

The Role of Development Informatics in Wealth Creation among Smallholder Farmers: A Case Study from Kenya

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Abstract

Development Informatics (DI) seeks to develop and disseminate theoretically-grounded and practice-oriented understanding of information and ICTs for socio-economic development. Good examples of DI application include integration of developmental ICTs in policy, economics, e-agriculture, e-governance, e-business and e-learning. Agriculture promotes the greening of the environment, a common feature in most rural agriculture. Seen from this perspective then DI focuses on technology solutions associated with systems and ICTs that bridge the efficiency gaps, resulting to growth in the economic and social good of all people. They are mechanisms and infrastructure for sharing and exchanging knowledge generated through research at national and regional levels and boosts human capital's ability to rapidly absorb and use them. This paper reports on a DI initiative carried out to smallholder Dairy farmers to enable them fetch better prices for their produce earns from the marketplace. This approach was to diminish the abuse of information asymmetries created by middlemen in the marketplace who use it to exploit farmers. This paper presents an in-depth analysis of how to change this scenario by promoting research in ICTs that integrate agricultural value chain activities of inputs, production care, harvesting, post harvest processing and management, and eventual marketing. The paper proposes the need to propagate research that integrates DI in smallholder farmer activities if knowledge and wealth are to be generated. This way DI emerges as a tool for achieving pro-poor empowerment and hence increases the wealth of a nation. The paper concludes that institutionalization of DI among smallholder farmer initiatives can provide an avenue for achieving success in sustainable DI implementation.

Key Words: Development Informatics; Dairy Farming-Kenya; Smallholder farmers; Agriculture-Kenya; ICT and Development; Famer's Cooperative

Introduction

Development informatics (DI) is a field of both research and practice that creates an understanding of the application of information systems in socio-economic development. DI focuses on developmental issues concerned with the ICT based sectoral practices, such e-economics, e-agriculture, e-governance, e-business and e-learning. As a branch of learning it encompasses the systemic assessment of the role of data, information, knowledge, and ICTs in development activities. Furthermore it integrates the processes

of learning, decision-making and communication, within the wider human, organizational and national contexts. In implementing DI, use of information and ICTs is particularly important as it takes into account the provision of content-based systems through the internet and cloud computing. In a nutshell, research in DI is driven by the desire to integrate ICTs into the economic, social and political contexts of a sector, a region, or a country and therefore uses the existing institutional infrastructure while enhancing process orientation for efficiency gains.

This paper explores what can be done to achieve success in DI by analyzing examples of DI in practice and then presents a case study of how DI is emerging as a source of wealth and knowledge creation at the smallholder agricultural level, by exploiting the power of ICTs driven processes. Arising from the analysis done here, the authors aver that achieving success in DI in economies where institutional infrastructure is still in its *raw state* can only be realized if research in DI is grounded on a societal level implementation of DI initiatives.

The Role of Technology in Community Development

Information and communication technologies are thought by some to offer a firm solution to world poverty. It is argued that ICT will allow poor countries to 'leap-frog' the current resource gap and become engaged within the 'new economy' (Clarke, 2010) Technology is a term used to define the evolution of practical know-how and tools from manual to mechanical, to electrical, to electromechanical and electronic systems. We now have nanotechnologies and the evolution continues. Whatever they are they have to be appropriate for the environment and needs of the consumers. Technology that used at community level has to be appropriate to the needs of the communities. Appropriate technologies are the technologies that apply from the bottom up; addressing technology consumer needs. Information and Communication Technologies (ICTs) are appropriate at individual and institutional layers. They interlink data, or computer, networks with telephone networks using media or devices that facilitate the inter-linkage. Where media are used to interface voice and data through electrical signals they are called multimedia devices.

When used to deliver written materials stored on computer servers that are linked on a global network that interconnects computers, they form the internet, a resource that is used to store data/knowledge from diverse sources and resources. Data and knowledge are necessary for decision making and they too have to be appropriate which is the basis of DI. For appropriateness, an assessment of what technologies needs to be used have to be mapped in the contextual focus of a community. The biggest challenge in DI is that the education system provides packaged learning, where information and technology learning is packaged as useable by institutions of a given layer - from community enterprises to multinationals. With the advent of mobile technologies, the role of development informatics must change, has to change, to make nonsense of the

knowledge silos that academia has created for stream based education. Innovations as discussed next is therefore necessary to achieve this

The Value of Assessing and managing Expectations

In his 3rd Law of the 100 Unbreakable Laws of Business, Brian Tracy explains the Law of Expectations which states that whatever you expect with confidence, whether this is positive or negative, becomes your reality. The law thus avers thus: if you confidently expect to succeed, if you confidently expect to learn something from every experience, if you confidently expect to become wealthy as a result of applying your talents and abilities to your opportunities and you maintain that attitude of confident expectations long enough, it will become your reality. It will give you a positive optimistic cheerful attitude that will cause people to want to help you, and will cause things to happen the way you want them to happen.

