farmers are allowed credit, there are reported cases of delay in payment and unwarranted limitation of amount of money which can be accessed. A study conducted by the Global Food Security Response (2009) on Ghana also revealed how lending to the agricultural sector by formal financial institutions is comparatively low particularly for the commercial banks. Where lending is available, interest rates are high (GFSR, 2009), preventing farmers from accessing the loans, disallowing them from improving upon their productivity. Major part of their profit goes back into paying those loans, a vicious cycle that compels farmers to always need to go back for the loans to continue production. In

some instances, financial services providers demand collateral farmers are unable to provide and as a result are denied loans (GFSR, 2009).

Marketing, Post-Harvest Handling and Standardization

Marketing of produce poses serious challenges to farmers resulting in predetermined farm gate prices by buyers. Reasons such as poor road network and high transportation costs are assigned to the challenge, leading to pre-determining of produce prices by traders. While most perishable irrigated crops are sold to middlemen/women at predetermined prices to the disadvantage of farmers due to inadequate storage facilities, other crops such as rice are sold in paddy form due to the difficulties in processing the produce. Undeveloped post-handling of crops such as simple rice threshing methods largely result in poor quality of locally milled rice which attracts not only lower prices, but also disqualifies local rice producers from competing with ‘better quality’ rice imported into the country (GSSP Working Paper, 2011). Ghana’s agricultural modernisation has become more of “tractorisatation” and fertilisation policy, making no room for smallholders’ participation in contributing to policies that will provide exactly what they need. While tractors are good farm labour saving farm machinery, it is equally important for policymakers to note that not all farmers need tractors, and not every farmer needs fertilisers. And until there is a reversal of the current policy framework from top-down to bottom-up, the gap between actual needs of smallholders and what government deems fit for the ‘development’ projects will continue to widen mostly to the disadvantage of smallholders.

Socio-Cultural Challenges

Gender disparities have greatly affected crop production in Ghana. Although women are engaged in rice production, there are cases where women are discriminated against in relation to access to land and credit facilities against the evidence of women’s credit worthiness. In

communities where rice production is the principal source of livelihood to women as seen in parts of the Volta Region (NRDS, 2009), lack of credit denies women of improved livelihood, largely affecting female-headed households since there are no means to invest in expanded production.

Women faced land acquisitions challenges mostly on irrigation projects. On the irrigation schemes in the Northern Region Konings (1986) describes how women were eliminated from land allocation by the Land Allocation Committees on the Veia rice irrigation scheme on the premise that women “traditionally worked on their husband’s farm(s)”, an argument which according to Konings (1986:302) was not completely true. What this means is that women whose lands were expropriated for the scheme particularly unmarried women were reduced to dependent positions, needless to say, on men. This explains the large numbers of women engaged in menial jobs on irrigation schemes rather than owning parcels of land for actual production. What is more, these women are underpaid for their labour supply. On irrigation projects where women have access to land (for Konings stated that widows were latter considered on the Veia irrigation project), they have limited access to credit to invest in farm equipment and machinery though they are more credit worthy compared to men. Evidence has shown that women’s inability to mobilise themselves for government subsidies for farm machinery and equipment results from their poor political connection, leading to their domination in post-harvest activities such as winnowing and threshing (GFSR 2009), rather than engaging in the actual production process. Meanwhile, it is clear that innovations at irrigation schemes fail to pay critical attention to gender biases by including women in their technology designs. Women for instance are denied source of livelihood when mechanisation increases without women’s access to machinery and equipment (GFSR, 2009). Once such roles as winnowing and threshing are mechanised, men take over and women are thrown out of job, leading to hardships in female-headed households.

Input Supply, Support Services, and Seed Markets,

Inputs used in rice production – fertilizers, pesticides and herbicides - are mainly imported into the country by wholesale distributors such as Agrimat, Dizengoff Ltd, Wienco Ghana Ltd and Yara who supply smaller wholesalers and retailers who then sell to private retailers before it reaches farmers - smallholders and some commercial producers for use on farms (GFSR, 2009). Although Ghana has made substantial advancement toward deregulation and liberalization of the agricultural input supply systems, and thereby enabling the private sector to play a dominant role in supplying various inputs, agricultural input markets are still faced with lots of challenges which affect farmers' easy access to inputs at affordable prices (IFDC, 2002). While macro policy factors such as the devaluation of the Cedi greatly contributes to high pricing of imported inputs and scares away investors due to risks, poor infrastructure such as bad roads to the farming communities also contribute to expensive input prices, and restrains the amount of needed inputs to be supplied to the rural areas. Consequently, input dealers are much concentrated in urban areas and towns, a situation which compels farmers to travel several kilometres to purchase inputs, adding to the already escalating production cost. Next to macro policy factors is the market development issues which comprise “policy-induced uncertainty, inadequate human capital and market information, lack of affordable finance, and poor enforcement or absence of regulatory frameworks for inputs marketing” (IFDC, 2002: xi-xii). Since Ghana's agricultural policy concerning input markets is tentative, investors are deterred from entering into the input business which is significantly concentrated into the hands of a few resulting in high purchase costs. Consequently, farmers begin to shift from prescribed cropping systems to re-strategise combining indigenous and modern practices in order to save money for labour-saving technologies. The recombination of knowledge systems where farmers, against project management prescriptions, resort to traditional strategies with low external input use does not only reflect the resilience of indigenous cultivation processes but is also proof against the premise that external input usage is a

panacea for increased productivity. This development calls for modern researchers to gather relevant information directly from farmers to enable them understand how farmers successfully combine both knowledge systems on their farms. This will contribute to inventing specific low cost technologies using local materials which will be healthy to humans and the environment rather than projecting linear agricultural models. These are issues which call for smallholders' participation in policies which outline and implement processes of production in the different production systems. This will contribute to bridging the wide gap between farmers, extension officers and policy makers on the subject of knowledge exchange., Rather than close alternatives (as those promoting monocultural agriculture which flourishes on external inputs), it is essential to keep all options open in order to find solutions to attaining sustainable agriculture. All attention has been given to formal technical knowledge by policymakers. However, the failure of most of those innovations which are transported wholesale to farmers without specific considerations to specific production systems and ecologies, results from initial planning which excludes the voices that actually matter. It is imperative that those gaps be filled and for policy makers to realise the need to collaborate with farmers in promoting sustainable production that will be beneficial to farmers. As noted by Taylor (Taylor, 1993),

Sustainable agriculture needs to be productive, stable, environmentally sound and maintained with a minimum of external inputs, yet at the same time must offer all farmers an equitable return. What this means is that a new orientation is needed. This should build upon the risk-reducing and resource-conserving complex systems of sustainable agriculture derived from indigenous knowledge and practice, but selectively include the advances of modern science and technology.

Linking both knowledge systems in agricultural production will promote not only better farming methods, but will help restore our degraded environments, indigenous landraces, and quality cultural practices.

Support services to farmers include land preparation services from machinery or animal traction providers, in addition to irrigation services from GIDA. There are financial support

service providers who give out loans to farmers to improve upon production by hiring machinery or purchase of inputs. The National Association of Agricultural Mechanical Service Centre Operators (NAMSECO) is the main body responsible for the provision of agricultural mechanization services to farmers in Ghana (GFSR, 2009). In rain-fed ecologies, farmers receive support services from hired labourer who perform manual farm tasks such as clearing of fields, harvesting and threshing, leading to major post-harvest losses, adding to the cost burden of farmers.

Current agricultural support policies in Ghana allow the Ministry of Food and Agriculture (MoFA) to annually procure tractors which are sold to farmers and service providers on partially subsidized terms. Generally, this is laudable. However, agricultural modernisation policies have largely been influenced by patronage politics rather than solving specific needs related to the different production systems. For instance, issues related to huge post harvest losses, requiring urgent provision of threshers, combine harvesters, provision of storage facilities, etc., have not received any considerable attention. Only few production equipment for harvesting and post-harvesting activities, and inadequate combine harvesters, few threshers, and almost no mechanical transplanters, are available to rice farmers (GFSR, 2009). The situation is reflective of expensive costs of support services culminating in major post harvest losses which result in profit loss to farmers. Policymakers must be willing to move out of their offices to interact with cultivators to identify their specific needs under the different production environments.

The privatisation of the Ghana Seed Company (GSC) in 1991 endorsed the involvement of the private-sector, including farmers in the production of improved seeds. This transformation mirrors market expansion which would enhance seed availability, access and affordability. However, seed markets are still constrained in their operations while poor resource farmers who are expected to benefit from its liberalization continue to battle with unavailability, inaccessibility and high-pricing of seeds. Rather than open up seed markets, a few powerful

political actors have collaborated to usurp the market in which voices of poor resource farmers have been excluded. These actors have currently defined Ghana's input and seed market in which high yield is linked to input usage. Amanor (2011: 49) pointed out that:

Although the expansion of the market can result in creating new choices and freedoms for rural producers, it can also lead to trade monopolies and expropriation of the resources of the poor, including intellectual property rights, the erosion of local varieties, the denial of farmers of rights to store and multiply their own seed and the forceful integration of the powerless into alienating markets that offer them little sense of security.

The monopoly of seed markets by few public-private actors has excluded public contributions and opinion regarding what goes on in the market, and has progressively denied smallholders who may be in need of the seed. In addition, the formal seed sectors continued investment in certified seeds denies the development and expansion of the informal seed sector which is largely vibrant among smallholders particularly under indigenous production systems. Policymakers must be concerned with researching into the informal seed system, a situation that will to a large extent, serve smallholders' interests and save endangered local varieties from extinction.

Conclusion

Rice production in Ghana is potentially a commercially viable enterprise which apart from solving food security issues also has the prospective of employing a large workforce, the majority of who are smallholders, while contributing enormously to national income. The feasibility of this can be seen in the vast rice production ecologies which abound in the nation. Nevertheless, agricultural policies over the years have not paid particular attention to the majority of smallholder cultivators and their specific production system needs, resulting from policymakers' failure to allow smallholders space to participate in decisions affecting their diverse production systems.

