International Journal of Agriculture Innovations and Research
Volume 7, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy):
Received: 18/09/2018 | Accepted on: 28/09/2018 | Published: 04/10/2018

The Rice Value Chain in Tanzania

R. Trevor Wilson
Bartridge Partners, Bartridge House, Umberleigh EX37 9AS, UK.
Corresponding author email id: trevorbart@aol.com

Abstract – **Rice is grown throughout Tanzania and is the third most important food crop in the country. Production is dominated by smallholders farmers operating in a largely traditional system. Upland rice is far more common than the crop grown under irrigation. Yields are low and variable. The rice value chain, from supply and use of inputs, via production and processing to marketing and retailing, is confounded by a plethora of technical, financial and institutional impediments. Fragmentation, lack of organization, absence of control (in spite of over-regulation) and an almost total lack of coordination are major characteristics of the chain. Many participants have more than one role. Goods and services include land, labour, input supply, transport, energy, finance and (perhaps above all and what is most lacking) institutional support. Clearly defined and enunciated standards and a regulatory framework under law are needed. Many of these requirements continue to be weak or non-existent or, more commonly, are not applied in Tanzania.**

Keywords – **Input Supply, Irrigation, Legislation, Marketing, Paddy, Smallholder Producers.**

I. Introduction

Rice[1] (2.99 million tonnes of paddy in 2016) is the third most important food crop in Tanzania after cassava (5.58 million tonnes) and maize (5.88 million tonnes) [1]. Sales of rice also contribute to household income [2] - [3]. Official data indicate that total production currently averages about 1.35 million tonnes. Rice is grown throughout most of the country: Coast, Morogoro, Tabora, Mbeya, Mwanza, Shinyanga, and Arusha Regions each produce in excess of 100 000 tonnes. Almost 20 per cent of farmers are involved in rice production. Most rice is grown by smallholders under rainfed conditions but some small farmers grow 2.0-2.5 ha under irrigation in schemes that are often initiated and controlled by government [4]. Larger farms have larger areas under irrigated cultivation but large scale commercial rice farming is limited to a few private firms who bought their land when the large scale National Agricultural and Food Corporation (NAFCO) schemes were privatized [5].

In recent years, government, private sector and civil society have demonstrated a sustained commitment to realizing Tanzania's agricultural potential. The Agricultural Sector Development Programme (ASDP) 2006-2015 of the Government of Tanzania (GOT) is part of the broader National Strategy for Growth and Poverty Reduction (known from its Kiswahili acronym as MKUKUTA) [6]. A private sector initiative to invigorate agriculture through the 'kilimo kwanza' ("Agriculture First") campaign was endorsed by the government in 2009 [7] - [8].

Government has assigned high priority to rice through its National Rice Development Strategy (NRDS) [9] - [10]. This sought to double rice output by 2018 to provide food security and the potential for export to neighbouring countries[1]. NRDS aims to improve cultivars and input supply, the availability of irrigation, marketing, Research and Development (R&D) and agricultural credit. The major programmes and policies include:

- Fertilizer and seed subsidy and seed R&D;
- Infrastructure development (irrigation and roads);
- An import tax of 75 per cent on milled rice for mainland Tanzania; and
- Removal of the export ban during 2012.

II. Materials and Methods

This study derives from work in Tanzania in 2012 and 2013. A thorough review of the literature was first undertaken. Field visits were made to all the areas in the country where livestock are reared, except the western provinces. Discussions were held with individual participants operating throughout the chain, with focus groups and with technical and administrative personnel in both public and private sectors. Analysis was then carried out according to standard methods [11] - [12].

III. Results

A. *Overview of the Value Chain*

The value chain describes the range of activities required to move a commodity through the various stages that bring if from the first point of production to the last point of consumption. This usually involves a combination, often complex, of physical change, inputs from various producer services, transfer of ownership and delivery. Commodity value chains are increasingly recognized as providing a solid framework for the analysis of the public and private sector stakeholder players within them as well as the overall performance of particular markets [13].

The Tanzanian rice value chain from supply and use of inputs, via production and processing to marketing and retailing and on to the consumer is confounded by many technical and institutional impediments. The chain is fragmented, unorganized, disorganized, uncontrolled (in spite of being over-regulated) and uncoordinated. It is dominated by large numbers of small holder producers, an unknown but undoubtedly immense number of middlemen who operate across every link and a similarly unknown number of small processors and individual sellers who supply restaurants, cafes and street vendors or put products

[1] Rice is the English generic term for the growing crop (although "paddy" is also used in this context), unmilled grain (also sometimes known as paddy), milled grain and the cooked and ready-to-eat product: in Kiswahili the crop and unmilled grain are 'mpunga', the milled grain is 'mchele' and the cooked product is 'wali'.

International Journal of Agriculture Innovations and Research
Volume 7, Issue 2, ISSN (Online) 2319-1473

on the market for the consumer but who mainly lack the technical and financial ability to run it efficiently and profitably. The horizontal and vertical linkages of the value chain are generally weak and uncompetitive and in need of support to strengthen them.

In Tanzania the rice value chain includes multiple horizontal and vertical links from the producer to the consumer. Those involved in the chain include primary producers, traders in paddy and milled rice, processors, wholesalers, retailers and consumers (Fig. 1). Most actors are not specialized and their functions relate to various segments of the value chain.