Drawing from the law of expectation then, DI has no choice but succeed in delivering the expectation accorded to it. Development workers expect DIs to help societies come out of poverty and manage development resources to that end. This is the reason that makes governments invest in communication infrastructure in line with their expectation from DI. The management of DI expectations will however not be met if clear objectives around the economic activities that DI stakeholders engage with are not formulated.

Managing a DI implementation calls for the implementer, whether institutional or individual, to align the client expectations by defining the operational parameters designed to meet the set objectives. The level of confidence that the client has on the driver of the implementation is a key parameter in the eventual implementation success. Before hiring an implementer one of the necessary qualities a client considers is the implementer's ability to build confidence in the client.

An implementer who trains his eyes on the future will understand that his future success depends on the track record they create so that once the project starts, realistic goals are set. This then helps to influence or manage client expectations early enough, by creating trust. Confidence thus creates another parameter that is so much needed in any developmental initiative -Trust (Morgan, 1994). The learning that an implementer gains by involving himself with one project provides him with an arsenal of tools in knowledge, or experience, that propels him to win the trust in future project implementations. Armed with such experience the implementer is able to guide clients through whatever rough edges, and corners, that there may be in a chosen implementation approach, particularly when the clarity of the approach to the client is blurred. Another critical and another very important parameter in managing expectations is proactive-ness. This helps

in tackling obstacles to what, in proper consideration, are bottlenecks in realizing the goals.

Explaining the link between Development and ICT Innovations

Development is a process through which acceptable living standards for *all people* are achieved. The process enables people to know that they have the right to make choices about their lives. The tag of *achievement of standards for all people* perspective is important as a basis for linking ICTs to development. This is so because the assessment of peoples' standards implies that data on the parameters of what defines standards must be identified, collected, aggregated, classified, and comparison made as necessary. In a collective action focus, development is a cooperative effort of many people working to improve their livelihoods through increased incomes. They set their goals together, and once such goals are set, their responsibility is then to ensure that the goals are met, collectively and individually.

Documenting livelihoods data, such as levels of income and what the sources of earning an income that they have, is also important as it links the livelihoods data to create the desired development perspective onto which ICTs are mapped. If development goals are not achieved, people record their achievement at a particular time, and keep trying. It is critical to document such achievements since development is a continuous process which does not come to a halt because the basic goals are met, or fail to be met in the first instance. To assess success, development should be sustained at a desirable level, parameters that are best documented in a DI to support sustainable development. Which all this means is that there is need to record, to document and to continuously follow up- a feat best achieved with the current, and future breeds of ICTs.

Development is about assessing the living standards of a people. For this reason, the process and approach of capturing data, and assessing the gaps between the various levels of development has to be systematized. When data and gap analysis come in, then a system has to be put in place. In this case, the definition of a system is defined on the basis of the research work of Ludwig von Bertalanffy (1945) in his treatise on models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relation or 'forces' between them. The components that define and drive development are subsystems which must be managed using an information system. Information systems are best understood as defined in the business directory as *the combination of hardware, software, infrastructure and trained personnel, organized to facilitate planning, control, coordination, and decision making.*

The linkage between development and ICTs therefore derives from the foregoing definitions, which then calls for comparison of datasets or system components. Such comparison further invokes the use of information systems comprising of information and communication technologies. We therefore revise the definition of *Development Informatics* from the foregoing perspectives to indicate that they are “*the technology solutions associated with information systems and ICTs created to bridge the efficiency gaps resulting to growth in the economic and social good of all people, otherwise described as improved standards of living*”.

This then defines the discourse of development as predicted that nations which have joined the global market will use ICTs to harness global knowledge that enables them to be competitive and hence attain development. This is the basis that makes nations want to change their local policies to mimic international policies as they embraced ICTs as the next big development tool (Harvey, 2010)

Adaptable Methods to Improve Impact of DI Research and Practice

A method is a technique used to acquire new knowledge, or of correcting and integrating previous knowledge to the current body of knowledge. Used as defined here, the method for improving positive impact of DI has to be based on the mechanisms that provide the foundation of DI research and practice. As previously defined DI ***are the technology solutions associated with information systems and ICTs that bridge the efficiency gaps, resulting to growth in the economic and social good of all people.***

This definition provides us with a way of identifying the methods that can be used to improve the impact of DI. For information systems are in this case one technique that can be used. ICTs that promote efficiency, within the context of growth in economic and social good, are the other technique. The challenge then is to identify the information systems that can be mapped to all people. Given the ubiquity of ICTs, there is no doubt that they present a clear potential for the adoption of such information systems.