What agricultural policies over the years seek to promote is a single general agricultural knowledge system (whose adoption comes with high costs) belonging to few profit minded intellectuals. Indigenous cultivation strategies which allow farmers to cultivate diverse food crop varieties, serving as staples, risk prevention, and biodiversity and environmental conservation are being destroyed, backed with policy. While there may be justifications for some of those policy-backed ‘innovations’, advocates often overlook the significance of indigenous production systems whose careful study will enable them generate new knowledge systems resulting in great contributions to sustainable agriculture, environmental and biodiversity conservation, income for all stakeholders, in addition to food security. Agricultural policies regarding production knowledge systems must be kept open to evaluate formal and informal knowledge systems, thereby bringing together divergent practices that are not only beneficial to the different ecological systems, but also healthy to the environment as a whole, while providing food and financial security to all actors in the production process as well as maintaining farmers’ sense of safety.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

Smallholder-led agriculture has over the years made immense contribution towards food security all over the world using indigenous knowledge. In spite of this, modern agricultural technological concepts have sought to relegate this knowledge by referring to it as inferior and undeveloped. Attempts at ‘innovating’ this ‘backward’ agriculture has led to the creation of agricultural technological treadmill which has been bias towards poor-resource farmers who are not able to benefit from the market-driven agriculture model. The treadmill has made smallholders poorer and succeeded in driving most of them out of employment through appropriation of their land to large commercial farmers through the implementation of successive national agricultural policies. In Sub-Saharan Africa, and for that matter Ghana, where food crop production has basically been smallholder-driven using indigenous knowledge, national agricultural policies over the years have sought to make smallholders dependent on the state for their source of livelihood by creating structured farming through expanded irrigation schemes focussed on agricultural modernisation. These schemes, apart from controlling smallholders’ means of production (land, inputs, technology) have also succeeded in taking away farmers autonomy over what and how to produce by making production dependent on external inputs and support services which require large capitals that are not accessible to smallholders. Where these credits are available, interest rates are very high making it difficult for farmers to compete in a market flooded with cheap imported food crops. Meanwhile, Buckland (2004:83) has argued that external inputs which include mechanisation are not ‘cost-less’. High costs of inputs and poor prices of produce negatively affect cultivators’ landholdings. In environments where food crop is still produced under indigenous agriculture and land is available, lack of credits and access to mechanised

technology limit their production. This chapter by comparing rice production at Avatime and Weta (which are representative of indigenous and improved production models respectively), seeks to discuss from the view point of farmers, various strategies and knowledge combinations used by smallholders to sustain rice cultivation in the challenging face of the treadmill. The findings will also focus on the relevance of land tenure under the various production systems by discussing how it affects productivity of the different categories of smallholders. The findings will also concern with the impact of external input use on productivity, and also on the extent to which external input use has helped smallholders to meet market standards which guarantee their effective competition in the market. The chapter also discusses the pros and cons of both methods regarding farmers' livelihood, the choices they make in relation to what they do and how they do it under the two production systems.

Farming Systems in Avatime and Weta (Afife) Traditional Areas

The Avatime practise the indigenous agricultural system in cultivating rice. Farming is completely rain-fed, farms are not mechanized, farm sizes are small and farmers do not use modern farm inputs. Farmers do not cultivate certified seed. Instead, indigenous *glaberrima* rice varieties are cultivated in addition to some modern rice varieties. Simple farm tools such as cutlasses and hoes are used to farm. Yields are able to meet survival needs of farm families, and there is surplus to sell for income which caters for family needs that cannot be produced from the farm. The Avatime only produce rice once in every year which begins from June which is the major rainy season. This farming system was handed down to generations by their ancestors and it has since remained with them. According to Djoborson Gbagbo, a farmer,

Rice is our staple food. When our ancestors came to settle here, they brought two rice varieties with them – Kru and Egomu (Evemoli). Both varieties are red in colour. Though these varieties still exist, we have many more other varieties in addition. We also have

Nerica which was introduced to us by the agric(utural) extension officer who lives at Amedzofe. But our priority is to cultivate the local rice.³

Rice farming at Afife (Weta) on the other hand is representative of a modern farm with irrigation facilities. Though farm sizes are small, they are mechanized. The crop is cultivated as a cash crop and is not a staple among any of the farming communities in the area. Farmers use inputs including fertilizers, herbicides and pesticides. They also use modern farm machinery such as tractors, combine harvesters and threshers. There are two farming seasons at Weta: major and minor seasons as a result of the irrigation facility. Farmers do not cultivate certified seed; they cultivate improved seed. Different rice varieties are not found at Weta as with the Avatime. There is only a single improved variety known as Togo Marshall which every farmer at the project site cultivate. Halm Annas, a farmer narrated:

We used to cultivate different varieties such as Congo and Kabila. But now we only cultivate Togo Marshall which was introduced to us by one farmer called Charles about ten years ago from Kpalime in the Republic of Togo. When we tried it, the yield is good and it tastes better than all other previous varieties. So we settled for it and we have been planting it since. In addition, since we began cultivating Togo Marshall, marketing has drastically improved. Now traders from Accra and Kumasi even come here to wait for us to harvest so they can buy immediately. Some of them don't even allow us to dry the rice; they go to dry it themselves.⁴

Farmers at Weta and Avatime do not cultivate certified seeds. Those in Avatime explained that their interest lies most with seeds indigenous to them but would like to try it if they are made available to them. They pointed out how NERICA was introduced to them by the extension officer in the area but they discontinued with its cultivation since it was difficult to thresh. On the same issue, Mr Annas, a farmer from Weta said:

We have never seen certified seeds though we hear the yields are good. What we want is to produce quality rice for our clients. So why not? If they bring some, we will try it and if it works better than what we currently have, then I'm sure, we shall plant it.⁵

An IDA staff Mr Ebenezer Appiah at Weta noted:

³ Interview with Djoborson Gbagbo – March 20, 2011 at Avatime.

⁴ Interview with Halm Annas – April 14, 2011 at Weta.

⁵ Annas, a farmer at Weta – May 20, 2012.

I am the agronomist on this project but as I speak to you now I don't even know where certified seed is sold. The Ministry of Agric is more of a policy-making body and we don't have implementation agencies to liaise with us. I don't even know how the Ministry releases the seed to farmers. It's a difficult situation. The variety farmers plant here, I believe, may be a hybrid from Togo. The management is now trying to trace its characteristics and behaviour patterns to see how we can further develop it. Farmers have been using this variety for over 15 years now. The seeds are now contaminated and on the fields, you can see there is no uniformity because they reproduce the seed themselves and also exchange it among themselves. There are no seed growers here and there is nothing like seed selection. What they harvest is what is replanted.⁶

While each stage of the rice production at Avatime requires the farmer's attention (from pre-planting, planting and post-planting activities), the farmer at Weta on the other hand does not participate in almost all farm activities such as clearing and harvesting which are mainly done using farm machinery. This gives the farmer autonomy over what he/she does and how it is done, and thereby making the farmer a central actor and a major decision-maker in the farming process than in Weta. It is through this sovereignty mostly involving the farm family that local knowledge concerning rice cultivation is passed on to younger ones through observation as they assist their parents and other guardians in the rice fields.

Land Tenure

Land can be said to be the most significant resource in production. At Avatime where farmers are engaged in indigenous cultivation, farmland is abundant and any farmer can acquire as much as she/he wants through various means. However, lack of credits and mechanised technology farmers productivity resulting from cultivating smaller holdings. At Weta where improved farming methods are used, land tenure arrangements are controlled by the Irrigation Development Authority's management that oversees the distribution of limited parcels of land to farmers, and also controls the processes of how the rice should be cultivated. Land holdings are limited unlike at Avatime since producers have outnumbered the available irrigated land. The scarcity of land at Weta has resulted in permanent use of external inputs, a situation which is referred to by Buckland (2004:83) as 'cropping intensity'.

⁶ Interview with Mr Ebenezer Appiah, a staff of IDA at Weta – April 14, 2011.

Different land acquisition opportunities exist at Avatime: family land, hired land, or individually owned land (acquired through outright purchase). Respondents say access to any of these types of land poses no challenge to farmers since there is enough farmland in the area. There are farmers who also engage in sharecropping. The study however discovers that none of the respondents engaged in sharecropping during the previous season and none were contemplating doing so in the coming farming season. It was clear from the discussions that it is more profitable in absence of family land, to hire land than to engage in sharecropping. During this study, farmers pointed out that family land is the commonest land type used in farming and the need for other land types arise only if family land becomes unavailable during the period of bush fallowing. The significance of family land tenure is that farmers are not charged any fees since they are entitled to the land as members of their various families. There are a few farmers who on the other hand farm on leased lands in which case a fee is paid to the landlord for the farming period. Leased farm lands are mostly got from neighbours at Kpuita and Saviefe. There are landowners who accept paddy rice as a form of payment for leasing their land. Nevertheless, there is no generally accepted measurement for the rice given to the landowner; the amount of rice to be given to the landowner is agreed upon between the farmer and the landowner. This contributes to disparities in rice quantities received by various landholders. In spite of the variations, the system has always played out well. There are no records of landholders' refusal to lease land to farmers or farmers' complaining about 'unfair' payment in kind demanded by any landowner. Farmers said landlords appreciate their share of the produce because there are no other significant uses for wetlands in the area. Sometimes, friends also give out lands in which case they normally do not demand any payment from the cultivator. The reason is that some day, they may also be in need and require assistance from their friends. Justine Osei, a cultivator narrated the process of farm land acquisition at Avatime:

My family has abundant farmland which is given out by our family head to any member who wants to farm. But you see, during the last rice farming season, I had to rent land from another family because my family land was not available because it was under bush fallow (to enable it regain its lost nutrient) so I had to rent land and pay for it. It was one acre for which I paid forty five Ghana Cedis (GH¢45.00) to the landlord for the farming period. But if you can't afford to pay for one acre, you can settle for something smaller in which case a 12 arms rope will be used to measure the land for you. There are 9 of those ropes in one acre and one 12 arms rope costs GH¢5.00. If I decide to farm during the next season, I must go to hire the land if my family land is still not ready. And I know it will not be ready by the next farming season too.⁷

Table 1 below represents land types used in the two communities and the percentage of farmers who use them.

Table 6: Various types of land used by farmers

Land type/Area	Avatime %	Weta %	Total %
Family	50	0	20
Hired	20	0	8
Personal	0	0	0
Irrigated	0	73	44
Family and hired	15	0	6
Family and personal	10	0	4
Hired and personal	5	0	2
Irrigated and hired	0	27	16
No. of respondents	20	30	50

It is evident from the table that a significant number of rice farmers at Avatime use family land while a number of farmers at the irrigation site have equally acquired hired land in the community. Though the percentage of farmers who own both irrigated and hired land may seem insignificant, it is a confirmation that farmers are not satisfied with their “small” farms on the irrigation project and are therefore looking for other means to expand their farms. At Avatime where the table shows farmers using a combination of land types, it is a proof that rice farms are scattered at different places. For instance, John Doe stated:

⁷ Interview with Justine Osei at Avatime – March 20, 2011.