Fig. 1. Generalized rice value chain in Tanzania (Source: constructed by author).

B. *The Value Chain Map*

A preliminary evaluation of the value chain shows that the whole is suspended from the consumer (Fig. 2). Were a link to the rest of the chain to be broken the whole would be susceptible to collapse. This situation is more or less true for all other links in the chain. Each link takes the product from its immediate predecessor and "processes" it to an output that is used by the next link. Nominally, the value of product increases at each stage until it reaches the consumer. It is possible to provide a succinct list of most of the participants in the chain (Table 1) but pivotal roles are played by the middle links through which all products must pass. Many participants in the chain (Table 2) occupy more than one role. Some small scale producers but especially those of slightly larger scale also act as processors and retailers. Further up the chain some processors are also wholesalers and retailers and operate in both the domestic and export markets. Primary producers may sell rice directly through a market, to a trader or to a processor or may use a combination of all three outlets. A trader can sell to another trader, directly to a wholesale or retail merchant or to a processor or, again, may broaden his option by using a combination of these channels. Processors, especially the smaller enterprises, may buy rice directly from farmers or from traders and sell the products to wholesalers or retailers.

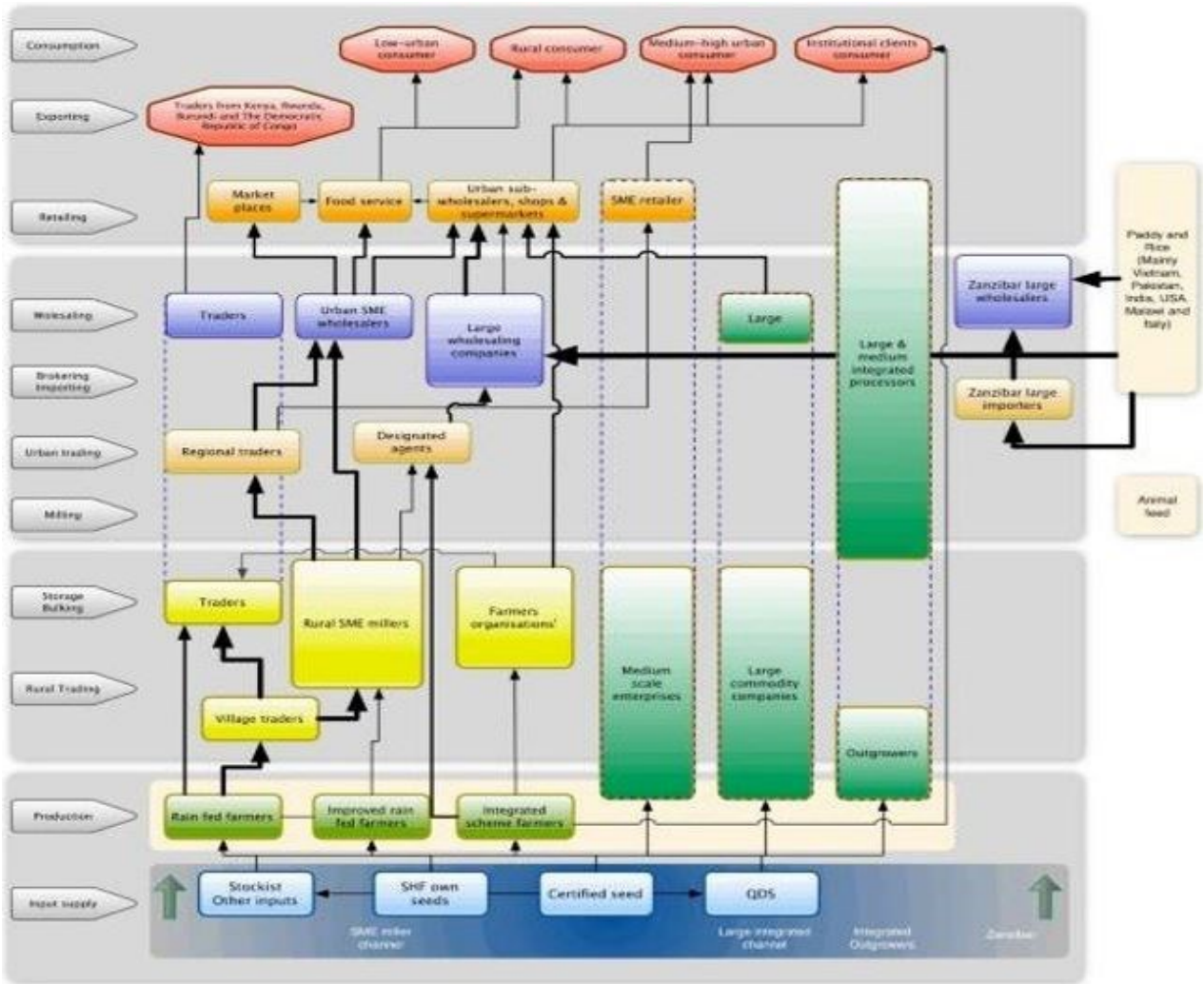

Fig. 2. The Tanzania rice value chain map (Source: constructed by author).

Table 1. Simple listing of supply and service participants in the Rice Value Chain.