The unfortunate bit in the foregoing however, is that the general definition of information systems assumes a corporate institutional setting. Studies on institutions and their strategies have been based on the assessment of performance for competitiveness of organizations. Indeed, much of what has been documented by the author of the value chain; Michael Porter (1980) has been corporate thinking. In his competitive strategy model, Porter fashions the value chain as comprising of the five (5) operational layers of inbound logistics, operations, outbound logistics, marketing and sales, and service activities. He further ascribes four support methods as adoptable for driving corporate strategy. These methods are the firm infrastructure, human resource management, technology development, and procurement. Unfortunately as noted in the assumption of the *firm*, grassroots development efforts are not well resourced to deploy the elements depicted in the Porter Model.

Porter Model derived its foundation from a method that was used in 1942 by Alfred Pritchard Sloan, Jr. (May 23, 1875 – February 17, 1966) at United Motors, later General Motors, when he amplified the need to systematize his style of management. Sloan then defined the 3S Model of Structure, Strategy and Systems which he isolated as needed to turn around the precursor of General Motors. The 3Ss are identified as the drivers for institutional knowledge and have guided the thoughts of present day organizational strategies. One of the Ss is Systems which we now call information systems. Insofar as they are invoked to drive development they are referred to as Development Information Systems (DIS), the study of which is DI.

As noted in the foregoing, while the Porter model is clearly useful in defining the corporate value chain, the resource deployment requirement makes it a challenge to map directly to the grassroots institutional level. While knowledge-bases may exist in hard copy document, or in the minds of leaders, at the community institutions level, the associated knowledge systems, and strategy to integrate the knowledge-bases for effectively efficient management do not exist. What this then means is that the community knowledge systems need to be documented so as to guide research. This is a useful gap in research in what can create information systems for structure-less, strategy-less institutions, which is where DI research and practice come in. This paper therefore provides some insights into what can make a change to sustainable development using DI.

The method of identifying the information systems that can be mapped to communities and community institutional processes is the foundation of DI research. In the view of the authors, the identification starts with studying the potential for social institutions created by communities as the basis for more research. It highlights the need for the object of interaction, which then promotes the need for processes that can then be managed within a systemic model.

In line with the foregoing, DI seeks to identify the social and economic locale of low-end communities, and then help them move to levels that are higher and more advanced. If this is achieved, then the economic gaps and hopefully social gaps are abridged. In agricultural communities, organization is normally done around what communities produce. This makes it possible to bring together individuals with the same interests into social networks called *producer groups* or *common interest groups*. Once the basis of the clusters or groupings, and thus identification of the social form that this takes has been identified, then the form or **Structure/Cluster** (the 1st S in the Sloan's model) has been identified. This then takes us to the next step which is the realization of how to map a **System** (the 2nd S in the Sloan's model) to help address the economic and social gaps. The next step which remains unaddressed is the crafting of the **Strategy** (the 3rd S in the Sloan's model) to achieve desired goals. This is the level that calls for a shared understanding in the expectations of how to achieve economic empowerment. It is here that there is the integration of *Systems* into the *Structure* to formulate a *Strategy* that can

always be used at the farmer organization level and hence use Porter's models to take the benefits of the firm to the farmers and their development perspectives.

DI research has to painstakingly spend as much time as is practical to ensure that the economic activities that communities engage in are studied and mapped to the right technologies, with a view to optimizing the value chain. The intention then would be to identify technologies that can address community empowerment gaps, given the available human resource base at the community level, and the capacity constraints that this comes with.

The contribution of DI research can only be assessed if the object is met as to why systems are to be adopted in an institution. The object of discussion here is the economic goal (wealth and knowledge), which makes all peoples equal and seems to have no equal. To achieve this, a clear analysis of the processes involved in what communities do to earn a livelihood is necessary. This paper is written within the agricultural perspective but uses the institutional models developed over time to demonstrate what is needed at the smallholder agricultural level. A case study that demonstrates how DI is emerging as a powerful intervention is presented. The research in DI and its impact has been studied and is therefore indicated from an agricultural value chain research perspective but can generically be applied to any other value chain focus.

Selected Theory and Model in DI Practice

Theory of Coordinated Management of Meaning (CMM)

The Theory of Coordinated Management of Meaning (CMM) (Pearce, 1976), relies on three basic processes in interactions - coherence, coordination, and mystery. In any interaction, a participant consciously or unconsciously experiences coherence, coordination, and mystery with each step of the interaction further clarifying and explaining how social realities are created when we engage in conversation. The first step, coherence, describes how meaning is achieved in conversation. Each time we enter into dialogue, we have expectations for that new situation. We can still recognize, however, that all interactions are unique and we are able to adjust to new experiences. This then presents the thinking that in conversation; people co-create meaning by attaining some coherence and coordination.