My wife and I have two different farms. Half an acre is on hired land while one acre is on family land.⁸

Similarly, Patience Asamani who has two farms said:

My one acre farm is on family land while the other half acre farm is on a hired land.⁹

At the Weta irrigation site, farmers go through a registration process to get their portion of land. This process includes an application letter to the farm management, followed by an interview session organized for the prospective farmer. Once the process is successfully completed, the farmer is allotted his/her portion of land. The land is not paid for and there is no gender discriminations. Any individual, female or male who meets the requirements for land acquisition is given the land. Presently however, prospective rice farmers are faced with the issue of land shortage. An interview with Mr. Seth Djaba an officer from the IDA on April 14, 2011 reveals that:

The irrigation project was a social intervention by the Government of Ghana to create employment opportunities for the people living within the surrounding environments in order to improve upon their livelihood. The land was good for rice farming but undeveloped so government took it from the people, developed it and gave it back to them. The people own the land and cannot pay for what belongs to them. The only fee farmers pay is water charges, part of which is used for maintenance of the irrigation facilities.¹⁰

According to Deku, a farmer,

At the beginning of the project, land owners (those whose plots of land were taken for the project) were allocated between two to three acres whilst labourers working on the project were given a plot each. All other applicants from the surrounding villages were allotted two acres. However, farmers who abandoned their farms at the time government left us on our own transferred their plots to other farmers in exchange of money. Though official farm management records show that farmers own between one to four acres of land, we are here and we know there are farmers who, through those illegal transfers, own more (up to ten acres or even more) than that but those farmers won't tell you the truth.¹¹

Speaking on the farm land allocation and illicit transfers by farmers, Mr Appiah from the IDA narrated:

⁸ John Doh at Avatime – March, 21 2012.

⁹ Patience Asamani at Avatime – March 21, 2012.

¹⁰ Interview with Deku, a farmer at Weta May 05, 2011.

¹¹ Interview with Mr Seth Djaba, IDA staff at Weta – April 05, 2012.

We know those deals and we keep advising farmers to come to the office to make farm transfers official so that when the original farm owners return to take over their farms, there'll be no problems but they don't listen to us. What we are trying to do is to develop a kind of land market where those who no longer want to cultivate rice can advertise their fields for those who have the money to buy it. When that happens, then farmers can own land through outright purchase at the site. We believe that will lead to medium scale production because those who have the money can own as much acres as they can afford. But they still illegally re-allocate land and this is creating insecurity in the rice fields. Right now the only means of getting land here is through re-allocation.¹²

First, the trend of farmers abandoning their plots to those who have the means to continue cultivating on the project due to financial constraints is a growing reflection of an emerging class of wealthy smallholders who will later transform into large-scale farmers on an intervention project initially meant to 'serve the interest' of smallholder cultivators. In addition to losing their land, these now landless smallholders will be constituted into a group of labourers who will be engaged by the wealthy farmers to provide services in return for meagre allowances. The effect of this negative development on the landless labourers will extend to their large dependents as well. Second, each day, new application letters are received by management yet there is nothing to be done in order to assuage the situation. Disappointments of those who do not have land to farm have culminated into grievances against management and 'aliens' who are landholders in the rice fields. Sometimes, the aggrieved persons whose parents' or grandparents' land was expropriated enter rice farms belonging to others and destroy the farms, a situation which has resulted in the arrest of some people by the police. These developments according to cultivators have become seasonal rituals. While they condemn the destruction of rice in the fields, original landowners/cultivators have also justified actions of the aggrieved persons saying they must be given some land to cultivate because the land belongs to them. In addition, landholders who make illicit transfers without management's knowledge are confronted with the problem of taking over their rice fields whenever they are ready to do so. Sometimes, the tenants refused to give up the land, degenerating into conflicts, leading to permanent loss of their parcels of land.

¹² Interview with Mr Ebenezer Appiah, IDA staff at Weta – April 14, 2011.

Francis Amuzu, a farmer narrated:

We need more land to expand our farms but the irrigated site is not enough for us. Most of us have therefore looked for land in the marshy area where landowners charge GH¢100.00 for one acre for the farming season. Since that area is not irrigated, we only cultivate it for one season. I own five acres on the irrigation project and twenty acres at the marshy area. I know the risk there is very high but I am a commercial farmer and ready to bear the consequences. If the rains fail, I lose all but if they don't, I get everything. As I speak to you, I've already cleared my field awaiting the rains so I can seed.¹³

According to Annas,

My wife and I own three acres at the irrigation site but this year, we have gone to hire ten acres of land at the marshy area which we have already cleared. What we know is rice farming and that's all we have in the area. At least, there are traders here always looking for the rice to buy so the risk is worth taking though it's not the best. Government should come and develop the area for us.¹⁴

Though farmers from both study areas are small scale farmers, there are differences in their farm sizes, with farmers from Avatime having smaller holdings. The constraints on land holdings are not related to scarcity of land but suggest lack of access to mechanised technology for land clearing and inadequate capital to expand areas cultivated. Table 2 below represents farm holdings in the two communities and percentage of respondents.

Table 7: Farm sizes and percentage of farmers:

Farm Size (Acres)	Avatime	Weta	Total
½	0%	0%	0%
1	30%	0%	8%
1½	20%	0%	12%
2	45%	50%	48%
3	0%	13%	8%
4	5%	10%	8%
5	0%	10%	10%
More than 5	0%	17%	6%
Number of farmers	20	30	50

¹³ Interview with Francis Amuzu at Weta, April 15, 2012.

¹⁴ Interview with Annas at Weta – April 15, 2012.

From the table above, the majority of farmers from both study areas (48%) cultivate their rice on a two acre land while only 6% percent of the respondents have more than five acre land. At Avatime, only 5% of the total number of respondents from Avatime own up to a four acre rice farm. From the analysis, it is manifest that rice farmers from both study areas are small scale farmers, the majority of whose farms sizes are less than 3 acres.

Capital

Preliminary funds for Avatime rice farmers are raised through individual efforts and sometimes through family support. Farmers are not able to access loans formal financial institutions and have not received any significant attention from the government. Farmers mentioned that the only government financial assistance they received was over ten years ago. They indicated that the loan did not serve them well since they received it after the farming season. According to Charity Kwadam:

We wrote several letters to the Agricultural development Bank in Ho for loans. They asked us to join a bigger group of farmers which they said would negotiate on our behalf because our farms are small and the bank people were not sure we could pay back the loan. They asked one person from the larger group to either use his/her house or any other property as a guarantee for the loan but none of us has the kind of property they wanted so we never got the money. When the bank people said our farms are small, they forgot we can only expand them when we have the money. The work is difficult and we cannot do it on our own but they don't understand us. Our farms are small but we are able to feed ourselves and even sell part of the rice in the market. What makes them think we can't do more and pay back their money?¹⁵

Similarly, Peace Dagadu recounted:

The bank people said we don't have bank accounts but there is no bank in this area. Our income is small. How do they expect me to pay close to GH¢10 as lorry fare to Ho and to go and deposit how much? If there are banks here, I can walk there to go and deposit GH¢5 any time I have the money. There is land here but the work is difficult and we need money to hire people to do some of it but there is no money. The little we have is what we always depend on. These bank people are also part of our poverty problem.¹⁶

¹⁵ Interview with Charity Kwadam at Avatime – March 22, 2012.

¹⁶ Peace Dagadu at Avatime – March 22, 2012.

All respondents at Avatime claimed to rely on personal funds to support their farming. This they say is inadequate but since they have no other option, they keep managing that source of capital. Respondents also said personal funds are responsible for their small farm holdings.

At Afife, Amegatse, a farmer recounted:

At the beginning, government provided services on the rice fields and gave us inputs at subsidised costs. We repaid after the rice was sold. Then around 1983 that way, those subsidies were removed so we had to look for our own capital. The Agricultural Development Bank also used to support us but that is no longer an option now. The problem was that, we formed co-operatives and our leaders negotiated with the bank on our behalf. The money was given to us as a group and paid into the accounts of our leaders so that at any time you needed money for a specific work on the farm, you contacted the leaders and they released the money to you. For instance, in the year 2000, ADB gave us loans in April at an interest rate of 37%. When I needed money for harvesting in September, the leaders gave the money to me at the same interest rate at which the loan was given to us by the bank in April. Do you understand that? How is it that somebody would be using that money for other businesses, making a lot of profit because he has the money in his account and when I take part of that money several months after, I should be charged the same interest rate beginning from April? Does that make any sense? And why can't the bank give us loans as individuals? That is why we abandoned that option because others were making money at our expense.¹⁷

Atsuga narrated:

The bankers told us the loan was given at simple interest but our leaders had deals with them and the simple interest turned into compound interest. “*Ɖeko mia nunɔlawo fi mí, dumí nyanɔnyanɔ heda fukpekpe ɔe miadzi.*” (our leaders stole from us, exploited us and unleashed hardship on us.) They claimed to have bought subsidized fertilizers for us but we discovered the fertilizers were expired so that when it was applied, there was no change on the crop. We confronted them and the case went to court. A sample of the fertilizer was sent for test but they could not release the analysis. We were ready to face them in court but they couldn't come to us. That was how this ADB loan project collapsed. Now the money lenders are our refuge although that is equally another albatross but we have no other alternative.¹⁸

Amegatse recounted:

The market women give us loans at 50% interest rate payable soon after harvest at either in cash or kind. Even though management always budgets how much a bag of paddy (86kg) should cost as farm gate price, traders always manipulate the situation by refusing to buy the rice at the appropriate price. Since they know our creditors always come after us, you see them around but they refuse to buy. They hold meetings among themselves and come out with a price of their own which we can't refuse otherwise your creditor could ask the police to arrest you. The traders have agents here who help them to cheat us. There are others too in town who join the traders to exploit us by buying the rice cheaply. We are also told some big

¹⁷ Interview with Amegatse, a farmer at Weta. April 21, 2011.

