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## Choosing the right technology

This is one of a series of information sheets for people designing and implementing agricultural market information systems in Africa.

When setting up a market information system, a wide range of technology options are open to you. The choice will depend on various factors: the scale and nature of the system you want to set up, the availability of supporting infrastructure (such as electricity, internet access and mobile phone coverage), and your budget.

The technologies described here are not mutually exclusive: you may want to use a web-based system in an area with internet access and a paper-based one in more remote locations.

### Types of data

A market information system uses three types of data: quantitative, qualitative and images.

**Quantitative data** include farmer profiles, prices, weather, locations, weights, volumes and quantities supplied. Such data can be highly structured: they fill in the rows and columns of a table. They can be collected using forms, forcing the enumerator to enter only certain types of information into certain fields. Because the normal ranges of prices, for example, are known, it is possible to check them automatically for major errors.

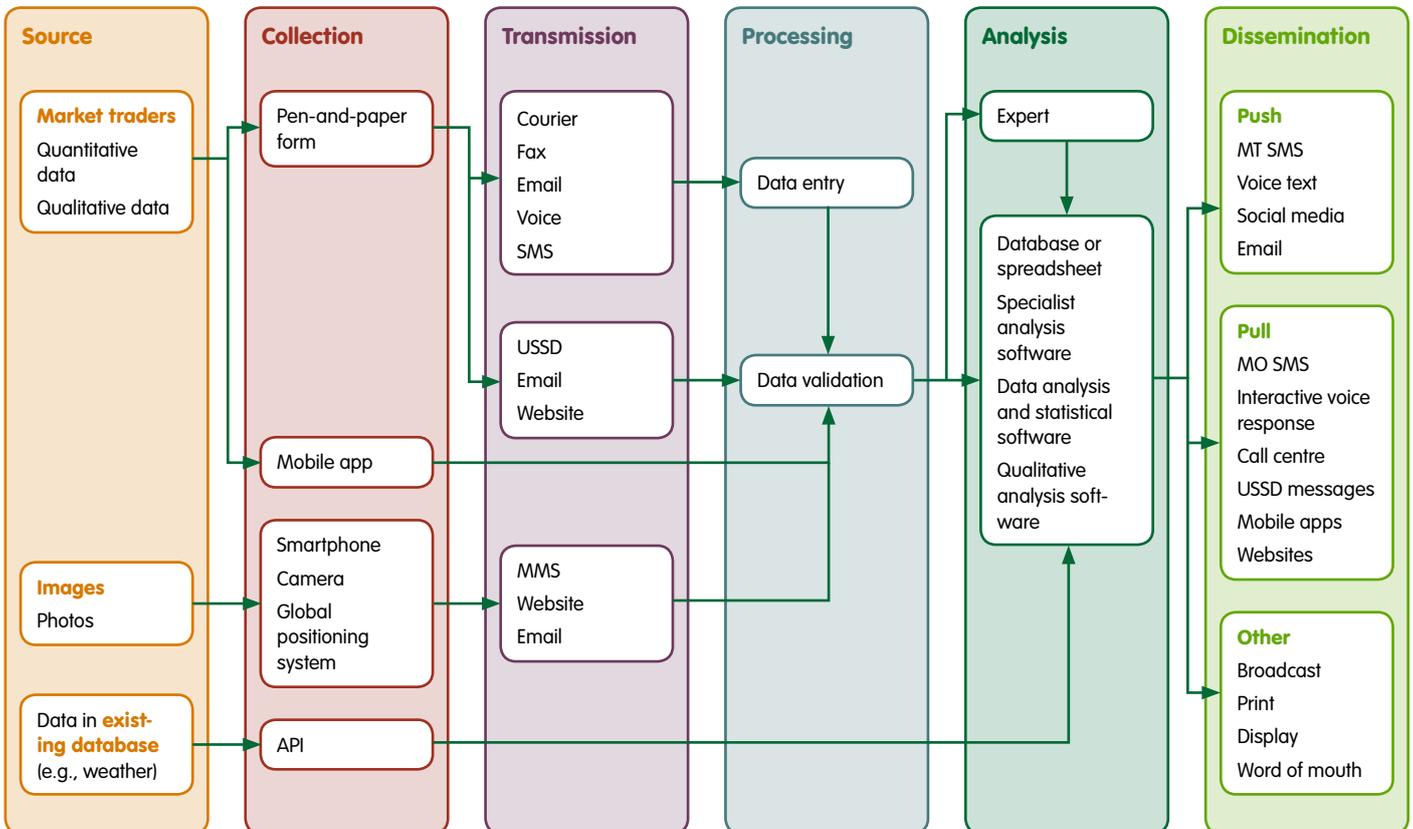


Figure 1. Technologies for gathering, analysing and disseminating market-related information (see text for explanation of terms)

**Qualitative data** are more open-ended. They include market analysis, as well as possibly production tips, farmers' stories, questions and problems. These types of data are harder to structure and require more human intervention to check and process.

**Images** may include photographs (of crops, pests, diseases, individuals, farms or buildings), maps, diagrams, and aerial or satellite images. Smart-phones have cameras that can take good-quality images and send them to a market information service; they can also display images sent by the service.

Figure 1 summarises the technologies used to gather, transmit, analyse and disseminate market-related information.

## Data collection and transmission

Here are some options for gathering and transmitting data. Most are for use by enumerators in the field.