Core actors	Service suppliers
Producers (traditional primary producers (rained), improved smallholder production (inputs and limited irrigation), commercial producers (partly integrated enterprises, irrigation, few out growers)	Research Training and Education Institutions Extension services (public and – increasingly – private)
Traders and agents	Inputs (seeds, fertilizers, agrochemicals)
Wholesalers	Transport
Dry rice retailers (rural, urban, supermarkets)	Financial services
Rice product retailers (street vendors, cafes, shops, supermarkets)	Associations (producer, trader, processor)
Importers	NAOS and International Aid Agencies International Rice Research Institute (IRRI)

Table 2. Participants and functions in the Southern Highlands Rice Value Chain

Participant	Functions
Research and Extension	There is considerable research on rice in Tanzania. The International Rice Research Institute has a major presence as do other centres of the Consultative Group on International Agricultural Research (CIGAR). Zonal Research Institutes and other stations of the Ministry of Agriculture, Food Security and Cooperatives (MAC) carry out research on rice but are in need of reliable long-term core funding. Research, in principle, works hand in hand with extension.
Input suppliers	MAC and the municipalities provide limited extension services. The Agricultural Research Institutes (AIR) and Agricultural Seed Agency (ASA) have developed several new varieties and IRRI have released two new types bred especially for Tanzania but demand for and uptake of these is very low. None of the 15 private seed companies in Tanzania distributes improved rice seeds. Government subsidizes fertilizers via a voucher scheme but this benefits large farmers more than smallholder. Financial services are limited and available only to a favoured few.
Producers	Most rice (74 per cent by area) is upland rice grown by smallholder, next in production magnitude (20 per cent) is the improved small scale rained production (with some limited irrigation) and finally (6 per cent) is the large scale production and trading companies which may be partially vertically integrated (and to a lesser extent horizontally throughout growers).
Traders	Primary buyers and secondary buyer-agents operate throughout the country. Much trading takes place at the point of production. There are some larger and a multitude of middle and small sized traders throughout the country. There is some trade by road from surplus to deficit areas but the main long distance trade is towards the Dar es Salaam market.
Processors	Initial processing – threshing out the paddy, drying and storing – takes place mainly at the point of production usually under intensive labour and often primitive conditions. Post-harvest losses are extremely high with as much as 50 per cent of the original grain being lost for various reasons. Local traders and millers further along the chain add value through milling the paddy. Milling is the central hub of processing when the hull (husk) is removed from the grain to become "rice". Most mills have a capacity of 5 to 20 tonnes of paddy per day and these probably account for in excess of 90 per cent of milling operations. The larger millers – up to 120 tonnes per day – generally operate for about five months in each year. Small mills generally produce inferior rice of "standard" quality (30-50 per cent broken) whereas larger mills produce "Grade One" rice with less than 15 per cent broken grains.
Retailers	Retailing of raw milled rice ('mchele') is usually done through local shops or 'duka' by recognized but often informal businesses. Street traders and cafes sell cooked rice 'wali' in various ways almost always accompanied by a vegetable or meat sauce. Better quality rice is available at most supermarkets and some specialized retail shops.

Every link in the chain relies on goods and services in order to fulfil its role (s). At the various stages, goods and services include land, labour, machinery, seed supplies, fertilizers, pesticides, transport, energy and finance. Also required are clearly defined and enunciated standards and a regulatory framework under – and applied by – law. Many of these requirements continue to be weak or non-existent in Tanzania.

The rice sector lacks integration. Transparency, enforcement of regulations, traceability and a conducive business environment are largely lacking [14]. Production/ processing, trading /distribution through wholesalers and marketing /retailing operate largely independently of each other and on a transaction basis with little information sharing.

There whole chain largely lacks governance. No one player controls or drives the development of the chain (although greatest influence is exerted by millers and

wholesalers) which operates on a commodity basis and is transaction- rather than consumer- or customer- based. The chain does not operate as an entity and each link looks to serve its own interests. Any interest in backward integration by larger established traders is impeded by a lack of investment data. Little value is added along the chain. Small producers are particularly disadvantaged because of their distance geographically and physically from the main consumer markets and lack of information on market prices. Factors driving dynamics in the value chain Include:

- Government trade, market, transport and land tenure and irrigation policies;
- Weather (climate) and its effects on production;
- Consumer income and related preferences;
- Investment decisions by large producers, traders and millers in production, storage and processing; and
- Competition from other crops. Uncertainty and risk permeate the value chain.

These factors underlay many of the constraints to growth. The uncertainty varies for the various links in the value chain (Fig. 3) and is caused by inconsistent or poorly implemented policy, a dearth of information, inadequate infrastructure and an inherent lack of trust and strong relationships among the players in the chain. These risks create inefficiencies in the system and discourage capital investment (via debt equity) that can be minimized and capitalized on only by a large fully integrated company.

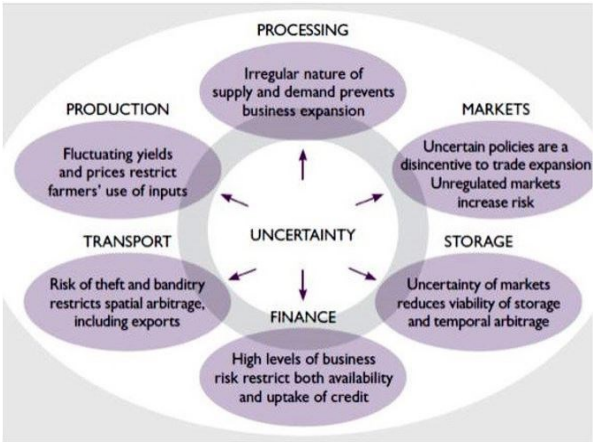

Fig. 3. Uncertainty and risk in the rice value chain (Source: [14]).