¹⁸ Interview with Atsuga at Weta, April 21, 2011.

politicians also have agents here who buy for them. Those big men have shops in Accra where they sell the rice, making lots of profit at our expense. After a week or two, the farm gate price increases and keeps increasing until we have new rice in the system. Those who are not farmers turn to make more profit than us except for those who have their own capital. The perfume rice we plant here is of international quality and we don't understand why the government can't buy from us, store it and resell to the public latter. Or the banks should come to our aid individually with long-term loans at reasonable interest rates so that we can also enjoy something. Right now, we are only working for others to enjoy.

The marketing constraints faced by cultivators resulting from poor credit terms indicate negative impact of the technology treadmill which has subjected cultivators to hardships unleashed on smallholders by the market. Even though cultivators are 'free' to determine when and how much to sell their output, they have been bound by costs (credit interests, inputs and services prices) to sell when prices are at their lowest, affecting how much income they accrue from the sale of their produce. Again, only those who have the means to keep their rice until prices are high are the ones able to make profits. The likelihood of 'wealthy' cultivators' consuming plots of poor cultivators over time cannot be underrated, a situation which will once again lead to the re-creation of large-scale private cultivators. The table below represents the percentage of farmers who sell their grains immediately after harvesting and those who store theirs and sell it during the lean season. The illustration from the table indicates that the majority of cultivators at Weta sell their produce just after harvest. This is not the case at Avatime but it is important to note that in situations where Avatime cultivators have urgent financial needs, their circumstances will be no different from Weta cultivators since they lack favourable credit facilities which could have been set aside mainly for rice cultivation. In view of rice price increase during the peak season most cultivators at Weta will not make enough profit yet they have loans with high interest rates that need repayment. This explains why policy should consider making favourable long-term credits available for smallholders to enable them maintain their autonomy over decisions concerning when and how to sell their produce. As it stands now smallholders' sovereignty over when and how much to sell their rice has been eroded by the technology treadmill.

Table 8: Different sales period and percentage of farmers

Period/ Area	Avatime	Weta	Total
Sale just after harvest	30%	77%	58%
Sale during the lean season	20%	13%	16%
Partial sale during both periods	50%	10%	26%
No. of respondents	20	30	50

A visit to the Weta irrigation site by the researcher in April 2012 (the beginning of a major season) revealed that a bag of paddy was being sold at GH¢110.00 instead of GH¢70.00 at which a bag sold during harvest. This means only 13% of farmers would be able to make more profit - GH¢40.00 on each bag since they do not take loans. The 10% which sells part of their produce during the lean season would make some profits while the majority 77% would not enjoy any profits from the GH¢40.00 difference. What is worrying according to the cultivators is the period between the low and the high produce prices. Cultivators claimed sometimes, prices shoot up within two weeks. While they agreed that they lack storage facilities and store the rice in their living rooms (which they agreed is not a good practice since they lose some of the rice when sacks get torn or mice eat it), they maintained that but for repayment of loans, they would prefer to “sleep on their rice” and sell it only when there is high demand with good price. As Anagbla, a cultivator put it, “with my 3 acre farm with 21 bags from each acre, you can imagine how much loss I made by selling all that just after harvest and only for prices to increase after a few weeks. Agblea ɔ́ko míedem dzodzro. Naneke mele eme o. Gake èwò ɔ́tsu xoxo, srɔ́ kple viwo le asiwò, àteɔ́nu afɔ́ ko dɔ́ aɔ́ke mawɔ́mawɔ́a? Amedɔ́gbɔ́ ko woayɔ́ nawò. Yata koe dzro”.¹⁹ (We are farming for nothing. We gain nothing from it. However, as a mature man with wife and children; can you just wake up doing nothing? You’ll be tagged a lazy man. That is why we continue cultivating the rice). At this point, one realises that even

¹⁹ Interview with Anagbla at Weta – April 15, 2012.

though farmers work hard enough, it does not complement their earnings. Having been caught up in a bias market chain, cultivators are rather becoming poorer every new season. While the treadmill squeezes their profits through input purchase, traders at the other end also worsen the case by widening the poverty gap between the rural poor and the urban rich. Cultivators themselves have pointed out that the circle of input purchase, high support service charges, high interest rates on loans and poor farm gate produce prices are responsible for the huge poverty levels among them, making it difficult for them to progress. At Avatime respondents said they are able to store their rice until there is good price for it before it is sold. Vivian Quansah recounted:

Here, we are able to determine the price of the rice because we can keep it as long as we choose. Besides, we funded the production ourselves and so there is no need to rush. We know the price is expensive but the work is equally difficult and we cannot labour in vain. Sometimes, I sell my rice after harvest because the difference is really not too much when it is stored over time. We are the same people who choose how much it should be sold.²⁰

Farmers believe at Weta that the cost of production is too expensive and the government should help do something about it. According to Taller, a farmer,

The production cost here is killing us. It is very expensive and you can't do anything without money. If the cost reduces, our profit margins can increase. We beg the government to come to our aid with farm machinery. The tractors you see around are privately owned. Though management has drawn a budget for them, they don't follow it. Their charges are always higher and they claim the increases are due to fuel prices. They squeeze the blood out of us yet we have no other option. The work too is difficult and you can't do it on your own so government should help. Sometimes too, because we are many and the tractors are few, the work delays and once you are left behind, your crop doesn't do well because they can't open the water for you alone. The inputs too come very late; sometimes, subsidized fertilizers and herbicides come when you are harvesting so you are forced to buy from private sellers at higher prices.²¹

Table 9 below represents a one acre production cost in the two study communities in 2011.

²⁰ Interview with Vivian Quansah at Avatime, March 20, 2012.

²¹ Interview with Taller at Weta – April 15, 2012.

Table 9: One acre (0.4 hectare) production cost (GH¢) at Avatime and Weta:

Item/Are a	Seed	Land Preparation	Agro Inputs	Labour	Irrigation Charges	Others	Total
Weta	40	66	248	432	41	40	867
Avatime	0	90	0	200	0	Uncertain	290

It is obvious from table 9 above that rice farmers at Weta spend far more capital on one acre rice field as compared to rice farmers at Avatime. While the variations in production cost may be attributed to agricultural mechanization, and input use, it is also an indication that production cost under the indigenous farming system is cheaper than the modern system. This is clearer from the interview with Mr. Taller who indicated that the actual cost of production is far higher than the budget from the IDA management given the instances with the use of private machinery, fertilizers and other chemical inputs. In spite of this, it is clear from the table that the specific cost for land preparation under the indigenous system is more expensive than under the modern system. This evidence should be a source of concern as to why agricultural modernization packages should create room for farmers' participation in policy that outlines agricultural packages for cultivators since they are in the best position to say what they need and that which they do not want under a particular farming system. Presently, agricultural policies do not have room for cultivators to participate in deciding what they actually want on their field of cultivation. The system is best described as "supply-push". For instance, famers at Avatime under the indigenous system have mentioned the need for mechanization and not chemical input use. Charity Kwadam narrated:

We need tractors and power tillers on our farms. The work on the farm is difficult and labourers charge us so much. We have been told two gallons of diesel can be used for power

tiller to work on two acres in a day. When we get a power tiller, it will save a lot of labour cost.²²

Labour

In the olden days, farm labour at Avatime was exclusively provided by the farm family. Presently, family labour according to farmers, no longer plays a major role in rice cultivation. All respondents admitted that they use hired labour without which it is impossible for a farmer to have any surplus for sale. Justine Osei from Avatime narrates:

Labour these days is expensive. Those days when rice production was just for home consumption, we did the farm work on our own, supported by our children and other family members. Now because of school, our children help except when they are on holidays. Young ones who are not in school too have left town saying the farm work is tedious. Even your own family members work for you for a fee. The labourers now decide the type of labour to offer – by day or 12 arm rope. You pay GH¢ 5.00 to a labourer who works on your farm daily until the work is done, or GH¢8.00 to a labourer for a 12 arm rope. In both cases, you cook for the labourer(s). However with ‘by day’, the labourer may not do enough to warrant that payment but we don’t have any other option. They make the choice. “Ne ètsi ŋkua, makpæ o” (if you want to be difficult, you will not get labourers to work for you). Now some of the labourers say they don’t want food and they are charging GH¢10.00 for the 12 arm rope. During the last farming season, it cost me GH¢144.00 to clear my two acre farm land.²³

Gladys Gerfiorh at Avatime narrated:

Apart from the cost of clearing the land, labourers charge us heavily for harvesting the rice. 12 arm rope costs GH¢15.00 in addition to food. I paid GH¢270.00 for my two acre farm during harvesting last year. The food I cooked for them was not part of that money but I had no other choice. Two of my nephews were part of the labourers but they charged exactly what others collected. But sometimes when they visit me at home, I give them food to eat but things have changed these days. That is not all; carting the rice home is another. We engage the services of motorists and they charge GH¢1.00 on every mini bag. You see, that is why we the farmers do part of the work because the charges are too much for us.²⁴

For farmers at Weta, labour forms a very significant component of the production, an area where most of the capital is spent on. This is illustrated by the production cost drawn by the

²² Interview with Chaity Kwadam at Avatime, March 20, 2012.

²³ Interview with Justine Osei at Avatime – March 22, 2012.

²⁴ Interview with Gladys Gerfiorh at Avatime, - March 21, 2012.

IDA staff. Mr Deku disclosed that there are times that farmers spend far more than the estimated expenditure.

Table 10: Labour cost (GH¢) for one acre rice farm in both study areas

Area / Item	Avatime	Weta
Clearing/Spraying of weeds	45	4
1 st Harrowing/Seeding	0	50
Reshaping of bunds	0	12
Hand picking	0	110
Bund weeding	0	30
Refilling of mixing bunds	0	40
Scaring of birds	0	35
Harvesting (cutting, packing, threshing,)	135	100
Food for labourers during harvest	20	30
Residual removal from threshing box	0	20
Carting	16	37
Drying, winnowing and bagging	0	30
Total	216	498

Drawing from the table above, the labour cost for farmers at Weta far outweigh that of Avatime rice farmers. However, it is important to note that farmers at Avatime, unlike their counterparts at Weta, do most of the farm work such as seeding, handpicking, scaring of birds, and many more on their own. The difference is that they are unable to quantify those services by paying themselves for the labour. Avatime farmers admit that it is far better to take care of your own crop rather than engage the services of others who may not do it well, resulting in either loss or poor quality of the crop. They therefore choose to perform some important farm tasks especially those directly related to caring for the crops.

