ICT Enabled Agricultural Transformation: Some Notes for Fiji

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Abstract

Food security has become an increasingly major concern, especially due to the effect of climate change in Pacific island countries. Variable topography, different agro-climatic conditions and paucity of information technology in agriculture, contribute to Fiji's low agricultural and livestock production. ICT has great potential to enhance production and productivity of crops, fruits, flowers, livestock and fisheries. This essay discusses some ways in which ICT can help agriculture. ICT based tools such as decision support system, modelling software, e/m-learning, e/m-consulting, management information system and networking tools (mobile phones, radios, wireless networks) can be adopted in Fiji for providing the support necessary for farmers and fishermen to raise their productivities.

Introduction

Agriculture is the main source for providing food and fibre for the growing global population. Sustainability of this source in a rapidly changing global climate, therefore, is a critical issue. Sustainability is defined as a requirement of our generation to manage the resource base such that the average quality of life that we ensure ourselves can potentially be shared by all future generations. Sustainability is a term that has been used extensively in recent years in many aspects of our lives, especially in agriculture (Hanson et al., 2007). FAO (2007) has indicated that sustainable land management will be essential for long term agricultural production. Sustainable agriculture is the eventual management and utilization of the agricultural ecosystem to maintain its biological diversity, productivity, regeneration capacity, and vitality and ability to function, so that it

can fulfil significant ecological, economic and social functions at the local, national and global levels in order not to harm other ecosystems (Dordas, 2009). Increasing population (Hanson et al. 2007) and climate change (Brown 2006) are now challenging issues for agriculturists to develop more sustainable management systems as in no other time in history. It has been projected that global food production must increase by 70% by 2050 (Varshney et al., 2011) to meet the food and nutritional needs of a growing population. Agriculture, thus, will need to move beyond the past emphasis on productivity to encompass improved public health, social well-being and a sound environment (Hanson et al. 2007).

Food security has become an increasingly important agenda especially with climate change in Island countries of the South Pacific.

Fiji, an archipelago with a land area of 18,400 km^2, is made up of over 300 islands, but two larger islands (Vitilevu and Vanualevu) makeup 88% of the total land area. The country is topographically divided into three classes - Flat land (16%), undulating and hilly land (17%) and Steep Mountain land (67%) (Chandra, 1983). Agro-climatically, there are three different zones based on rainfall patterns, viz., wet zone, intermediate zone and dry zone. Various crops, fruit plants and livestock are reported in different zones (Table 1). But because of lack of sufficient information and communication technology in agriculture, Fiji is far away from optimal agricultural production, despite high soil fertility and favourable climatic conditions.

Table 1: Agro-climatic zones, Rainfall Pattern, Major Crops & Livestock

Zones (Rainfall)	Major Crops and fruit plants	Livestock
Wet (3000 mm/yr)	Coconuts, ginger, cassava, taro, yaqona (kava), bananas, plantains, breadfruit and coffee	Dairy and beef cattle, poultry & pigs
Intermediate (2000–3000 mm/yr)	Vegetables, cocoa, passionfruit, maize, sorghum, tobacco, watermelons, sweet potatoes and Irish potatoes	Beef cattle and horses
Dry (upto 2000 mm/yr)	Sugar cane, irrigated rice, upland rice, pulses such as mung and pigeon pea, yams, citrus, masi, pineapples & mangoes	Goats, sheep and beef cattle

Modernization in the agricultural industry requires infusion of necessary agricultural infrastructure; adaptation of new technology for cultivation, and irrigation; development of agriculture enterprises, and new information systems to link with farmers and agriculture stakeholders. Information and communication technologies (ICT) have significant poten-

tial to contribute to enhancing production and productivity of crops, fruits, flowers and livestock.

ICT in Agriculture

The use of ICT in agriculture in Fiji remains low compared to countries with dynamic agricultural sectors. A majority of the farmers rely on traditional knowledge and practices of agriculture. ICT has a tremendous role to play in bridging the communication divide created by geographical barriers. Fiji is a typical case to challenges in reaching out to the individual in rural areas. ICT transfer mechanisms from haves to have not enabled rural people to have access to good education and information in agriculture, human resource development and capacity building and training for advancement of agriculture.