Most rice is grown in Tanzania as a rainfed crop. Yields are therefore uncertain and dramatic fluctuations in price result from variable national production causes. Uncertain yields and price fluctuation discourage farmers from investing in improved seed, fertilizer or postharvest grading, sorting or quality improvements. As most smallholders consume most of their output the surplus varies even more than production itself (if 80 per cent is consumed a 10 per cent yield fluctuation leads to a 50 per cent surplus fluctuation). Use of processing plants also fluctuates as a consequence and results in limited investment in processing with many small mills instead of fewer more efficient large ones.

Market contracts are rare and even more rarely enforced [15]. Informal agreements, rice given on credit and sold on commission are the norm. In most transactions both parties to the deal are present and witness the goods change hands. All other transactions involve a significant risk of one party reneguing on the agreement. This uncertainty is coupled to variable bag weights and variable quality and inevitably means that trader margins are increased to minimize the impact of bad deals.

Inadequate storage capacity and distribution means that farmers and traders have little choice on the timing of sales. Without storage facilities farmers are forced to sell during or immediately after harvest when there is a glut on the market and prices are low. Were producers able to store their grain they would be able to sell some in the harvest period and store some until prices on the market rose. Better storage would smooth the supply and demand (and thus the price) for paddy. Poor feeder roads result in very high transport costs.

Low value rainfed agriculture including rice production is considered a risky proposition for banks and investors. This restricts both availability of finance or credit (lenders) and uptake of credit (borrowers): women have particular difficulty in obtaining credit even from informal sources and high interest rates further inhibit uptake [16] - [17]. A lack of understanding of how to evaluate and price this risk contributes to the stalemate on both sides of financial transactions.

C. *Technology Generation*

The technology in use at each link and throughout the chain as a whole is old and outmoded. The sole exception is some new rice varieties. The variety TXD 306 (commonly known as Saro 5, 'Saro' = semi aromatic rice) is high yielding cultivar which has been developed at the Ifakara Research Centre (formerly Kilombero Agricultural Research and Training Institute (KATRIN) and a Regional Rice Centre of Excellence) which has responsibility for rice technology improvement and transfer. Other new varieties, also developed at KATRIN, that were released in 2013 were IR05N 221 (called 'komboka', meaning be liberated) with a yield potential of 6.5-7.0 tons/ha and IR03A 262 (named 'tai', meaning eagle) with and 7.5 tons yield potential. These potentials – if achieved – are a vast improvement on the national average of 1.8 tons. 'komboka' ripens 5-7 days faster than Saro 5 and 'tai' 7-14 days faster. These varieties are moderately resistant to leaf blast and bacterial leaf blight. 'komboka' is an aromatic rice and both varieties are liked by farmers for their long, slender and translucent grains and soft texture for cooking [18]. Commercial ventures such as Kilombero Plantations Limited (KPL) are a source of new technology generation in the Tanzania rice sector. KPL is involved in several stages of the chain but particularly with inputs (improved seeds, fertilizers), irrigation, production, harvesting, storage, milling and distribution to wholesalers. KPL aims to be the lowest cost rice producer in Tanzania and is prospecting best practice technology wherever rice is produced. It is thus influential in introducing new technology to the various levels of the chain in which it is involved. This applies to both KPL's own large farm and its involvement in improving smallholder farming. The main examples of technology generation and dissemination used

by KPL Include:

- Evaluation of 170 new rice cultivars for productivity and quality in the Kilombero environment (obtained by Syngenta, a Swiss global chemical and seeds company, from IRRI in the Philippines and from elsewhere in the world);
- Introduction of the System for Rice Intensification (SRI) for smallholder farmers originally developed in Madagascar to improve yields and quality where it has achieved impressive results (KPL brought the originator of the system to Tanzania to plan its introduction and technology transfer to KPL's smallholder scheme);
- Introduction of mini-combine harvesters from the Phan Tan company in Vietnam to be used by small out growers to improve the efficiency of harvesting and threshing, to maintain paddy quality and to reduce labour costs;
- Burning waste (hulls and bran) from milling to generate heat for drying harvested paddy before it is stored and milled (proper drying of paddy is a critical step in maintaining grain quality);
- storage of dried paddy in large white plastic tunnels on the ground;
- Use of high quality medium volume rice milling machines from the Bui Vanngo company in Vietnam based on advice from postharvest specialists at IRRI;
- Centre pivot irrigation as it allows more efficient water use than traditional flood irrigation techniques and will also allow a dry season crop to be grown (thus two crops per year but from a very capital intensive technology) ; and introduction of conservation farming / minimum tillage practices.

IRRI, with which KPL has developed close links, has an extensive portfolio of cutting edge technology projects that is being implemented on a global basis. One example is the C4 project involving the introduction of higher capacity photosynthesis systems to increase yields but there are many others related to production and postharvest handling (Table 3).