Inputs

Rice farmers at Avatime do not use chemical inputs such as fertilizers, weedicides, herbicides, and pesticides. They do not also use modern farm machinery such as tractors, power tillers, harvesters and threshers. At a focus group discussion however, it came to light that though farmers are firm on their decision not to use chemical inputs on their farms, they are willing to use modern farm machines if they have access to them. Charity Kwadam narrated:

We don't use fertilizers and all those chemicals on our farm because our land is fertile. We do not use those chemicals on our farms because when you spray the weeds and broadcast the rice, birds come around to pick most of them. Only few seeds germinate. So we prefer to use the hoe to turn the soil so that the rice can be covered and you are sure the most of it will germinate. You see, when they introduced those chemicals to us, we refused to use them because they are dangerous to human beings. The former secretary to our group was the only person who used them on his farm. He fell ill and died and we all know the chemicals killed him. Even those who don't farm knew that those chemicals killed our former secretary. So we shall not use them. Besides, the land is very fertile so we don't need chemicals. What we need are tractors, power tillers and machines to harvest the rice²⁵

At Weta where farms are mechanized and farmers use inputs, Amuzu stated:

Without inputs, our crops will not do well. The problem is the high prices. Those from the government are cheaper but they always come late so we have to buy the expensive ones from the private shops. Now, we don't harvest as much as we used to, the yields are reducing so if you don't use fertilizer at all, how much will you harvest? As for me, I was here since the beginning of the project and I can tell you that those times, we could harvest between 40 to 50 bags (86kg paddy) of paddy from one acre field. I ever had 50 bags from my field but now, the yield has so much reduced that despite the use of fertilizers, the highest one can get during a major season ranges between 15 to 24 bags. As for the minor season, some farmers even harvest as low as 9 bags. Yet we can't stop fertilizer use because the yield may even be worse.²⁶

Input Use and Yield in One Acre Rice Field in Both Communities:

At Avatime where farmers use no chemical inputs at all and their farms too are not mechanized, farmers said they are able to realise up to 16 bags (1 bag = 86kg) paddy rice. At

²⁵ Interview with Charity Kwadam at Avatime – March 20, 2012.

²⁶ Interview with Charles Amuzu at Weta – April 17, 2012.

Weta where yields thrive on inputs according to farmers, they are able to realize up to 24 bags (1 bag = 86kg) and between 9 to 15 bags when the harvest is poor.

Table 11 represents rice yields of individual farmers in both communities and percentage:

Table 11: Yield from one acre field in 2011 major season(s) and percentage of farmers (1 bag = 86kg):

Area/ Yield (Bags)	Avatime	Weta	Total
Less than 9	0	10	6
9 – 12	0	20	12
13 – 16	75	30	48
17 – 20	25	20	22
21 – 24	0	17	10
More than 24	0	3	2
No. of respondents	20	30	50

From table 11, a significant percentage of farmers harvest between 13 to 16 bags of paddy rice while an insignificant percentage (2) realize more than 24 bags from their farms. Farmers gave varying reasons for the variation in yield. At Avatime, Kwadam recounted:

I usually harvest up to 16 bags from my farm. Sometimes, it is more but not less than 16 bags. But when the rains fail us, you can harvest sometimes up to 5 bags only. But thank God, in this area, the rains always come in time and because we all farm together, I can say our yields have not been too bad.²⁷

At Weta, Ameyo narrated:

Well, last season, I harvested 25 bags from my one acre field. But I can also tell you that most farmers had less than 10 bags.²⁸

Recounting his plight at Weta, Mawuko Amekudi, a cultivator said,

²⁷ Interview with Charity Kwadam at Avatime – March 25, 2012.

²⁸ Interview with Ameyo at Weta – April 19, 2012.

It felt like I lost everything last season. All I had from my one acre farm was 9 bags. The yield was bad.²⁹

Among various reasons cited for poor yield by farmers are lack of capital, poor rainfall, and labour constraints. As Amegatse, a cultivator at Weta put it,

There are times I use the cutlass to clear my field after which I burn the grass because the tractors are not enough. Everybody is waiting for his/her turn and that can delay your farm. If you are late, you either miss the rain or the irrigated water. Your crop will never do well if you are late.³⁰

The above constraints are not the cause of poor yield in Ametorwoyorna's opinion at Weta:

Rice farming is about experience and not about swallowing everything they tell you. See, though they say we should cultivate four buckets of rice in one acre, I have never done so. That is too much for an acre and the rice will be competing for space to grow. Then you don't gain much but if you reasonably broadcast between 2½ to 3 buckets, then there is enough space for the crop to feel free and do well.³¹

Table 12: Inputs and quantities in one acre field at Weta and their prices (GH¢)

Input	Quantity	Unit Price	Amount
1. Fertilizer			
a. N.P.K	2 bags	27	54
b. Urea	1	25	25
c. Sulphate of Ammonia	2	18	36
2. Herbicides			
a. Roundup (Turbo 450)	1 lit	12	12
b. Stomp	1 lit	10	10
c. Condax	10 pieces	0.80	8
3. Fungicides Carbendazium	16 kg	0.25	4
4. Rodenticides			
5. Tarpaulins	2	7.5	15
6. Threshing	2 boxes	7.5	15
7. Sacks (no.4)	60 pieces	1	60
8. Catapult	4	1	4
Total			243

²⁹ Interview with Amekudi at Weta – April 19, 2012.

³⁰ Interview with Amegatse at Weta – April 20, 2011.

³¹ Interview with Ametorwoyorna at Weta – April 19, 2012.

Rice seeds

Several rice varieties are cultivated at Avatime. Apart from Egomu, also known as Evemoli and Kru which are indigenous to the Avatime, several other rice varieties are cultivated in the area. They include “Akpese, Viwonɔ (children’s mother), Lolobi, Idanɔ (Ida’s mother), Efɔne, Òwósówòsó, Martha, Yevumoli (the white man’s rice), Dzinu eve (two months), Togo-Marshall, Nerica and Perfume”. This research discovered that Egomu and Kru were the two rice varieties which were originally brought into the area by the forefathers of the Avatime. The other varieties were introduced into the area by farmers themselves, visitors or the extension officer in the area. The study found out that Nerica for instance was introduced to farmers by the extension officer.

Names of rice varieties among the Avatime evolve from diverse factors. Though the origin of some varieties stated above could not be traced, it is clear that the Avatime have their own means of naming rice varieties regardless of what the original name of those varieties may be elsewhere. Farmers admitted that ‘localization’ of rice varieties is a way of giving them identity in order to make them their own. The study also discovered that the two original rice varieties which were brought by farmers’ ancestors are still cultivated in addition to all the “new” varieties stated above. Apart from NERICA which has maintained its original name among the Avatime, all other rice varieties introduced into the area were renamed by the Avatime. For instance, Akpese, Martha and Idanɔ were named after people who introduced them into the area. Togo-Marshall and Lolobi were named after the country and the town where those varieties came from respectively. Farmers mentioned that Dzinu eve had no name when it came in to the area but since it matures in two months, it was given the name ‘two months’. The study also discovered that Egomu (Evemoli), Kru Akpese, Viwonɔ (children’s mother), Lolobi, Idanɔ (Ida’s mother), Efɔne, and Martha are red in colour and can therefore

be classified as *glaberrima* varieties. The other six, Òwósówòsó, Yevumòli (the white man's rice), Dzinu eve (two months), Togo-Marshall, NERICA and Perfume are white.

Different rice varieties mature at different times. For instance, while Egomu and Martha are early maturing (mature in two months and are harvested at two and a half months). Lolobi, Akpese, Idano, Togo-Marshall, Klu, and Viwonɔ mature at two and a half months and are ready for harvest at three months. Dzinu-eve is ready for harvest at two months.

It was found out that though several *glaberrima* varieties exist in the area, the Avatime mostly use Egomu which is indigenous to them due to the distinguished nutritious and cultural values associated with it. Respondents said though patrons of *glaberrima* rice who live outside Avatime may be conscious of its nutritious significance, their knowledge about the rice is limited to its red colour for which reason they call it 'mòlidzě' (red rice). Farmers admit that most clients are unaware of the existence of the numerous *glaberrima* varieties in the area and therefore are only interested in mòlidzě'.

Seed Selection, Preservation and Storage

At Avatime, processes of seed selection, preservation and storage are all done by farmers. The study found out that these processes were handed down to farmers by their ancestors. Even though farmers admit they sometimes purchase seeds from the market, they added that this seldom happens since they mostly rely on seed reproduction on-farm. According to John Doh, a cultivator at Avatime,

Seed selection for planting during the next season is done through observation. This begins when the seeds germinate. The farmer keeps an eye on the crop to ensure that they all grow at the same height and are ready for harvest at the same time. Sometime, one realizes that some crops grow taller than the rest. When this happens, you cut the top of those tall ones to make all of them equal. Sometimes you uproot the tall ones if they still grow tall after cutting their tops. When you harvest uniform rice, then you can go on to preserve it and store it for planting during the next season. After harvesting, you begin the drying process. The rice is dried each day until all the moisture content in it is dried up. You must be sure there is no moisture content left in the rice. After that, you put the rice in a sack and put it in the room

on a raised platform where it will have no contact with the bare floor. This is done to avoid the rice in coming into contact with moisture which is on the floor. If you don't do that and moisture enters the rice, it will never germinate. The platform is usually made of wood. In the olden days, our forefathers used a clay pot known as 'Ewlo' for storage of seeds but we no longer use it. We store the rice in sacks instead. Once the rice is well dried, no insects can attack it because it is stored in paddy form. Well preserved paddy rice can be stored for over four years without it being contaminated. However, seeds meant for cultivation are only viable within one year. Beyond that period, they no longer germinate.³²

Seed selection, preservation and storage processes are the same at both study areas since all respondents said they reproduce their seeds on-farm but when seeds are contaminated, farmers have strategies to ensure that they look for viable clean seeds. Amuzu from Weta narrated:

Here in Weta, our seeds get contaminated or mixed-up on the drying floor in the field. During winnowing, air blows other seeds which are not likely to be uniform to mix up with others. When this happens, you can't use the rice as seeds; you can only sell it as grain. That's why I always bring my rice home and dry it on my own tarpaulin so I can have clean seeds. But when your seeds are contaminated, you can buy from your colleague farmer or exchange yours with hers or his so that yours can be sold as grain whilst you have clean uniform seeds to plant during the next season. But before you do so, you have gone to the field to observe the rice to ensure that it is uniform. A good farmer will always know the difference between uniform rice and mixed up one in the field.³³

All farmers during focus group discussions admitted that they engage in seed exchange or sometimes purchase from their colleagues or from the market. The table below explains various means through which seeds are obtained among farmers in the two study communities:

Table 13: Origin of seeds planted by farmers

Origin of seed/Area	Avatime	Weta	Total
Own seed	80	43	58
Buy from grain sellers in the market	0	0	0
Exchange with friends	5	27	18
Own seed and buy from grain market	0	0	0
Own seed and exchange	15	17	16
Buy from farmers	0	13	8
No. of respondents	20	30	50

³² Interview with John Doh at Avatime – March 24, 2012.