According to this theory coherence occurs when information is passed or told as stories. Coordination on the other hand exists when information is converted to knowledge or stories are lived. The separation of otherwise interlinked perspectives provides a clear framework or model of looking at data, information, knowledge and ultimately wisdom. CMM focuses on the institutional model or relationship between an individual and his or her society. CMM is implemented through a hierarchical **structure** in a manner akin to what is the focus of this paper, the institution within which processes and hence systems can be mapped in the governance and management structures that can then use ICTs. Within CMM technologies are used by locally empowered individuals to organize the

data collected that span periods of data capture. The challenge is to integrate DI so that it is the **system** that provides the glue to bind the many elements of the hierarchical structure in order to achieve the **strategic objectives** of a community or a development initiative

Georgiou's Model of Health Informatics

To implement the knowledge or wisdom seeking model presented in the schema in Fig. 1, we adopt the Sloan's 3S model which was further enhanced by the foundation provided by the theories in health informatics by Georgiou (2002). Dr. Georgiou presents an informatics model consisting of three essential parts: data, information and knowledge. According to this theory, data, information and knowledge are the foundation for establishing information and leading, in turn, to the potential generation of knowledge. The data-information-knowledge-wisdom model is used here as it applies to agriculture. This model derives from the systems model rather than the information science model where information scientists start with knowledge to mine data that yields to other outcomes. The indications of the actions that occur to each output from the data-wisdom chain are the authors' and are what defines the institutional operations, and management, roles.

Where information and communication technology (ICT) devices are used, the model that is best mapped to study their engagement is the Georgiou model to describe the case study that ensues. Here field data is captured through manual or electronic devices in its very raw form of activities or unprocessed records which when processed yields information. Processing the documented activities or raw data creates knowledge through the process depicted in the model shown in Fig. 1. According to this model, data is processed to produce information. Data is itself derived from field data capture tools such as production activities, surveys, market statistics etc.

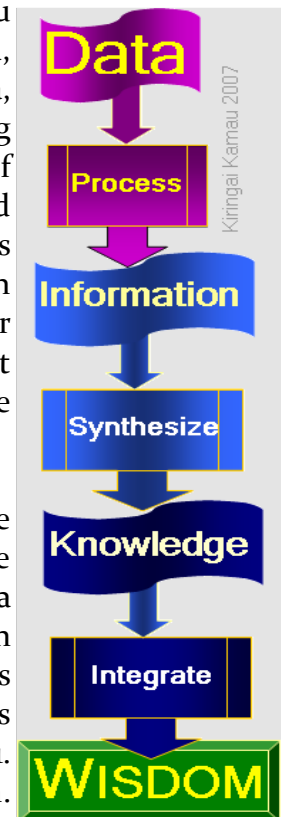


Fig. 1: Knowledge Model

Transcription of the data into digital formats then leads to the process of aggregating the data then analyzing it inline with whatever constraints or reasons that may have created the need for the capture. This processing then yields information. Once synthesized, pieces of information from diverse but related sources provide the basis for decision making. Decisions are made on the basis of the information, and if the desired outcome is successful, then the approach to achieving this success forms a stream of knowledge that decision makers will henceforth invoke in decision making. Decision makers with such diverse knowledge streams gain insights from the knowledge and are regarded to be wise men, or that wisdom has invaded them. While wisdom may not necessarily emanate from digital or organizational transcription it can emanate from observations, listening

and by learning by doing. Whatever the case, then model depicted in Fig 1 holds when the data processing chain is taken as the model of focus.

In smallholder agriculture, the most critical point in the implementation of this model is at the produce data capture. When the data processing and report production is automated, then the gigo (garbage in – garbage out) rule operates. A farmer therefore loses everything from the transcription process which may be due to the inaccuracies of the weighing scale, or the intended, or un-intended transcription errors of the clerk, when the data is captured manually or even in the transmission of the data.

The research currently in progress presents the basis of engagement of various field data capture solutions currently competing for usage in field data acquisition. These may include iPods, Digital Hand Held Scales, Mobile phones etc. Our research demonstrates the use of the Digital Hand Held Scale among other rural community ICTs used in knowledge creation and process management in the dairy sector. A comparison of two community institutions was done which demonstrates that the DI research dream in financially empowering rural communities will come when the impact of the data capture devices used at the farm level ensures universal equity in the measurement of what a farmer produces and delivers to their Common Interest Group (CIG), or any other collective action initiative, that promotes the aggregation of their produce for delivery to the marketplace.

This study demonstrates that appropriate use of DI insulates farmers from the inaccuracies of the weighing devices and the data collection that go with it by eliminating manual intervention. At the same time ICTs also provide farmers with necessary knowledge on markets and production systems. If a farmer's production record is accurately collected, then the wealth making is left to the decision making; outside the processing. It is therefore an information and decision making arena based on market yields. DI therefore scales throughout the agricultural value chain and should invoke different skill sets to ensure wealth creation.