Table 3. Opportunities for technology advances for rice development in Tanzania

Intervention	Time frame		
	Short term	Medium term	Long term
Improved varieties	Hybrids	New generation stress tolerance	C4 varieties
	Stress tolerance	Varieties for conservation agriculture	Biotechnology (drought, heat, salinity, nitrogen efficiency)
Improved systems	Agronomy (site specific nutrient management, alternate wetting and drying)	Ecological intensification and diversification	
	Conservation agriculture	New generation Integrated Pest Management (IPM)	
	Mechanization		
Improved value chains	Postharvest technology	Grain quality and speciality rices	New value added products and by-products

Input Supply and Demand

Improved seeds, fertilizers, chemical and finance are critical inputs. There is limited use of all these inputs across all cropping systems in Tanzania.

The ASDP Performance Report for 2009/2010 indicates that the number of crop farming households using improved seeds increased from 18 per cent in 2002/2003 to 24 per cent in 2007/2008 [6]. Use of chemical fertilizers increased marginally from 12 per cent to 13 per cent in the same period whilst use of insecticides and fungicides declined from 17 per cent to 14 per cent. Fertilizer use across all crops is minimal, varying from 5 kg/ha to 8 kg/ ha whereas annual nutrient depletion is estimated at 61 kg/ha. Tanzania experiences some of the worst soil nutrient depletion in the East African region which makes the case for extensive fertilizer use all the more compelling.

A Baseline Study by KATRIN of 722 randomly selected households across six rice producing districts (Mbarali, Kyela, Sengerema, Bunda, Kilombero and Mvomelo) provided a detailed understanding of rice production. Some 70.1 per cent of the production area was lowland rice, 24.9 per cent was irrigated and 5.1 per cent was upland rice. Most producers cultivate small plots of land ranging from 0.2 to 2.0 ha. The major findings of the study in relation to inputs were: improved production technologies have not been adopted by a wide range of farmers and most farmers are unaware of the technologies available; some 34.5 per cent of farmers used improved rice seed but only 19.0 per cent of the planted area was with improved rice varieties with 18.0 percent of farmers using improved seed producing lowland rice, 14.5 per cent producing irrigated rice and 2.0 per cent producing upland rice;

- Average yield was 2.8 t/ha in the range 2.1-3.4 t/ha with Mbeya (2.8 t/ha) and Morogoro (3.4 t/ha) having the higher yields;
- Yields of 3.6 t/ha were achieved by farmers growing improved compared to 2.4 t/ha for those growing local varieties;
- Yield was significantly higher with irrigated compared to lowland and upland rice;

- There was limited use of improved sowing or planting methods;
- more men than women used improved seed;
- Unavailability of seed was the main reason for not using improved varieties;
- Some 40 per cent of farmers used saved seed of local varieties but even those using improved seed recycled seed for at least 3 years;
- Where retained seed was not used 30.5 per cent of farmers obtained seed from neighbours, 28.8 per cent from local markets, 15.7 per cent from local stores and 10.2 per cent from extension workers ;
- Seed price was considered by farmers to be too high (the high price was due to strict certification regulations which required compulsory certification but contributed to increased transaction costs);
- Demand for improved seed was higher than production (in 2009/2010 only 1.5 tonnes of breeder seed was available to the Agricultural Seeds Agency from which it produced 56.8 tonnes basic seed which in turn was multiplied to produce 550 tonnes certified or commercial seed;
- The most preferred attributes in rice varieties were yield and taste (aroma) – in a separate study in Nzega and Igunga districts heavy yield, good aroma, marketability, heavy grain and disease and drought resistance were sought after traits;
- Some 47.2 per cent of farmers said they applied fertilizers and 41.4 per cent used pesticides (note the contrast with ASDP findings);
- No farmers owned tractors but some hired them;
- Loans were obtained by 16.5 per cent of households (41.5 per cent from microfinance institutions, 25.2 per cent from neighbours and 8.1 per cent from relatives);
- Some 24.4 per cent of loans were used for purchase of seed, 19.5 per cent for fertilizer and 17.1 per cent for pesticides;
- Input subsidy (vouchers) was obtained by 36.9 per cent of households of which 87 per cent was used to buy fertilizer; and
- Each farmer was visited by a village extension officer at least twice during the rice growing season and 51.1 per cent of farmers obtained information on improved seed from extension officers whereas 27.5 per cent got this information from other farmers.

The Rural Urban Development Initiative (RUDI) supports more than 15 000 smallholder farmers in Kilombero, Iringa Rural and Mbarali Districts. According to RUDI less than 10 per cent of these use new improved high yield cultivars. This, in part, at least, is because they have no access to them but also because these cultivars do not meet consumer needs especially in palatability and aroma. As paddy is a cash crop farmers prefer cultivars with strong market demanded. It has also been found that the introduction of improved rice varieties is best done as a package of technologies including other agronomic practices in order for the new cultivars to achieve their potential.