³³ Interview with Charles Amuzu at Weta – April 17, 2012.

There is evidence from the above table that farmers from both communities use their own seed for planting and engage in farmer to farmer exchange rather than purchase the seed from grain sellers, which seems the least alternative from the table. While Afeafa, a cultivator from Weta revealed that even though she knows where some seeds are sold at Accra, she was quick to add that apart from the high cost, she would rather not buy it in order to prevent the risk of either poor yield or poor marketing since she was unsure if seeds from Accra would be appealing to traders against seeds they currently cultivate. In his view, Amuzu from Weta recounted that:

You can be sure you have viable seed when you reproduce it yourself rather than buy it. Otherwise, it is still better to exchange with your friend because you would have observed the seed in the field from the onset to know that it is clean, and you can also tell from your friend's field if the yield would be good.³⁴

Rose Amoako at Avatime similarly narrated:

We normally reproduce our own seed because we take care of them and know what to do in the field to make the seed uniform for planting. We usually don't buy seed because we are together and know whose seed is good for planting. As for mixed up seed, it happens but not always. Sometimes, we cultivate different varieties in one field. While all other varieties sometimes get mixed-up, Egomu does not. When you harvest, you don't see any other variety in it.³⁵

Even though cultivators at Avatime could not explain why Egomu seeds do not mix up with others, they believe it has something to do with its uniqueness in terms of its high nutritional value. While a bag of exchanged indigenous seed at Avatime is replaced with two after the farming season, cultivators said a bag of NERICA which was introduced to them by the extension officer was replaced with the same amount after harvest but they prefer the indigenous rice to NERICA because a lot of it is lost during threshing in the fields. Meanwhile, corrupted seed which are exchanged at Weta attract no extra charge. They are just sold as grains to consumers.

³⁴ Interview with Charles Amuzu at Weta – April 17, 2012.

³⁵ Interview with Rose Amoako at Avatime – March 24, 2012.

Reasons for Preferred Varieties

Even though several rice varieties exist at Avatime, not all are cultivated for sale. Farmers said they produce what sells in the market in order to satisfy customers' needs. For instance, all respondents cultivate Egomu in their farms because it has high local demands due to its cultural and nutritional values. The high internal demand for Egomu derives from the endangered rice industry at Avatime since the majority of rice farmers have abandoned the occupation. As noted earlier in this study, whereas the cultural significance of Egomu is fundamental to all Avatime, its cultivation in recent times has however been limited only to women and few men at Vane. One disadvantage of Egomu, respondents noted, is the petite nature of its seeds, requiring a lot more to fill "the standard market sack" resulting in its scarcity in the market and its comparatively high price. Cultivation of Egomu is mostly done for home consumption as well as for local market since the local consumers are able to distinguish it from other *glaberrima* varieties. Farmers admitted that Egomu will normally not be found in the open market for external clients unless at specific requests. In addition, all respondents cultivate Egomu every season because it is high-yielding, early-maturing, drought and disease-resistant and does well both in the lowland and the upland ecologies. In case of rain failure farmers said, one does not lose all. Apart from Egomu, farmers said they look out for other varieties which are high-yielding and those that can be easily threshed. As a result, varieties such as Klu, Viwonɔ, and Martha are cultivated by the majority of farmers and sold in the open market since they have the aforementioned qualities. Some varieties such as Òwósówòsò and Nerica for instance are no longer farmers' favourite albeit they are high-yielding but difficult to thresh. As Kwadam put it, "Nerica is difficult to thresh so we don't like it anymore". Even though farmers cultivate Togo-Marshall, they said their interest lies more with the local rice.

At Weta, farmers cited early maturing, high-yielding, good taste and traders' preference for cultivating Togo-Marshall both in the major and minor seasons. No other varieties are found either at the irrigation site or in the marshy area. Farmers said traders are not interested in other varieties and any farmers who plant them will not have market.

Farming Strategies

Various farming strategies observed by farmers are either in response to ecological needs, economical requirements or risk prevention. Mamaga at Avatime stated:

We observe a six year fallow period to allow the land to recoup its lost nutrient. In situations where the land is insufficiently regenerated, we hire land to continue with our farming. The practice helps prevent the land from being destroyed. When the land is good then our harvest will always be good.³⁶

The above contradicts the situation at Weta. According to Halm,

We don't practice bush fallowing here. The land is not even enough and how can you not farm for one season? What will you eat? There is no other work here apart from rice farming. That is why we use fertilizers to make sure that we get something every time.³⁷

Farmers at Weta are engaged in permanent cultivation, a situation which justifies the use of agro chemicals and fertilizers. Though farmers said prices of these inputs are high, they cannot do without them. While farmers at Weta cultivate just a single variety to satisfy their clients, farmers at Avatime cultivate diverse varieties. As noted by Mamaga at Avatime,

What will happen if the rains should fail us? That is why it is good to plant different types of rice. Egomu can do well in the valley but it does well upland too so we always plant it there so that even if the rain doesn't fall, Egomu won't fail. Then we use the valley for other varieties which need a lot of water. There is always some water there so even if the rains fail, you get something. We can't plant one type of rice. It is not good.³⁸

At Avatime, farmers mentioned that they also cultivate other indigenous crops such as cassava, maize, various types of beans, cocoyam, and vegetables such as tomatoes, garden eggs, pepper, etc. which are all meant to supplement the meal at home. It is clear that in the

³⁶ Interview with Mamaga at Avatime – March 20, 2011.

³⁷ Interview with Halm at Weta – April 19, 2012.

³⁸ Interview with Mamaga at Avatime – March 20, 2011.

event of failure of all rice varieties cultivated in the area (which respondents vehemently said is impossible), farmers will still have other food crops in their farms to support the home.

Clearly, these are risk management strategies used to cope not only with uncertainty, but also to preserve biodiversity and conserve the environment. For example the following practice is one strategy which ensures maintenance of biodiversity. Not only that, beans and cocoyam according to farmers, are good source of nutrients for the soil. In addition, in times of uncertainties such as rain failure, farmers still have other food crops to rely on. On the contrary, cultivators at Weta are likely to lose all their investment in times of any uncertainty since they cultivate only a single variety which does not cater for environmental conservation or maintenance of biodiversity. What is more, the persistent use of chemical inputs is also known to have devastating human and environmental effects. What is important here is to note how indigenous farmers do not only cultivate food crops for financial gains but also for various reasons as stated above. Modern agricultural technology does not recognise this or rather lacks the capability to devise such useful techniques in response to other vital human and environmental needs. Without doubt, the need for modern agricultural researchers to get closer to indigenous farmers, listen to them to enable them understand what farmers do and why they do it, needs to be stressed. Until modern agriculture recognises and appreciates the role and relevance of indigenous agriculture, they will be two worlds apart (with the same vision though), in which the underdog continues to bear the brunt.

At Weta, Amegatse recounted:

Production cost is expensive so sometimes, we depend on the rain water. We pay for the water too so when the season begins, we look up to the rains until we are sure the rains won't come then we all meet and ask management to open the irrigated water for us. And to cut down cost, we usually exchange seed instead of buying it.³⁹

³⁹ Interview with Amegatse at Weta – April 19, 2011.

Although cultivators at Weta use irrigated water which averts risk particularly during dry seasons, it comes with cost, hence in order to minimise cost, they also rely on rain water.

Farming Styles

Rice cultivation presently within the Avatime traditional area can be largely categorized under the I-Calculus or the intensive farming style. Labour objects are improved through the process of continuous reproduction aimed at improving both quantity and quality of labour. Instead of chemical fertilizer application to the land for instance, the bush fallowing system is observed to retain the fertility of the soil. Rice seeds are mostly reproduced on-farm by farmers instead of purchasing them from the market. There is also greater farmer involvement in the production process by carrying out activities such as seeding (broadcasting), care for the germinated rice such as hand-picking of weeds ahead of maturity, as well as fencing of the farm to prevent rodents from destroying the crop. Although hired labour plays a role which helps to expand farms in the production system, specific activities are performed by farmers themselves to ensure that the crop is well catered for, resulting in quality output. While farmers' involvement qualifies them as active actors in the production chain, it ensures quality productivity and guarantees the preservation of local knowledge which is handed down to generations. It is also a way of de-commoditization of the production process. As stated earlier in this study, the use of modern farm inputs such as certified seeds and chemical fertilizers, weedicides, herbicides and pesticides is a way through which the agrarian sector is submerged into the market. However, the case of Avatime is different since farm processes still principally derive from local knowledge.

Farm tasks are determined by farmers and not any external institution or technical officer. For example, even though there is an extension officer in the area who visits farmers, it is clear from this study that he does not play a central role in the prescription of farm tasks to farmers in relation to how things must be done on the farm. Instead, such tasks are determined and

carried out by farmers based on local knowledge, long periods of farm practice and observation. A clear case is the introduction of chemical fertilizer by the extension officer which was resisted by farmers who strongly believe that their land is still fertile due to six years bush fallowing practice which is observed by the whole community to ensure continuous retention of soil nutrients. A second attempt to introduce a modern form of transplanting rice seedlings was also discarded by farmers who said the practice is a waste of time since a farmer does very little in a day by trying to “arrange the seedlings in line”. As a result, farmers have maintained the indigenous broadcasting method of planting rice. Again, the introduction of Nerica variety which farmers tried at the beginning has now been discarded by farmers who said the variety is difficult to thresh, leading to heavy post-harvest loss. The analyses above are obvious demonstrations of the independence of Avatime rice farms of market forces and other institutions which have assumed the role of technical experts who externally prescribe farm tasks as with the case of the E-Calculus.