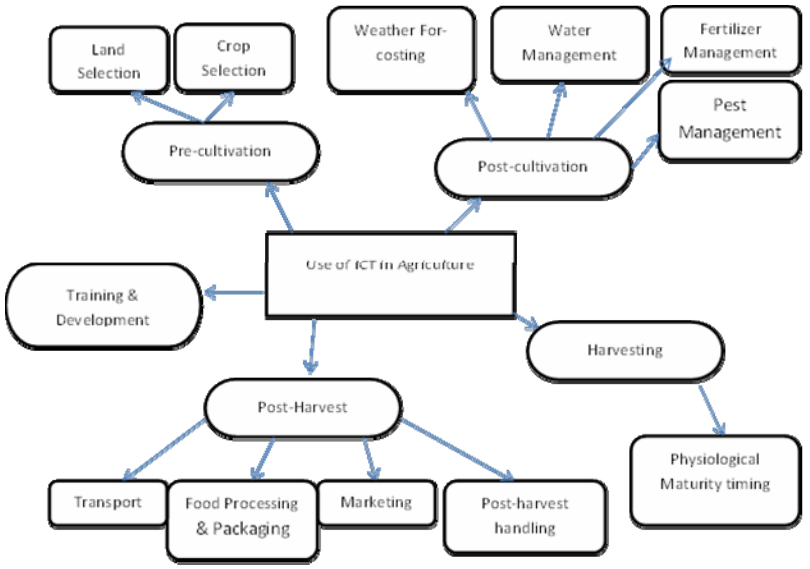
In Fiji's agriculture context, ICT is revealed into two ways: first, as a tool for direct contribution in production of major crops, fruits and flowers, and second, for empowering farmers with current technological and marketing advances in agriculture. ICT can help in agriculture in different ways throughout the farming cycle:

- *Pre-cultivation*: land preparation and selection, including crop selection and management.
- *Cultivation*: including weather forecasting, water management, fertilizer and pest management.
- *Pre-harvest*: including assessment of physiological maturity and right timing to harvest.
- *Post-harvest*: including harvest handling, packaging, food processing, marketing and transport.

Fig. 1 shows the various components in the full process where ICT can intervene. ICT can assist agriculture as a mechanism for training and for empowering farmers with scientific knowledge, and information on farm husbandary and marketing.

In Fiji, small size land holding of farmers is a major barrier for adoption of new technology. This hurdle can be crossed through farmers coming together through co-operative or similar alliances. Farmers are cautious; they avoid risks. Decision Support Systems can facilitate farmers in making proper SWOT analyses and take appropriate decisions for a range of decision making issues, ranging from crop selection in different agro-climatic zones to marketing. Geo-informing system (GIS), remote sensing and e-consultancy provide a platform for agriculture, from prepare of land before cultivation to farm husbandary.

Figure 1: Significance of ICT in Agriculture



Weather information is an important input for agriculture production. Short term weather patterns can also be significantly different within small geographical areas like Fiji. Cost effective models that are able to deliver information in timely manner to different agro-climatic zones is essential. Mali's National Meteorological Service launched a pilot project in 1982 to provide climatic metrological information to farmers, resulting in higher yields in field crops, where farmers earned 80% more income (Anonymous, 2007). Real time meteorological information forecasts help to determine sowing, weeding, irrigating, spraying and harvesting. It helps farmers to make decisions that can save time and resources. For example, with forecasting knowledge that rain is expected, farmers can postpone irrigation schedule, or postpone spraying pesticides or herbicides on their crop and save both the cost of washed off chemicals, time and wages. ICT can disseminate warning or alert for disasters and extreme weather events. The Finnish Meteorological Institute, for example notes that citrus crop is vulnerable to premature fruit drop disease when temperature is low, weather cloudy and leaves wet; specific weather fore-

casts, enabled by properly timed fungicide application, can prevent more than 50% loss of citrus yield. In coastal areas where low-lying land is prone to frequent flooding due to inclement weather, flood warnings are also important for farmers to manage their crops.