Among the determinants of technology adoption is the availability of credit. Credit has a positive effect on fertilizer use but little impact on the adoption of improved varieties. The National Microfinance Bank (NMB) and the Cooperative Rural Development Bank (CRDB) are the main and largest providers of credit to agriculture in general in Tanzania. NMB has a range of products including loans for farmer groups and also Small and Medium Enterprises (SME) loans applicable to processors. Collateral requirements are strict. Interest rates are based on Treasury Bills plus 1 or 2 per cent and range from 19 per cent for SMEs to 24 per cent for micro enterprises. Both banks provide funds to Savings and Credit Cooperative Societies (SACCOS) and Microfinance Institutions (MFI). Several other banks, including the Tanzania Postal Bank (TPB), National Bank of Commerce (NBC) and Exim Bank (Tanzania) (EBT) operate around the country and could be sources of credit in the future [19]. Government established the Tanzania Agricultural Development Bank in 2015, a proposed in the 'kilimo kwanza' initiative, with the primary objective of which is to provide short, medium to long-term financing to catalyse credit delivery to the agricultural sector and thereby accelerate agricultural growth [20]. In June 2018, however the President ofthe Republic criticized the bank for its failure to deliver credit to farmers [21].

Inadequate access to finance is thus a continuing problem at every stage of the inputs chain. Access to finance is an important determinant of the ability of importers and dealers to undertake their business. Importers and wholesalers, rather than banks, extend trade credit to agrodealers but the latter do not normally offer credit to customers. Most farmers must therefore resort to the proceeds of crop sales to finance the purchase of inputs. Input purchase, however, competes with numerous other needs for cash, including payment of taxes, school fees and food and medicines.

Government's main policy response since 2007 to overcome low use of inputs has been the National Agriculture Input Voucher Scheme (NAIVS), funded by the World Bank, for the purchase of fertilizers and seeds. The NAIVS is delivered through village councils, was introduced in phases and aimed to reach 3 million farmers by 2011. Beneficiaries received a voucher worth about 50 per cent of the retail cost but must find the other half themselves. Vouchers can be redeemed at designated outlets managed by trained agro dealers who have received complimentary training. Fertilizers packaged in 50 kg bags, whether local or imported, are generally too expensive for smallholders. As a response fertilizer is sold loose by retailers which increases the final cost because of spillage, caking and inaccurate scales. The value of the subsidy up to the end of 2011 was US$ 80 million but it is acknowledged that a major challenge is getting the input to the farm gate. One study demonstrated that farmers who used vouchers had improved productivity and better food security [22]. Another source discovered, however, high levels of corruption and collusion among accredited distributers and extension staff [23].

Additional issues that affect the uptake of inputs and especially seeds and fertilizers are:

- Fertilizer demand is subsidy-dependent which limits growth and investment opportunities for suppliers;

- Improved seeds and fertilizers are seasonal and capital intensive products but a retailer's limited inventories and capacity to borrow cannot meet the level of demand such that unavailability is an important constraint to uptake;
- Dealers lack knowledge of input products and have little basic business knowledge which can be both the cause and the effect of low profitability and can lead to high failure rates;
- Most agri-input retail stores are in major towns or along main highways with very few stores in rural areas because of poor infrastructure and high transaction costs; and
- Poor transport -- much of the input supply and most of the outbound crop are transported by head load or by bicycle – greatly increases distribution and marketing costs.

In summary several issues relate to the demand and supply of inputs – recently described as a "nightmare" [23] – and the systems that deliver them. Lack of farmer awareness of new cultivars has implications for the effectiveness and supply of public and private extension services and therefore of technology transfer. New technologies need to be promoted as an integrated package rather than piecemeal for individual actions. Farmers have concerns – in part at east, justifiable – that the attributes of new cultivars do not fully meet consumer needs and therefore affect marketability. There are availability, distribution and cost issues for both improved seed, fertilizer and crop health products that have an impact on input delivery to the farm gate. There are many challenges to dealers because seeds, fertilizer and chemicals are in demand only seasonally. Although rice inputs are unlikely to represent their main business there is risk from unsold stock.

IV. Discussion and Conclusions

Rice production and rice productivity remain low in Tanzania [24]. At the technical level this situation is seen to arise from a lack of a packaged application of basic cultivation techniques. Where extension services have attempted to introduce such practices they have not been taken up by all farmers and adopters have tended to abandon the practices after a short time because of the extra labour required [25]. Rice continues to be the most important crop in many areas as both a food and a cash crop. Yields remain, however, as low as 1 t/ha are due to diseases and pests, weed infestations, lack of and poor quality inputs including fertilizer and plant health products, insufficient water and use of low yielding traditional varieties even though New Rice for Africa (NERICA) varieties are available [26]. The System of Rice Intensification (SRI) [27] has been seen by some, mostly development workers, as a means of improving both efficiency and output [28] - [29]. These conclusions are, however, contested by some researchers s not having been adequately controlled [30] - [31]. In one Tanzania study of SRI the results indicated that a middle-wealth group adopted SRI to a greater extent than wealthier and poorer groups. Access to factors that consistently explained adoption were contact with extension services, land with water and labour. Low adoption is often assumed on reduced exposure to a technology and non-adopters are expected to adopt later but these results suggest, however, that farmers who have not adopted may not do so if the SRI package does not fit their socioeconomic conditions. The practical implications are that to support adoption across all wealth categories extension should focus on promoting individual practices rather than the package to enable farmers to adopt practices that fit their socioeconomic circumstances [32].