Scaling Up DI Initiatives

As earlier indicated, the key requirement in DI research and the realization of its impact from the same is the isolation of the institutional form, or structure, onto which a system of management and control is mapped. Without the structure or form, no system can ever be realized. A community institution, or enterprise, is driven by the object around which the community's common interest is created. The object is normally the undertaking of the income generation agenda for which processes, and hence systems, have to be created to capture the data on the activities that span the selected value chain. Isolated data capture solutions, or implements will not form a system, they have to be integrated into one unitary whole, which is where the strategic orientation of the development initiative gains visibility.

The scaling up of any DI initiative is based on the viability of the institution, or the collective action initiative itself, based on the economic benefit delivered to the communities. As it is, the key challenge in setting up an information infrastructure is the identification of the host institutional structure in which the information infrastructure will rest. Followed closely by this are the strategies that guide the realization of the institutional objects.

Many development initiatives, while having the structural formation, lack the strategic and system focus, for lack of the requisite human resource, with capacity to put these two into an organizational form. For many DI implementations therefore, the scale is very low calling for a scaled up setup. Identification of a physical institutional infrastructure, akin to a telecentre, which would then house the ICT and organizational infrastructure, is therefore not just important, it is very critical. The strategic leaning needed to scale up then calls for investment in human and technological resources. This then makes the communities enter the domain presented in the strategic orientation of the Porter Model.

A correlation in scaling up is made between DI as presented here with the research outcomes of Leavitt (1965) that observed that *in an organization, the technology employed, the structure, the strategy, individual roles and management process are interdependent*. Accordingly, there is need to ensure the existence of the organization, the informatics infrastructure, the strategy and effective management roles played by individuals, which should be clearly defined in the setup that promote DI initiatives..

Communities achieve the foregoing by identifying the physical infrastructure to integrate the layers of the DI initiative into an infrastructure they may refer to as the market for their produce. While few communities have created the physical infrastructural settings with development information solutions in mind, they start with the market for their produce which they then choose to automate. As noted in our ongoing research, when information infrastructure is implemented, computers and related communication infrastructure may not be economically exploited during slack hours when the data on market produce is not being captured or processed. Economic thinking points to the identification of an opportunity for the DI facilities to be accessible to people who may need to interact with the Internet or exchange email or chat messages. This then provides the next new dimension for the exploitation of DI infrastructure into an income generation perspective – technology solution service provision or a community telecentre.

While the perspective of the point of integration of ICT, and other development support initiatives in a physical infrastructure, referred to as a telecentre is still at the infant level, it is one that has gained currency. A telecentre is a community institution with a focus on the use of digital technologies to support community, economic, educational, and social development so as to reduce isolation. It helps bridge the digital divide by promoting

access to otherwise inaccessible economic, educational, health resources and other information sources. The wider focus is to create an avenue for accessing economic opportunities that community would otherwise not be able to reach out to, and tame the rural to urban migration.

The assessment of what telecentres do and assessing their impact then provides a basis for evaluating the impact of the development informatics. But it is the scaling up of the telecentre that now reflects as the scaling up of a DI initiative. The beauty of the telecentre as a facet of DI is its ability to attract other development actors keen in knowledge and technology diffusion.

Sustaining DI Initiatives

This paper has sought to identify DI as the basis, or object, behind which communities create the data collection infrastructure points – their collective action focus. Since ICTs are a costly resource, the entrepreneurial focus of what communities do is paramount. Any effort that seeks to deliver DI to communities must therefore identify cost recovery avenues. Many development initiatives have been excited by the provision of ICTs as the basis for providing information with a view that the use of ICT itself would provide sustainability. They then get stunned when they find the infrastructure decaying, and eventually dying out, with time, because the economics of the infrastructure was not addressed at the time of setup.

A community DI initiative therefore needs engage in income generating activities; so that it can generate financial resources to cover its operational existence. The following activities derived from the authors' engagement with the telecentres movement provide some of the activities that can be carried out to ensure sustainability:

- i. Provision of information systems resources to productive activities of community collective action initiatives
- ii. Provision of information access points for communities in a manner akin to what happens at cyber café service points
- iii. Provision of online learning points for delivery of such entrepreneurship based programmes as the Cisco Entrepreneur Institute learning curricula or any other eLearning curriculum
- iv. Rented cyber office services for people who use the cyberspace on a regular basis for e-commuting rather than like the casual cyber service user
- v. Delivery of eGovernment services
- vi. Provision of business process outsourcing services at community level
- vii. Provision of community linkage centre for people or programmes that seek to use the strategic and structural benefit of the DI initiative
- viii. Provision of infrastructure to support Agency-Banking/eBanking/mBanking though collaboration with telecommunication providers
- ix. Provision of ICT solutions and technology implementation centers
- x. Backend support to rural ICT infrastructure (Gurstein, 2000)