Capital for production is internally generated in view of the fact that farmers do not have access to any credit facility although they desire such facilities. This is done through the sale of surplus farm produce out of which those inputs such as cutlasses, hoes and sickles which cannot be reproduced on-farm are purchased from the market.

Farmers' choice to engage the services of hired labour on their farms is intended, according farmers, to ease the difficult farm work hitherto performed by them, as well as help expand their farms. Even though the use of hired labour offers a somewhat different dimension to the farming system since it involves payment of money and the introduction of ‘strangers’ on the farm, its significance cannot be linked neither to commoditization of the farm process nor scale enlargement because farm sizes still remain small as hired labour equally use cutlasses and hoes. Hired labour then has become a replacement of modern farm machinery which farmers desire to incorporate into the indigenous farming system based on their belief and

understanding that those equipment will help them improve upon productivity which eventually will result in increased incomes leading to reduction of high poverty rates among them. In addition the use of hired labour has also provided employment opportunity for the unemployed local people whose livelihood are dependent on the sustainability of rice production in the area. This labour force includes those who weed the farms, harvesters, carters, and millers.

At Weta on the other hand, the farming system can be said to relate more to extensification or the E-Calculus. The farm has been largely drawn into the market and farm activities are overseen by external institutions. Incorporation into the market is clearly demonstrated through the use of agro-chemicals and fertilizers, whose prices farmers said, keep rising always. All the rice farms at Weta are dependent upon inputs purchased on the market. Once there are changes in the market prices for those supplies, farmers are affected. To balance the equation, farmers are gradually resorting to scale expansion which they believe will help improve their income. This they do by acquiring either rice fields from other farmers on the irrigation project at a fee (GH¢100.00 per acre for a farming season) or by acquiring new plots outside the irrigation project since there are currently no land available on the project. One thing is clear though: that more rice fields mean increased production costs since cultivators will need to use the same inputs. Contrary to this fact, cultivators at Weta still believe expanded fields will contribute to more income. And that is exactly what the technology treadmill does.

Drawing from van der Ploeg's (1990) framework the farming style practised by rice farmers at Avatime is significantly representative of the I-Calculus or the intensive farming style. Farm practices largely derive from local knowledge and farmers are still in full control of what goes in and out of farm work. Not only has Avatime rice farming not been incorporated into the market; it has also not been institutionalized since no external institutions are responsible for prescribing how rice farming should be done. In addition, there are no uses of modern or

scientific technology in the Avatime rice farms. Farm practices still derive from indigenous knowledge. The case of Weta is different. The market and technical institutions largely play roles in determining what and how rice farming should be done.

Conclusion

The findings in this study have been thoroughly discussed to answer all research questions for the study. Cultivators from the two environments are all smallholders who use different production methods to achieve the diverse goals. However, findings so far have revealed how the different logic of the two systems leads to cultivation and marketing constraints. In the case of Avatime, lack of access to capital, labour and labour saving technologies prevent them from extending their cultivation and also limit their production for the market. This was seen in the smaller holdings farmers have, as well as the many cultivators who have abandoned the occupation based on their claim that the farm work is difficult due to lack of labour saving technologies. Today, it is only at Vane where rice is cultivated in the whole of Avatime. At Weta on the other hand, investment in technologies, inputs and irrigation results in high costs of debts that force cultivators to engage in advance sales which results in cultivators releasing their crop when prices are at their lowest. The high costs and debts also limit the products that cultivators can gain and allow traders to capture the premium in prices. The high costs also result in cultivators producing their own seeds which they also consider to be more reliable than seeds from the formal system. Thus, the framing of the importance of modern varieties in agricultural modernisation and Green Revolution approaches does not reflect the realities on the ground.

At Avatime, despite the fact that farming still largely derives from indigenous knowledge and experience, the findings also indicated aspects of modern farming practices which farmers have identified to be beneficial and are willing to incorporate into their system. Acquisition of modern farm machinery such as tractors, power tillers, ploughs, combine harvesters and

threshers are of immense need to farmers. All respondents said incorporating this modern practice into the indigenous system will enable them expand their farms in order to increase output which will add up to national productivity. They also mentioned that the introduction and the availability of modern farm machinery would revive the endangered rice industry at Avatime since those who abandoned the occupation did so based on the tedious nature of the work. Respondents are also keen to access loans which currently are unavailable to them and pointed out those credit facilities especially long term loans from the government will assist them improve upon their current output and minimize labour costs.

However, agricultural policies are not very clear on how subsistent farmers' specific needs should be met. For instance, even though FASDEP II (Ghana's current agricultural policy document) has identified the need to support smallholders to improve upon their productivity, the document has not been explicit on the type of assistance to be given to farmers. In fact, the national focus is seen to be more fixed on commercial farmers than subsistent ones even though they also contribute their quota to the national productivity. The findings of this study have clearly demonstrated how rice production using indigenous knowledge has paid off especially given the quantity of yield derived from the efforts of rice farmers at Avatime who produce rice without the use of inputs. What this means is that given the availability of those farm supplies farmers need, the possibility of doing better cannot be contested.

At Weta where farmers use inputs and farms are mechanized, certified and improved seeds are not cultivated. Instead, farmers have looked for their own seed which has been in cultivation for the past fifteen years. Findings from this study have revealed the high consumer preference for this rice, compelling traders to buy the rice right after harvest without it being dried by farmers. Even though this trend works against farmers' profit margin, the genuineness of consumers' high preference for Weta rice is clearly demonstrated when one easily witnesses frustrations of traders moving from one home to the other and from field to field in search of

the rice during the peak season. Although there is abundant rice at Aveyime and Akuse which are advertised on the airwaves as opposed to rice from Weta, it has become the preferred choice of most consumers of local rice. What is worrying is that, even though the Weta project is one of government's irrigation schemes, no efforts have been made to research into this Togo Marshall variety though the project management is aware of its quality and high market demand. Efforts are rather being made by management to research into other varieties which they hope to distribute to farmers (the researcher witnessed one of these efforts when varieties were brought from Ho and Akuse. The variety from Ho is currently under experimentation on the field under IDA management observation). Clearly, government's investment into developing this rice into "acceptable" market standards through research and provision of good storage facilities in addition to other farm equipment that will prevent huge post harvest loses, and reasonable loan facilities are issues that policy must concern with. Such efforts will also help to maintain the variety which is likely to become extinct when farmers find other varieties which are high-yielding and attractive to the market. Rather than developing, promoting and expanding farmers' interests and choices, national focus has been directed towards the input market which has fastened farmers to loans with heavy interest rates, deepening the already high poverty level among them.

Input use at Weta is synonymous with high yield, and input acquisition is dependent on capital. The situation has become more complex, making it difficult for farmers to detach from loans. More complicated is the unfavourable conditions attached to these loans which deny the majority of farmers of any significant income from their labour. The national policy which has introduced input markets to these smallholders has paradoxically not created conducive marketing condition for them where cultivators can exercise their sovereignty by deciding when and how much to sell their produce. This inaction by policymakers has led to a situation in which farmers are exploited by traders who now determine farm gate prices especially when

prices are at their lowest and creditors are ready to receive their pound of flesh. What the market has done is to make the smallholder farmer a medium for sections of the public – input dealers and traders – to make large volume of profit at the expense of the poor farmer. The situation compares well with that of Avatime where farmers have not received any significant attention from agricultural services and policymakers to enable them improve upon their productivity. This calls into question the feasibility of the national agricultural policy which has as its focus, the support and improvement of agriculture among smallholders. What is more, the creation of the input market as found out by this study has created farmers' dependency on inputs without taking into account the impact of their high prices on the livelihood of farmers.

From the findings, adoption of new varieties especially from the formal system has been low and attempts at introducing new certified seeds to cultivators have not fared too well as demonstrated in the study by the neglect of NERICA rice which Avatime farmers said is difficult to thresh, and the cultivation of only Togo Marshall variety at Weta which farmers have noted is the consumers' preference.

As Amanor (2012) points out:

Within the African context new varieties are often selected that require the use of inputs such as fertilisers, in which many small farmers are reluctant to invest. The promises of miracle seed have largely failed to materialize and adoption rates have often been low. With limited resources plant breeders have attempted to focus on creating new varieties with broad adaptability to different environments and seasons, and varieties that perform well in particular environments but not others are rejected in selection trials to make way for more generic varieties. However, these generic varieties fail to perform as expected under farmer conditions and may become adapted by farmers to particular conditions (as in the case of Obatanpa in minor season maize production in the transition zone) or rejected. The pursuance of generic varieties often results in a limited range of technologies that farmers can choose between and experiment with in their farm conditions.

While cultivators at Weta have mentioned that the soil at Weta could have some good nutrients which support the quality growth and yield of Togo Marshall variety, it is also

important for policymakers to direct researchers to investigate why Togo Marshall is not cultivated by other cultivators. Perhaps, they might have tried it and yet it did not work just as cultivators at Weta have indicated their cultivation of diverse varieties (most of whose names they claimed to have forgotten except Congo and Kabila) which did not do too well until they discovered Togo Marshall. Jasmine 85, a variety which has been heavily promoted by agricultural services does not also feature at Weta. Cultivators indicated that the IDA management has never introduced that variety to them. More importantly, cultivators stated that once there is high market demand for Togo Marshall, they are at least, not too concerned with other varieties. However, that thinking will change as soon as demand is low and yields begin to fall uncontrollably. That is why policy must be concerned with researching into this variety to either maintain it or add more value to it. It is imperative that attention is given to farmers' knowledge and existing indigenous technology which allows farmers to exercise choice and control over what they do. By so doing, new technologies can be built on existing ones based on farmers' choice and preference, as well as its suitability for the specific environment (as seen from the call for mechanization of rice farms at Avatime).