Vast areas of Tanzania are suitable for both upland and irrigated rice with abundant water resources for the latter. There now appears to be a more positive political will towards rice production than in the past. The policy environment is also more favourable than hitherto with tax exemptions on imports of agricultural machinery and subsidies to farmers on inputs such as fertilizer and seed. An enabling environment is being developed for private sector participation in production, processing and marketing. It is not clear, however, that rice production has doubled in 2018 compared to 2008, a target that was to be achieved through:

- Better access to improved varieties and improved crop management practices and postharvest technologies;
- Introduction (and adoption) of small - scale labour - saving technologies to improve timeliness and efficiency;
- Strengthened systems for delivery of improved varieties to farmers and other end-users (public and private);
- Enhanced capacity of public and private research, extension and training institutions for rice technology development and dissemination;
- Better agro-processing techniques and facilities and more added-value products; and
- Strengthened collaboration and linkages among national, regional and international institutions involved in research and development [33].

Acknowledgement

Michael Winklmaier, Chief Technical Adviser of the Southern Highlands Food Systems, is thanked for his encouragement and support during the course of the original study. Joan Kimirei was most helpful in the course of the field work and a good travel companion. Peter Jimbuku, driver extraordinary and general factotum, is thanked for his assistance during the course of field work. Numerous participants in all the links of the chain were extremely helpful in providing information.

References

[1] FAO. FAOStat Data. Rome: Food and Agriculture O r g a n i z ation. Available at : http://www.fao.org/faostat/en/#data/QC. Accessed on 18 July 2018.
[2] H.W. Mwatawala, E. Mwang'onda and R.N. Hyera (2016). Paddy production in Southern Highlands of Tanzania: Contribution to household income and challenges faced by paddy farmers in Mbarali District. Scholars J. Agric. Vet. Sci.: 3(3): 262-269.
[3] J.A. Ngailo, J.A. Mwakasendo, D.B, Kisandu and D.E. Tippe (2016). Rice farming in the Southern Highlands of Tanzania:

management practices, socio-economic roles and production constraints. European J. Res. Social Sci.: 4(3): 1-13.
[4] NBS (2007). Results of the 2002-03 National Agricultural Sample Census: Volume II. Dar es Salaam: National Bureau of Statistics, Ministry of Agriculture and Food Security, Cooperatives and Marketing, and Ministry of Livestock.
[5] NBS (2012). National Sample Census of Agriculture 2007/08: Volume IV. Large Scale Farms. Dar es Salaam: National Bureau of Statistics, Ministry of Agriculture and Food Security, Ministry of Cooperatives and Marketing, and Ministry of Livestock.
[6] ASDP (2011). Agricultural Sector Development Program (ASDP). ASDP Performance Report, 2009/10. Final draft, March 2011. Dar es Salaam: Ministry of Agriculture, Food and Cooperatives.
[7] JGDPG (2009). Accelerating pro-poor growth in the context of Kilimo Kwanza. Paper presented to the Annual National Policy Dialogue on 23rd November, 2009. Joint Government and Development Partners Group : Dares Salaam. Available : http://www.tzdpg.or.tz/fileadmin/_migrated/content_uploads/KILIMO_KWANZA_FINAL_Revised_S aturday2.doc.
[8] T Mgeni and Y.I. Bangi (2014). Is Kilimo Kwanza a reliable answer to the paradox of hunger in the midst of plenty in Tanzania? Challenges and Prospects of KILIMO KWANZA (Agriculture First) Strategy in Tanzania. J. Econ. Sustainable Develop. : 5(9): 94- 106.
[9] MAFC. (Ministry of Agriculture Food Security and Cooperatives) (2009). National Rice Development Strategy. Available : http://www.jica.go.jp/english/our_work/thematic_issues/agricultural/pdf/tanzania_en.pdf.
[10] RLDC (2009). Rice Sector Strategy. Improving rice profitability through increased productivity and better marketing focusing on Tanzania's Central Corridor. Dar es Salaam: Rural Livelihood Development Company.
[11] FAO (2009). Red Meat Agribusiness Handbook. Rome: Food and Agriculture Organization.
[12] H. Schmitz (2005). Value Chain Analysis for Policy- Makers and Practitioners. Geneva: International Labour Organization.
[13] M.E. Porter (1985). Competitive Advantage: Creating and Sustaining Superior Performance. New York: Simon and Schuster.
[14] USAID (2010). Micro CLIR/CIBER ASSESSMENT. The legal, policy, regulatory and institutional constraints to the growth of maize and rice in Tanzania - AGENDA FOR ACTION, August 2010. Dar es Salaam: United States Agency for International Development.
[15] J.A. West and R .Haag (2017) the vulnerability and resilience of smallholder-inclusive agricultural investments in Tanzania, J. East Afr. Stud. 11 (4) : 670-691. doi : 10.1080/17531055.2017.1367994.
[16] F. Girabi and A.E.G. Mwakaje (2013). Impact of microfinance on smallholder farm productivity in Tanzania: the case of Iramba District. Asian Econ. Finan. Rev.: 3(2): 227-242.
[17] J.M. Mmasa (2017). Determinants of smallholder women farmers access to informal credit in Tanzania -- A case of Singida and Chamwino Districts. Int. J. Econ. Business Manage.: 3(2): 78-95.
[18] IRRI (2013). New rice in Tanzania to boost production. Manila: International Rice Research Institute. Available: http://irri.org/news/ media-releases/new-rice-in- tanzania-to-boost-production.
[19] SIDO (2009). Consultancy Services to Study, Diagnose and Recommend Value Chains and Concomitant Support Activities. Dar es Salaam: Small Industries Development Organization.
[20] TADB (2015). Tanzania Agricultural Development Bank: "The Farmers' Bank". Dar es Salaam: Tanzania Agricultural Development Bank. Available: https://www.tadb.co.tz/about-us/.
[21] The Citizen. Tanzania: Agricultural Bank Chief Comes Under Fire. Dar es Salaam: The Citizen Newspaper. 4 June 2018.
[22] G.M. Aloyce, D.M. Gabagambi J.P. Hella (2014). National Agri--cultural Input Voucher Scheme impact on productivity and food security of smallholder farmers in Tanzania. J. Econ. Sustainable Develop.: 5(21): 32-43.
[23] ACT (2018). The nightmare of Agro-Inputs in Tanzania. Dar es Salaam: Agricultural Council of Tanzania. Available: http://actanzania.or.tz/news/the nightmare of-agro-inputs-in-tanzania/. Accessed on 20 July 2018.
[24] C.P. Rugumamu (2014). Empowering smallholder rice farmers in Tanzania to increase productivity for promoting food security in Eastern and Southern Africa. Agric. Food Security 2014, 3:7. https://doi.org/10.1186/2048-7010-3-7.
[25] N. Sekiya, M, Tomitaka, N. Oizumi, A.G. Pyuza, R.J. Shayo, A.N. Assenga, et al. (2017). Importance of basic cultivation techniques to increase irrigated rice yields in Tanzania. Paddy Water Environ.: 15: 847- 859. https://doi.org/10.1007/s10333-017-0597-8.
[26] J.J. Mghase, H. Shiwachi, N. Katsushige and H. Takahash (2010). Agronomic and socio-economic constraints to high yield of upland rice in Tanzania. Afr. J. Agric. Res.: 5(2): 150-158.
[27] SRI-RICE (2012). System of Rice Intensification (SRI). SRI International Network and Resources Center (SRI-RICE), Cornell University, Ithaca. http://sri.ciifad.cornell.edu/.
[28] N. Uphoff (2003). Higher yields with fewer external inputs? The system of rice intensification and potential contributions to agricultural sustainability. Int. J. Agric. Sustainability: 1: 38-50.
[29] Z. Katambara, F.C. Kahimba, H.F. Mahoo, W.B. Mbungu, F. Mhenga, P. Reuben, et al. (2013). Adopting the system of rice intensification (SRI) in Tanzania: A Review. Agric. Sci.: 4: 369-375.
[30] A.J. McDonald, P.R. Hobbs and S.J. Riha (2006). Does the system of rice intensification outperform conventional best management? A synopsis of the empirical record. Field Crop Res.: 96: 31-36.
[31] A.J. McDonald, P.R. Hobbs and S.J. Riha (2008). Stubborn facts: still no evidence that the system of rice intensification out-yields best management practices (BMPs) beyond Madagascar. Field Crop Res.: 108: 188-191.
[32] E. Tumusiime (2017). Suitable for whom? the case of system of rice intensification in Tanzania. J. Agric. Educ. Extension : 23 (4) : 335 - 350. doi :10.1080/1389224X.2017.1310660.
[33] ASDP. (2016). Agricultural Sector Development Program Phase Two (ASDP II): Final Report. Dar es Salaam: Ministry of Agriculture, Food and Cooperatives.

AUTHOR'S PROFILE

Richard Trevor Wilson was born in Yorkshire on 4 September 1938. He obtained a National Diploma in Agriculture in 1960, a PhD in Biology and Ecology from the Council for National Academic Awards in 1986 and a DSc in Tropical Animal Production rom the same Institution in 1990 on presentation of a collection of more than 50 publications in international peer reviewed journals after two years' service in the Royal Air Force he grew groundnuts and soya beans and then managed ranches in Tanzania from 1961 to 1970. He subsequently worked on rural development projects in Sudan and Ethiopia from 1970 to 1978. Recruited by the International Livestock Centre for Africa (ILCA) he was Director of its West Africa Arid and Semiarid Zones Programme based in Mali from 1978 to 1983. Between 1983 and 990 he worked for ILCA in Addis Ababa in various senior positions before working with the International Atomic Energy Agency IAEA) based in Vienna but travelling widely in Africa, Latin America and the Far East during 1990 to 1992. Subsequently he managed a Programme for the Improvement of Trypanotolerant Livestock with FAO, based in the Gambia but covering 18 countries in West and Central Africa. Since 1990 he has been a freelance consultant working for FAO, the World Bank, UNDP, IFAD and various national development agencies and has experience in more than 50 countries. He is the author of five books, some 170 scientific papers in international journals and a similar number of Conference presentations. Dr Wilson is a Chartered Biologist (CBiol), a Fellow of the Royal Society of Biology (FRSB), a Fellow of the Linnean Society of London (FLS) and a Fellow of the Institute of Agricultural Management (FIAgrM). Dr Wilson is a recipient of the Silver Medal of the Faculty of Veterinary Science of the University of Khartoum for services to livestock in Sudan and was awarded the Gold Medal of the Commanderie du Gouste-Chevre de France for his work in promoting goats as domestic animals.