A Case Study of Successful Connection between DI and Wealth Creation

Githunguri Dairy Farmers Cooperative Society

This model has been achieved in one of the cases investigated by the authors as part of a wider research in smallholder farmer empowerment, institutional governance and wealth creation. The paper therefore presents the outcomes of an ongoing research into what has been identified as a link to DI Research and which can contribute to the discussions on the models that can work to promote the practice of DI. The case study is based on Githunguri Dairy Farmers Cooperative Society. The society is situated some 47 Kilometers North-West of Nairobi in the tea/coffee transition ecological zone of Githunguri District. The cooperative which started in 1963 has had its share of turns of fortunate and misfortune. At one time before the society adopted the DI model presented here, they almost closed down. The challenge then was that the farmers were selling their milk directly to brokers with very little milk being delivered to the society. The society needed to be competitive; so that the few royal farmers can continue delivering milk to them they therefore had to retain very little profits after meeting the society's overheads.

Methodology to achieving results

When the society sought support to turn itself around, the criterion of the 3Ss was placed before them with the following methodology adopted:

1. Integrate a governance structure, which they had but lacked the mechanism of managing
2. Integrate pro-farmer empowerment digital recording system, which they did not have
3. Articulate a strategy for the organization to remove the broker from targeting their producers

The Innovation

The integration of ICTs in the milk collection presents the DI interface through a hand-held electronic scale (Figure 2), calibrated to the nearest 0.01 of a kilogram. The scale is driven with power from rechargeable batteries and has a memory to capture weightment records for 2,500 members doing two weightments per day. The scale is connected to a receipt printer or data is captured on a smart card. The scale captures information then prints the following for the farmer, as well as retain the same for the cooperative to facilitate payment:

- i. Member identification number
- ii. Milk Collection Centre
- iii. Route Number
- iv. Time of weighing the milk
- v. Milk weighed and hence collected from farmer



Figure 2: Digital Scale

vi. Number of milk jars

Once a farmer presents their milk for weighing and suspends it on the scale, that is hang through a hook on a stationary stand, the weight is recorded in the scale by pressing a return key on the keypad on the front panel of the scale seen in Figure 2. This operation can be done remotely to eliminate tampering with the scale using Bluetooth communication. Indeed, the digitally captured data from this ICT device cannot be manipulated in whatever way by a weighing clerk. This was a risk that made the farmers troop away from the cooperative due to cheating of farmers by society clerks before the implementation of the DI solution. The data captured for every farmer, whose details match the pre-recorded data in the scale, is then transferred to a data server at the cooperative. Only registered farmers can deliver their milk to any milk collection center that belongs to the cooperative.

Data so collected is aggregated through custom software at the cooperatives offices, on a daily basis. The milk is delivered to the farmer-owned processing plant and packaging for the market. The plant brands milk products under the name of Fresha. Payment for milk sales is made to the farmers proportionate to their digitally recorded weights on a monthly basis subject to deductions for the factory's running costs, which include:

- i. Cooperative's milk collection overheads
- ii. Farmers credit collections/purchases from the provision stores
- iii. Transport charges for any materials delivered to the farmer's household by the cooperative vans
- iv. Loan deduction from their cooperatives
- v. Artificial Insemination (AI) services, or
- vi. Any other invoiced services that a farmer may have received from the cooperative.

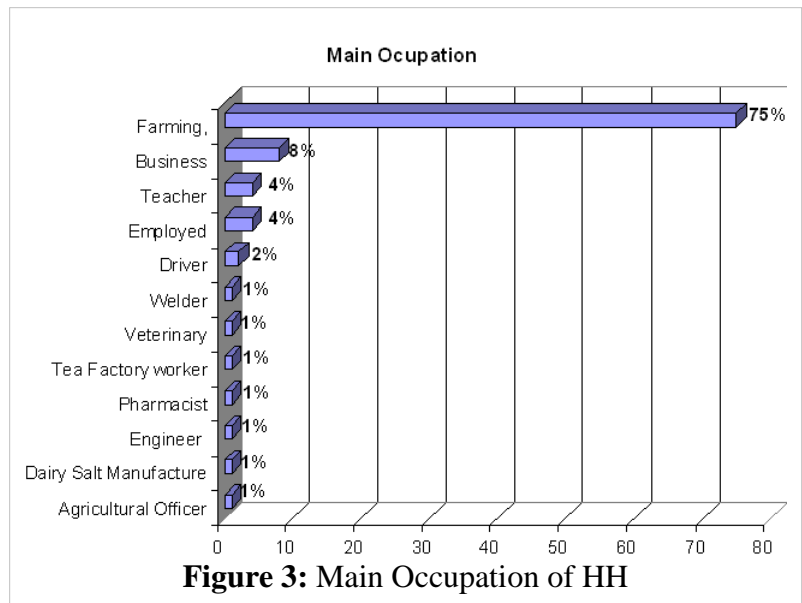


Figure 3: Main Occupation of HH

Case Study Research Outcomes

The case study shows that the main occupation of the household heads is farming (Figure 3 next page). A minimum age of a household head is 23 years, while the maximum is 83 years. The average age of a farmer is 49 years. Most of the farmers are literate with only 3% indicating they do not