The state of smallholders has deteriorated over time under the guise of markets and modern technology which are mainly controlled by large nations and Trans National Corporations (TNCs). This results from the pursuit of neoliberal policies by the state which promotes top-down agricultural research whose recommendations are pushed down the throat of farmers. As it stands, the various cases from this study have demonstrated how modern agricultural research makes no room for farmers' participation. The findings have also evidenced how modern agricultural research has failed to consider the different smallholder strategies and the recombination of technologies that are worked out by the different categories of smallholders in the context of the constraints and opportunities offered by their farming systems and the nature of their integration into markets. What needs to be done is to reverse the current

research approach by focusing more on farmer-led research since farmers 'have unique and diverse knowledge of their farm systems, farm environments and the socio-economic make-up of their communities. This will contribute to smallholders' effective integration into the market and lead to them benefiting from the market.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

Ghana's agricultural modernisation policies (largely directed by international policies) are for the most part focused on promoting rice cultivation under a single production system driven by external input usage – certified seed, chemical fertilizers, chemical inputs, and technology (mechanization). The concentration on this modernisation paradigm has led not only to a shift away from other specific production environments where food crop including rice cultivation is rooted in diversity using indigenous knowledge but has also undermined the relevance of farmers' ingenuity in adaptation under the different production systems as evidenced in this study. This presents a close-ended system practice which does not allow farming to be seen from the viewpoint of adaptations under the different production systems which represents the reality of what farmers do.

The policy framework of modern agriculture rigidly presumes the existence of one indigenous farming method and one modern way of farming. In reality however, there are various ways of adaptations in farming, in which modern inputs are also adapted. Findings from Weta (where farms are supposed to be modelled after modern farms) revealed farmers do not follow all the modern prescriptions. They are engaged in indigenous seed selection and use. At Avatime, there is evidence that even though farmers do not use modern inputs, they are willing to adapt to labour-saving modern technologies including tractors and harvesters. There are two paths to investment in agricultural development:

- Investment in labour and labour saving technologies
- Investment in high inputs and seeds for increased productivity

Often the labour constraints become the most critical one and this can determine the rejection of the packages which come with agricultural modernisation. This is demonstrated at Weta

where farmers use seed from their previous harvest to save cost for labour-saving technologies such as tractors, herbicides, threshers and combine harvesters. At Avatime on the other hand, farmers openly rejected the technology packages of chemical inputs and fertilizers. NERICA rice variety at Avatime has been ignored due to unavailability of threshers since farmers said the rice is difficult to thresh. On the contrary, farmers have expressed the need for labour-saving technologies. While Weta rice farmers need chemical inputs for the development and superior yield of their rice, such inputs are inconsistent with the needs of the farming system at Avatime, hence their rejection. Agricultural technology often appears to be constraining rather than supportive so that at Avatime, farmers need technologies that they do not have access to. These developments contribute to our understanding of farmers' critical needs in relation to their specific farming systems' needs. Policymakers must relate to farmers to understand these developments to assist them in their policy formulations and resource allocations.

Modernisation tends to work with standardised packages which do not take into account the different micro production systems and capital endowment of the producers so that at Weta, farmers are expected to adhere strictly to modern agricultural prescriptions based on external input usage without any room for local knowledge expertise. However, the ingenuity of the local farmer is displayed through knowledge combination using farmers' own seeds with chemical inputs to achieve results. These developments are proofs that smallholders are innovative and capable of generating their own technologies, and as such must be given room to participate in policy decisions related to the development of their specific new farm technologies. The combination of knowledge systems is a healthy development for agricultural scientists to learn from so they can incorporate them in their packages for smallholders.

Access to inputs require capital beyond what the farmers have yet access to capital is difficult, making modern agriculture appear as a system of constraint rather than support to farmers. This results from the failure between policy and extension and agriculture researchers

to allocate national resources and to develop technologies on existing systems to address farmers' constraints, and to also come out with packages which directly respond to the different labour and input needs of farmers. In absence of these developments, farmers begin to shift resources and economise other things as in the case of using own seeds to save money for labour-saving technology.

This study has revealed that farmers increasingly become defenceless and vulnerable in the face of higher commoditisation of agriculture so that at Weta, farmers have become dependent on credits with poor terms and tougher interest rates but are unable to disengage from them due to externalisation of farm input supply that comes with expensive cost. In effect, farm development becomes rather stagnant and smallholders poorer at higher levels of farm incorporation into the market. Policies and project interventions which are specifically designed to improve lives of smallholders should learn from farm practices directly from the farmers in the field as well as other relevant areas of their lives that influence their farm practices so that the interventions can be more responsive to farm needs. Modern agricultural research should create space for farmer innovative development.

Agricultural research should not only focus on developing new varieties but should also be focused on developing mechanisms at the community level for breeding indigenous varieties and maintaining their purity. The overriding priority of agricultural development research should be based on creating avenues through which farmers can exercise choice and gain support for developing their own strategies rather than boxing them into narrowly restricted packages that may not fit into the system and farmers' objectives, including the play-off between investment in labour and labour-saving technologies, and new seed and inputs, or in other ways of raising fertility and productivity.

Farms under specific conditions which do not follow 'ideal' cultivation processes as projected by modern agriculture conceptions are not unproductive. What is significant is for

policymakers to understand the complex and varied production systems under which farmers, particularly smallholders operate so that in planning technologies, such complexities are considered so as not to deny the poor farmers from increasing productivity and exercising choice in what they consider appropriate for their production systems.

There is potential for initiatives that combine indigenous and modern knowledge of food crop cultivations to enhance production. Policy should be directed at frameworks that enable farmers to display their innovatory capabilities based on their experience and adaptation. Often, policy has been detached from indigenous initiatives by pushing their ideals to cultivators without accounting for specific needs under specific production systems. The situation usually accounts for farmers' reluctance to accept 'modern' farming recommendations. A reversal of the trend, where policymakers would provide space for farmers to contribute to decisions affecting their different production systems would see research carried out in specific production environments that would form the root for policy's response to farmers' specific needs.

Public seed researchers must be resourced by the state to enable them work in partnership with farmers to research into more diverse indigenous seeds which multinational corporations are not interested in. This will enhance farmers' knowledge concerning seed multiplication selection, and strengthen their knowledge on breeding new varieties from mixed-up seeds, giving farmers a wide range of seed varieties to choose from. The initiative will help preserve seeds from the informal sector, and strengthen farmers' capacity to effectively control their own seeds rather than making them dependent on seeds from the market.

Agricultural research is currently based on 'researcher-managed trials' which turn to harness the connection between research-driven technologies and external input use (Amanor, 2012), regardless of their incapability to adapt to specific production systems. There is the need for a more collaborative effort to create a better understanding of specific situations under the

different production systems and their specific constraints leading to the identification of specific conditions under which particular seed varieties can grow well. This can be achieved through information that originates from farmers under the different production systems serving as a crucial guide to farmers' specific needs that agricultural markets must offer.

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APPENDIX 'A'

UNIVERSITY OF GHANA, LEGON

INSTITUTE OF AFRICAN STUDIES

**RICE PRODUCTION AND MARKETING: A COMPARATIVE STUDY AT WETA
AND AVATIME TRADITIONAL AREAS****INTERVIEW GUIDE**

Rice has over the years become an essential part of the Ghanaian economy. Efforts, both at national and local levels are being made to expand the rice production industry and also to improve upon lives of rice producers. The following questions aim at examining rice production and marketing at Weta and Avatime traditional areas respectively. As a rice farmer in your community, you have been chosen to assist this study by providing information on methods used in rice cultivation and also explain reasons for some of the cultural practices in the production process. Respondents' identity will not be revealed to anybody unless you desire that yours be used for the intended purpose.

PART 'A'**Bio-data of Respondents**

- | | |
|-----------------------|--------------------------|
| 1. Age: | 4. Marital status |
| 2. Gender: | 5. Religious affiliation |
| 3. Level of education | |

QUESTIONS

1. Where do you get your seed for planting?
2. What are the qualities you look for in selecting or purchasing the seed?
3. How do you select seeds for storage and preservation?
4. How many varieties of rice do you plant?
5. What are the characteristics of these different varieties?

- ii. Do they do well at the same place or at different places?
6. Are there any socio-cultural values attached to seed selection?
7. How do you store and preserve seeds?
8. Is there any local/community genebank in your town?
9. How many varieties of local rice exist in your community?
10. Do all the indigenous rice varieties still exist?
 - ii. If no, what happened to those which no longer exist?
 - iii. Is there any means to recover those lost varieties?
 - iv. Do you have any plans to prevent eventual loss of any more indigenous varieties? What are those plans?
11. Are there any cultural values associated with local rice?
12. Do you plant modern seeds?
 - i. If yes, where do you get them from?
 - ii. If no, why?
13. Which modern rice varieties exist in your community and how many do you plant in your field?
14. Which of the two seed types would you say does better – local or modern seeds?
15. Which of the modern or local varieties does well and why?
16. How do you improve upon the characteristics of local varieties that you wish to maintain?
17. How does a new local variety evolve in your community?
18. In the last year, how many rice farms did you make in the major season?
19. How many rice farms did you make in the minor season?
20. What was the size of your farm in the major season?
21. What was the size of your farm in the minor season?
22. How long did the land lie fallow before you cleared it?
23. What was the condition of the land before you came to clear it?

24. Why did you not choose better land?
25. Did you clear the land by yourself?
26. Do you use hired labour?
27. How many times did you weed the plot?
28. Who helped you weed?
29. How did you get this land/ who gave it to you/ whose land did you inherit?
30. How much land do you have in total here?
31. Who did you approach to get this land?
32. Did you pay for the land?
33. How much of your land is under fallow?
34. Is it easy to get land for rice farming?
35. Have you shared out any of your land to relatives?
36. If you do not have any available land to farm, what do you do?
37. Is land shortage a problem in this community?
38. What help and inputs do you receive from the government?
39. What has the Weta irrigation done to help the town and its people?
40. What are the bad things that have come about because of the Weta irrigation project?
41. What has been the effect of the rice irrigation project on the production of other food crops and the cost of food?
42. What has been the effect of the irrigation project on availability of labour for help in farming and the cost of labour?
43. When the land was taken for the irrigation project, what was the compensation for the land owners?
44. Did the land owners resist the takeover of their land?
45. Where do you get loans from if you need them?
46. What do you normally use the loans for?

47. Do you have any other source of income apart from rice farming?
48. What is the quantity of rice you plant in your field?
49. How much rice are you expected to plant?
50. Do you use chemical fertilizer?
51. Which types / how many bags do you use?
52. How many bags are you expected to use?
53. Do you use pesticides?
54. How much quantity of pesticide do you use?
55. How much quantity are you expected to use?
56. Do you use weedicides?
57. Which types do you use?
58. What is your knowledge concerning patent laws and what are their implications for small farmers?
59. What are your suggestions to policy makers in relation to patent laws?

APPENDIX B

A Map of the Volta Region Showing Study Areas