### Pen and paper

This is the traditional, familiar way of gathering information in the field. The enumerator interviews traders, farmers or other people, and records the information on a pre-printed form. The form contains a set of questions with checkboxes or spaces to write in names or numbers. For qualitative data, the form has spaces to write responses to open-ended questions.

The enumerator can fax the completed forms to a central data-entry facility, or send it by a courier service operated by a bus company, or scan it and send it as an email attachment.

Pen-and-paper is still a common way to collect market information, especially in government-run information services. It does not need expensive equipment or even electricity, and enumerators require little training. But it slows the dissemination of information because of the delay in entering the data. There are various sources of error: missing forms, untidy writing and mistakes in data entry. The lack of direct contact with the enumerators makes it hard to query and verify information.

### Pen-and-paper plus internet

Here, the enumerator collects the data on a paper form and then goes to an internet café or back to the office. There, he or she either types the data into a database and emails it to the data centre, or logs into a dedicated website and enters the information in an online form.

The website method is quite common. It is faster than using a courier, and allows the data to be verified immediately – both automatically by the website and by a human operator. The data centre can contact the enumerator directly (e.g., by Skype) to check the information as it is being entered.

It is important to eliminate errors when entering data. In general, safeguards (such as filters to block unacceptable values) are easier to build into databases than spreadsheets.

### SMS

SMS, or "**short message service**" is a text messaging protocol used by mobile phone companies. The enumerator collects the data using pen and paper, then sends an SMS with the information to the data centre.

This is not a common way of gathering information as it is expensive and does not require the information to be structured. However it is a common way of delivering information to users (see below).

The form is titled "FARMER PROFILING FORM" and is divided into three sections:

- SECTION A:** Identification Number (Tick One), Voter's Card, Village ID, National ID, GPS, Surname, First Name, Gender (Male/Female), Date of Birth (DD-MM-YYYY), Mobile Number, Email Address, DNA, Location (District, County, Sub County, Parole, Village), Level of Education (Tick One), Degree, Diploma, S6, S4, P7, None, Marital Status (Single, Married, Divorced, Widowed), Total Household Size, Number of Children, Number of Dependents, Name of next of Kin, Next of Kin's Phone Number.
- SECTION B:** Farm Name, Farming Since, Number of Labourers, Total Size of Land (Acres), Method used to acquire land, Enterprise Crops (Maximum 3), Other Enterprises (Fishing, Livestock Meat, Poultry, Livestock Dairy, Piggery, Livestock Goats), Where do you sell your produce? (Market, Bulk collection store, Buyer comes to my farm, Passing Lorry, Other please specify), Which Information would you like to receive on your mobile phone? (Market Price, Weather Alerts, Loans & Savings, Farming Tips, Market Opportunities), In which language would you like to receive the information? (English, Lumyinkole, Luganda, Luo, Other), Preferred SMS Type (Text, Voice), Are you willing to pay for the information? (Yes, No), Is an organization paying for you? (Yes, No), Which Radio Station do you listen to? (1=Most listened to, 2=Least listened to), What is the name of the agricultural program you listen to?
- SECTION C:** Bank (Do you have a Bank Account? Yes/No, Name of Bank, Do you always know how much money you have earned and spent in the last week? Yes/No, last month? Yes/No, last year? Yes/No), Budgeting (How do you keep track of your income and spending? In writing, Thinking, Not at all, If yes, can you share how much you spend/earned Last week: Earned/Spent, Last month: Earned/Spent, Last year: Earned/Spent).

Figure 2. A pen-and-paper data-collection form used by Infotrade, a Ugandan market information system

## USSD messages

USSD, or “**unstructured supplementary service data**”, is another type of message protocol used by mobile phone companies. The enumerator gathers the information using pen and paper, then dials a number on a mobile phone (USSD numbers start with an asterisk and end with a hash, such as \*123#). This links the mobile with the data centre’s computer, which replies with a series of text questions (such as “What is the price of 1 kg of grade 1 tomatoes?”). The enumerator enters the response, presses the # button, and the system then asks the next question.

A USSD service is expensive to set up but relatively cheap to run, as each sequence of USSD messages counts as only one call, and the enumerator does not need a smartphone: a “feature phone” – a mobile phone with basic features – is enough. The information goes directly into the system’s computer; no other human intervention is needed.

## Mobile applications

Mobile apps are currently the big trend in data gathering. The enumerator needs a smartphone or tablet computer, with a dedicated app installed. He or she enters the data into the app, thus doing away with the need for pen and paper. The data can be entered offline and uploaded to the data centre when the operator goes online.

In one system for use in areas with limited connectivity in Nigeria, the data is passed from one device to another when they are tapped together. That allows the enumerator to pass data to a supervisor, who can upload them when he or she travels to a location with connectivity.

A mobile-app-based system is costly to set up: the app must be programmed and the enumerators must have smartphones or tablets. But it is easy to use and eliminates many sources of error. With increased connectivity and the falling cost of phones and tablets, such apps are becoming the data-gathering technology of choice.

## Voice telephony

Voice calls (and SMS messages) are used mainly for confirmation and coordination with field enumerators rather than for reporting data. The data centre operator can call enumerators to check particular data items, while enumerators can call traders and other information sources to ask about prices.

## Images

The enumerator or field agent can take photographs with a digital camera or smartphone, then send them to the data centre via **MMS (multimedia messaging service)**, direct from the smartphone), through a website or email, or using a mobile app.

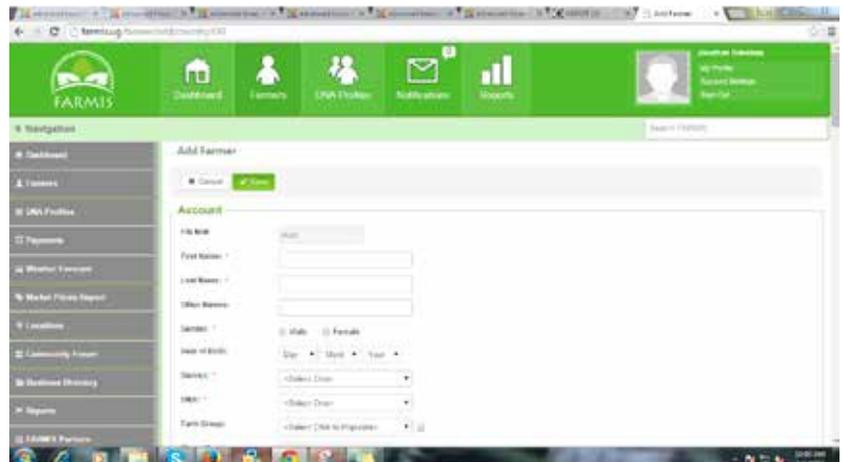


Figure 3. Online data-entry form for FARMIS, an application for managing production data operated by Infotrade