Site specific nutrient management decision tool, which provide scientific principles on field specific management of nitrogen, phosphorus and potassium for cereals, has resulted in increased yield, profitability of farmers and showed positive impact on the environment (Pampolino et al., 2007). In Fiji, small scale farmers can practice science based precision farming by developing 'Nutrient Manager' decision support tool, which uses advances in ICT to transform knowledge of readily deliverable nutrient management guidelines to farmers. The e-Krishak program for fertilizer recommendation solution (FRS), launched by the Bangladeshi Ministry of Agriculture is a web based solution to guide farmers on correct dosages and types of fertilizer for specific location and crops (e-agriculture.org). *Green Seeker* that measures crop status and variability in their nitrogen requirements was successfully launched in United States (e-agriculture.org). Normalized differences vegetation index (NDVI) and other environmental factors contribute to yield potential of a crop. NDVI is one of the best known methods, using data available from both satellites and field sensors, for analysing crop growth and accurate fertilizer requirements. Agriculture information system (AIS) could be used to provide information of major pests and diseases for crop and advice crop protection. A mobile app for pest and disease management for crops 'Plantix' was launched in 2016 by ICRISAT in Hyderabad. Farmers can upload a photo of their infected crop and the app will provide a diagnosis and guide for biological treatment options to control pests and diseases (www.icrisat.org/mobile-app-for-pest-and-disease-management-of-crops).

ICT assists farmers to have right information of physiological maturity to inform them to better harvesting of crops and fruits. Since the harvested products are not consumed immediately, post-harvest activities i.e., storage, processing, transporting and marketing, contribute to determine final value of harvest. Farmers need right information for minimizing post-harvest losses and market information on price of commodities to sell their produce from the farm or travel to market. In India Agriwatch (www.agriwatch.com) and e-choupal programme (www.ictportal.com/ruraldev_philosophy/echuopal.htm) support several million farmers with price information, tender and translocation facilities. The set-up of price and market information system implemented in many countries like Uganda, Ghana, Bolivia, Zambia and Tanzania (Stienen et al., 2007) are

useful tools for raising farmer incomes. ICT can be supportive to rural communities in interacting with agriculture stakeholders to strengthen their own capacities and reducing social isolation. ICT is playing an important role in providing a transparent and efficient marketing system. The Indian AMUL programme automates milk collection and payment for its 0.5 million members, thereby enhancing transparency of milk volume and quality which ensure fair payment to farmers (Stienen et al., 2007).

ICT as a potential tool for livestock

Decision support systems are used for management of cattle or poultry farms, covering layout of grasslands, feeding, nutrition, forage management, breeding and waste disposal with the help of hypermedia documents (Shashidhar and Sharma, 2006). The intensive adoptions of ICT is expected to benefit fishermen with respect to fish industry. ICT tools, viz. Geographical Positioning System (GPS), sonar, echo sounder, wireless set, remote sensing, mobile phone and radar, have proven to help increase productivity of fisherman (Ghee, et al., 2012). All these tools guide fisher man to asses exact location of fish to enable catch maximisation thereby saving time, labour and fuel costs. In Fiji these tools could be used for the fishing industry to optimise gains as well as strengthen safety of fisherman.

Constraints of ICT

Following are some major constrains in adaptation of ICT in agriculture

- ICT cost and infrastructure for developing countries,
- Lack of understanding and awareness of ICT tools to be used by small scale farmers and at community levels,
- Lack of marketing of ICT to farmers in developing countries.
- Lack of local language fonts and mechanism for synchronisation of content,
- Internet connectivity to the rural areas, and
- Lack of training of farmers about recent advances of various aspects of agriculture such as correct practices, weather information, irrigation and fertilizer management practice and efficient utilization of different tools of ICT.

ICT and future prospects of agriculture

ICT has a great potential to overcome a number of problems in agriculture. User friendly systems can generate interest in farmers. It is possible to create better connectivity of internet to make ICT services available to all parts of the country. Precision farming is a good option for export quality produce that can augment farmers' income. ICT can play a major role in facilitating the process of agricultural transformation to meet growing demand of producing more in sustainable manner.

Conclusion

Advancing technical knowledge and information availability is expected to enhance production and productivity of crop, fruits and livestock. ICT enabled information delivery system is critical for sustainable agriculture production. Some efforts need to be made to increase the education level of rural people and marginal land holders. ICT based tools such as decision support system (DSS), modelling software, e/m-learning, e/m-consulting, management information system (MIS) and networking tools (mobile phones, radios, wireless networks) can be expended in Fiji for information delivery with respect to weather forecasting, soil nutrient/fertility and pest management; these will lead to enhanced crop production.

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