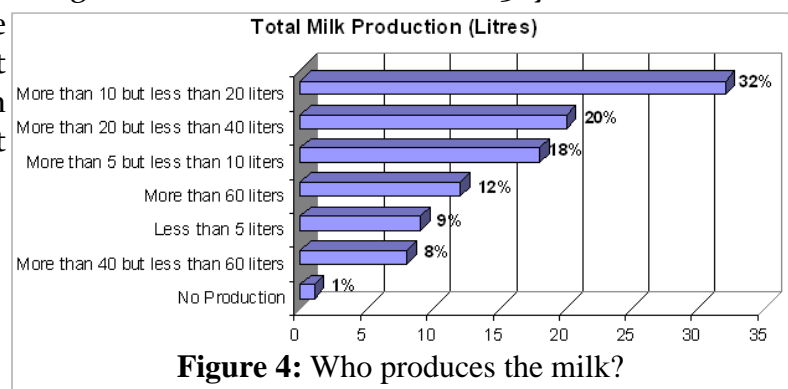


Figure 4: Who produces the milk?

have primary school level certification while, 32% had only primary school certification. Majority of the interviewees have secondary education with a total of 38% of the population having been certified at secondary school level. A sizeable proportion of the interviewees have post secondary education with a percentage of 27% having post secondary certification.

As shown in Figure 4, majority (32%) of the farmers are smallholder farmers delivering less than 20 liters with a few (12%) delivering more than 60 Liters.

While some ICTs were used at the cooperative level, the farmers nevertheless indicated that they value their usage and are beneficial to the households (Fig. 5), with the radio (25%) being the most important ICT. The Digital scale at 24% was ranked second meaning

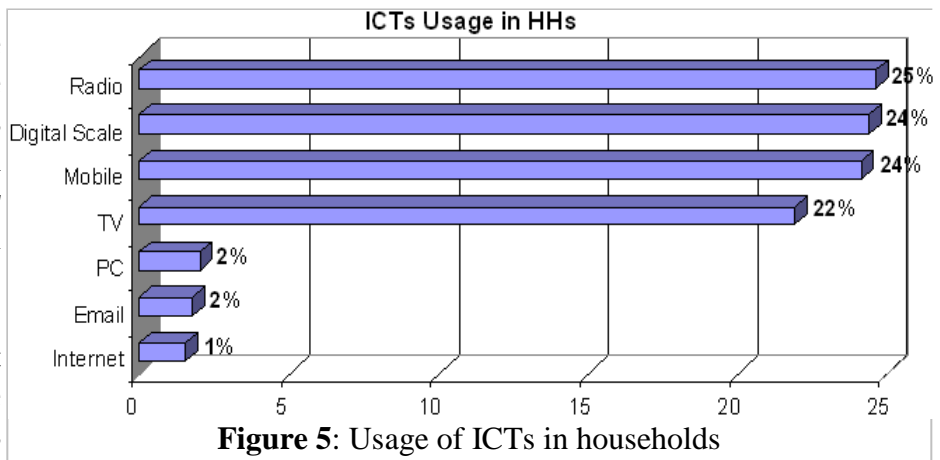


Figure 5: Usage of ICTs in households

knowledge on production which is related through the radio is regards rather high compared to the process management that leads to payments.

The survey revealed that farmers perceived ICTs as creators of wealth (Figure 6), with the digital scale at 29% ranking as the most important technology in generating earnings or contributing to savings. The poor supply of the PC, email and internet which the cooperative has not adopted as a provider of information or used for their dissemination perspective came last with only 1%.

Smallholder farmers are conscious of the effectiveness of management when they get their operational reports and are advised in board meetings from well tabulated institutional performance. They are therefore keen to note the efficiency of the ICTs used in their organization and the swiftness pin payment. When

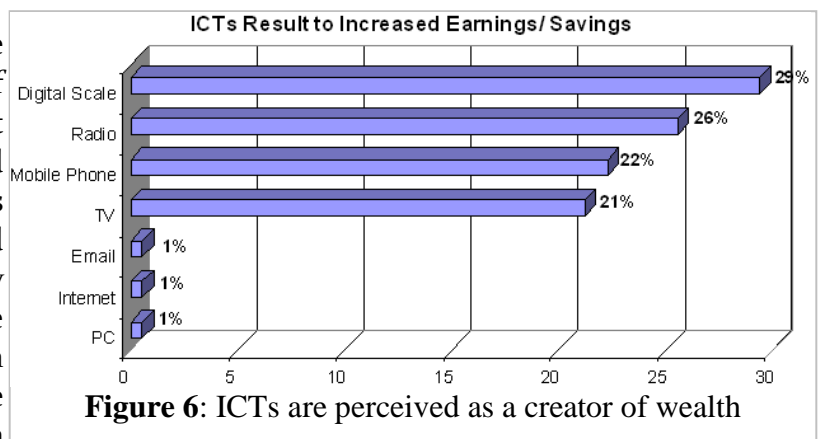


Figure 6: ICTs are perceived as a creator of wealth

ranking the operational efficiencies of the ICTs in terms of eliminating mistakes, bureaucracy and improving board decisions, their responses are as indicated in Figure 7