Paul Mundy

*While smartphones are an attractive way of getting information out to people, remember that not everyone has one, and many areas still have no signal coverage. Consider other, lower-tech, channels too.*

**Table 1. Types of software and platforms for analysing data**

Software type	Example	Website
Database, spreadsheet	Microsoft Access	products.office.com/en-us/access
	Microsoft Excel	products.office.com/en-us/excel
Specialist analysis platforms	Esoko	www.esoko.com
	Imagead	www.imagead.net
	Infotrade	www.infotradeuganda.com
Data analysis and statistics	Salesforce	www.salesforce.com
	Microsoft Power BI	www.powerbi.com
	SPSS	www-01.ibm.com/software/analytics/spss/
Qualitative analysis	STATA	www.stata.com
	Atlas.ti	www.atlasti.com

### APIs

An API, or “**application program interface**”, is how you can harvest data from other databases. It consists of a set of request messages sent to the computer hosting the data, along with a structure of the response wanted.

APIs are used to automatically gather data such as weather, production tips and information on crop varieties from the government or other services. They can then be made available to the users of the market information service.

See the sheet on *Collecting data* in this series for more information.

### Processing and analysis

If the data has not yet been entered, it must be keyed in at the data centre. It must then be checked for obvious errors (such as misplaced decimal points) and validated before being added to the database.

Quantitative data can sometimes be processed automatically, with no human involvement. The information is added to the database and the software automatically converts it into the forms required: spot prices, averages, ranges, summaries, trends and forecasts, along with associated graphs.

Mostly, though, semi-automated processes are used, combining automatic processing with human support. The data are cleaned manually, organised and structured before they are fed into the software to generate the outputs required. Experts may also interpret the data to produce reports or forecasts.

Qualitative data are best processed by people. Some programs such as Atlas.ti and SPSS can do content analysis of such data, but they must be used with care to avoid losing the critical meanings.

Various types of software can be used to analyse the data (Table 1).

See the sheet on *Data analysis and packaging* in this series for more information.

### Dissemination

You can get information to your clients in many different ways. The options include broadcasting (radio and television), print (newspapers, magazines and newsletters), display (bulletin boards, noticeboards), word-of-mouth, internet and mobile. You will probably want to use several to reach as many people as possible.

Here we focus on technologies for the internet, mobile phones and tablets. See the sheet on *Disseminating information to your clients* in this series for more information on the other channels.

### SMS

Many services send out text messages to clients’ mobile phones by SMS. Messages may be of two types:

- **MT**, or “**mobile terminated**” messages are where you automatically send out customised messages to customers who register to get them. Such a service is also known as **push**, because you “push” out the messages to recipients. These messages will probably form the bulk of your SMS traffic.
- **MO**, or “**mobile originated**” messages are where the client sends a keyword by SMS to a dedicated number, and gets an automatic SMS with the requested information in response. This service is also known as **pull** because the recipient “pulls” the information from the market information service. It will probably account for only a small proportion of your SMS traffic.

### Voice text

This is the audio equivalent of “push” SMS: it is useful for clients who are less literate or who prefer oral rather than written information. The client subscribes to the service. Every day (or week) at a specific time, his or her phone rings, and a pre-recorded short voice message is played. This voice service is more expensive than SMS, and there is no written message to remind the customer later what the message said.

### Interactive voice response

This is the voice equivalent of “pull” SMSs. The client dials a number and navigates through a series of voice prompts to the desired content. He or she can do this either by pressing numbers on the phone keypad, or by answering orally (“yes”, “no”, “one”, “two”, etc.). Speech-recognition software then converts the voice responses into digital format. Once

the client has reached the desired content, the system plays a pre-recorded voice message.

### Call centre

Interactive voice response can lead the client to a human operator, who can provide hard-to-standardise information such as farming advice and problem solving.

### USSD messages

The user dials a number (such as \*123#), and gets a series of text questions. He or she responds by pressing numbers on the keypad. Each response generates a new question, until the client arrives at the desired content.

### Mobile apps

Used on mobile phones and tablets, these can provide a wide range of information in text, image or audio form to clients with an internet connection (and the money to buy the device). You may have to design apps to work with different mobile phone operating systems (Android, iOS, Windows Phone) to ensure that your customers can get your service.

### Websites

Websites allow you to provide a full range of information to clients in text, image and audio forms. They rely on the client having a computer or smartphone, an internet connection, and the skills to navigate to your site.

### Social media

The most common social media are Facebook, Twitter, WhatsApp and Pinterest. They are currently used mostly for announcements and public awareness rather than to disseminate market information. There is potential to use them more.

### Email

You can use email to send subscribers market information, links to additional information on the internet, and announcements and other news.

### Build or buy?

Should you try to build your own market information system software, or should you buy and adapt a ready-made system?

If you have the in-house capability to build your own software, and it is a core part of your business, then you might consider building your own. But if you do not have the capability in-house, and if your business is more in market information rather than software development, you are better advised to buy. Rather than trying to reinvent the wheel, it may be better to buy a package that you can adapt to suit your needs.



Paul Mundy

*Remember the old marketing saying: "the customer is king". Here, both the fisherman and the trader may be your customers. Keep their needs central to the design of your market information system.*

If you buy, select an established, reputable software vendor, check that the software serves your needs, and make sure that it can be customised to do what you want.

Here are some things to consider.

### Build Advantages

- **Custom-made.** You can customise the system to your specific needs.
- **Control.** You keep control over the system and the data in it. You can ensure that the final product is the best quality.
- **Confidentiality and security.** Because you control the system, you can ensure that the data, including personal and financial information, can be kept safe and that you are complying with government regulations. But remember



Farmers and traders frequently do business at the side of the road. A market information system can make life easier for both – and can help make the value chain more efficient

that building a secure system is difficult: it may actually be safer to buy one.

- **Sale.** Once you have built your own system, you can sell or license it to other organisations.

#### Disadvantages

- **Time and cost.** Building a system from scratch can take a lot of time and money.
- **Local expertise.** Skilled programmers are scarce in many countries, and they attract high salaries. Can you afford to keep them?
- **Maintenance.** You will need to update the software continually to adapt to changing technologies, prevent security breaches and add features.

#### Buy Advantages

- **Quick.** Off-the-shelf software is faster to deploy than applications built from scratch.
- **Cheap.** Buying or licensing software probably works out cheaper than trying to build your own.
- **No maintenance.** Reputable vendors will provide maintenance and upgrading.
- **Broad applicability.** Successful software vendors have a wide customer base and cater to a variety of needs. Chances are that the software will cover your needs.
- **New features.** Vendors continually enhance their applications to keep up with the competition.
- **Flexibility.** You can choose among several software vendors, or among the different packages offered by a particular vendor.

#### Disadvantages

- **Lack of control.** You cannot control the direction the software may develop in. The vendor may discontinue certain features, make them harder to use, or add features you do not want.
- **Customizability.** It may be difficult or impossible to customise the software to your needs. Check that it is possible to do so before you buy.
- **Confidentiality and security.** Your data may pass through someone else's system. So check that the information remains secure and confidential.
- **Risk.** What happens if the vendor goes out of business, or discontinues this particular application?
- **Transferability.** You may find your data are stuck in a particular proprietary system, and cannot be transported to another system.

## Agricultural market information systems in Africa

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