(overleaf). An equal number felt that efficiency in correcting mistakes and enhancing payment efficiency was the best meaning the field data collection and the internal automation pay dividends in the minds of the farmers. Use of ICTs in Board management was ranked by 29% as the area of use of ICTs as the most beneficial contribution.

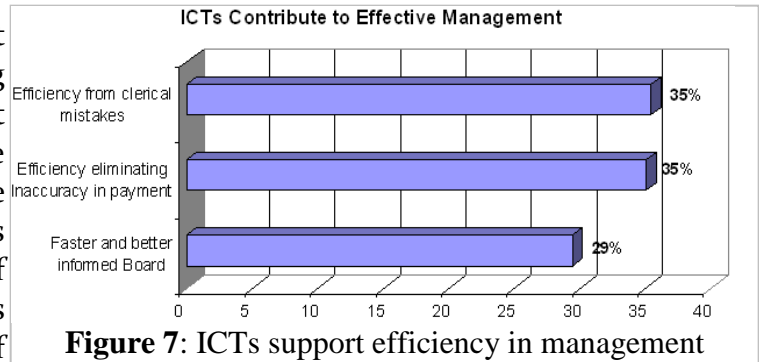


Figure 7: ICTs support efficiency in management

ICTs are a critical element in Development Informatics. The choice of the ICT to deploy for the activities the communities are engaged in is important depending. As shown in Figure 3, for impact to be realized, the mapping of DI has to be done on the basis of the activity where communities spend most of their time, in this case farming. If the activity was different, then the adoption of the ICT would have to be based on that activity. These results amplify earlier observations that institutional mapping is critical if development is to be realized.

Outcomes of the DI in Practice

Since the adoption of the DI practices, the cooperative has turned round and currently prides in a Ksh. 3 billion revenue generation (Ksh. 78 = \$1) for the 12,000 smallholder farmers who deliver milk twice a day to the cooperative. The milk is processed by a processing plant which has been constructed with funds contributed by the farmers from their retained earnings from the milk sales, much as some boost their investment through other sources of income.

Today, a smallholder dairy farmer on average earns some monthly income of Ksh.11, 000 from milk sales, which is more than the starting salary of a Kenyan primary school teacher. Given that dairying is not a fulltime activity, they proportionately earn more than a formal employee earns with the same or lower level of effort and skill. The benefits are even more interesting, for the cooperative has provision stores where farmers collect their animal feeds and other household needs on account of their milk delivery. The farmers are also able to get financial credit on the strength of their milk deliveries. Moreover, since the person residing in the homestead is the woman this effort and the institutional formation has become a pioneer model in women empowerment as they take the earnings from the dairy. The success of the dairying has been attributed to the economic benefit that came with the implementation of the digital handheld scale, which presented transparency in the management of the value chain activities.

Implications of the Research

The outcome of the research is easily discerned. The Githunguri community has created an institution that creates rules on how farmers relate with the market and as seen in the

Figure 7, it has impact on how decisions are made at the collective action level. Use of DIs has created opportunity for increased incomes and enhanced accuracy and efficiency in payment has been realized as noted in Figure 6. The trust that the DI has fostered has made more farmers to engage in dairy production thereby delivering more milk, seemingly increasing the productivity of smallholder dairy farming.

Lack of a telecentre leaning seems to play a role in the perception that the internet and PC have minimal benefits. There is need therefore to implement the telecentre model so that the benefits of online linkage can be seen.

The role of Ethos in Development Projects

The fundamental and distinctive character of development projects is that they have to be understood from a commons perspective. To a large extent, the tragedy of the commons where everybody's business is nobody's business seems to affect the implementation of community businesses a great deal. Given this scenario therefore, the approach to winning the ownership of the larger community is critical. The institutional structure, or form required to run and own the development initiative, needs to be informed through learning; or capacity to inform them needs to be resident with the implementer, whether individual or institutional.

It is very important to sell the benefits to everybody involved in the implementation of the projects. Making the community in Githunguri coalesce around the dairy project was not so difficult since the benefit in earnings was easily understood. But where the benefit is not clear, communities are hesitant to participate, meaning that the promoters of the community good in a technology have to do more to create community buy in. Without a clear benefit, any effort to introduce a technology, whether positively beneficial, or otherwise, as may be the case in the eyes of the implementer, such implementation will face stiff opposition and potential failure.

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