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Education for people and planet:
Creating sustainable futures for all

Measures of learning and teaching material availability and use in sub-Saharan Africa and other low income countries

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1. Introduction

The key role of textbooks and other learning and teaching materials (LTMs) in enhancing the quality of learning is almost universally recognized and is supported by more than 40 years of international research. This role is especially important in low-income countries where textbooks and other LTMs, if made available, can compensate for factors such as large class-sizes, poorly trained or even untrained teachers, reduced teacher/student contact hours, high levels of illiteracy among parents and a widespread lack of reading materials in homes.

However, despite decades of funding by governments and development partners relatively few low-income countries, and particularly those in sub-Saharan Africa (SSA), have been able to establish sustainable systems for providing adequate supplies of high quality textbooks and other LTMs. Although the general conclusion of significant under-provision of essential LTMs is widely accepted the country data on which this conclusion is based are often flawed and inaccurate and it is difficult to achieve useful comparability on LTM availability between different countries. This paper aims to review the accuracy and relevance of the national monitoring mechanisms used to establish national LTM availability.

As a general rule many low income countries do not have clearly-defined achievable LTM provision targets. Not all countries have access to data that enables them to do more than guess at the types and total national quantities of the LTMs supplied and how and where they should be allocated to individual schools, including the forward budgets needed to provide and maintain priority LTMs in the school locations to which they should be delivered. Up to date and reliable information on LTM stocks held in schools in usable condition is not easily available to most Ministry of Education (MOE) LTM management institutions (because the information is not systematically collected and maintained and is rarely verified). There is even less information readily available on the extent to which available LTM stocks are actually used in class by teachers and students.

All countries need to have a clear idea of the core textbook, teachers' guide and reading book provision targets for each grade level, the number of students who have access to these materials and the extent to which the materials are being used effectively in the classroom. But different countries will tend to have different curricula with different LTM specifications and target levels of provision. Accurate comparability of levels of provision between different countries only becomes possible and relevant when the country LTM targets are known and clearly stated.

This review is confined to hard copy print materials – effectively textbooks, teachers' guides and reading books.[1] It focuses on the monitoring of essential hard copy LTM provision to schools, maps the different ways used to measure textbook availability in schools and in the classroom; describes the relative advantages and disadvantages of different approaches to data collection and presentation, reviews the common constraints that affect the reliability and usefulness of the data collected and proposes improvements based on current conditions.

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[1] In many countries there are now broad policies in place that anticipate a shift towards the provision of digital textbooks and reading books to replace hard copy LTMs. In some countries digital LTMs are perceived to be in direct competition for available funding with hard copy LTMs. In almost all cases there is inadequate information available on the key digital indicators needed to plan in outline the transition from hard copy to digital requirements or to contribute to realistic estimates of the comparative costs involved.

2. Required Information and Common Problems in LTM Data Collection

The most basic elements of a LTM monitoring information system are the following:
- Clearly specified MOE LTM policies and targets as the basis for supply decisions.
- Accurate, comprehensive, reliable and up to date information on schools, school locations, and grade level student and teacher numbers.
- National language of instruction policies (LOIs) and their implications and the location and grade level student and teacher numbers of those learning in different languages.
- LTM grade level stock levels and condition in schools
- Reliable data on classroom usage of available LTMs.
- Information on LTM classroom life and annual loss and damage rates, which tend to vary with grade levels and urban/rural location.

In practice, in many countries these basic information requirements are only rarely met. Common problems are described below.

2.1 National LTM policies

Only a minority of country education systems attempt to specify the LTMs that they consider are essential for the effective delivery of the curriculum and the achievement of specified learning outcomes. These are often referred to as the *Minimum Profile of Learning and Teaching Materials* and can include a variable selection of the following types of LTMs with their typical target levels of provision:
- Textbooks – typically 1 per student although this is not commonly achieved or sustained in practice
- Teachers' guides – 1 per grade level subject specialist teacher
- Big books for shared reading practice – 1 per 5-10 students
- Reading books – 1 per enrolled grade level student according to language of instruction and other curriculum specified languages – but official supply targets for reading books – if they exist – vary greatly from country to country and between urban and rural locations within countries (see Box).
- Flash cards – 1 per target class per language
- Posters – 1 set per target class
- Grammar books – 1 per specialist language teacher
- Atlases – 1 per 10 students according to level
- Dictionaries – 1 per 10 students according to language and level

The list above is indicative only and not intended to be exhaustive of potential LTMs or typical provision targets. As an example, in 2000 Uganda established a Minimum Profile of required LTMs to support its new primary curriculum but in 2009 this list was withdrawn as no longer affordable and since this date only textbooks, teachers' guides and a limited number of reading books have been funded, but without meeting Uganda's own basic provision targets[2]. Rwanda established a comprehensive Minimum Profile of LTMs in 2009 for all primary and secondary grades and in 2016 this profile is still operational to support the introduction of its new competency-based curriculum, but

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[2] **Ibale A** 2016 <u>Uganda Global Book Fund Country Study</u>   Results for Development, Washington and International Education Partners, Windsor UK

current budget allocations for LTMs in 2016 may not be sufficient for Rwanda to achieve its own target provision rates for any of the specified LTMs except for the core textbooks and teachers' guides[3].

In a majority of low income countries the provision of basic textbooks to support curriculum subjects is the single specified LTM target required to deliver the curriculum effectively to all students. Thus, in the Indian sub-continent Bangladesh, Pakistan Provincial Governments and Indian state governments all aim to deliver basic textbooks to all primary schools for all primary students every year. In these countries parent-led accountability mechanisms appear to have been particularly successful in ensuring effective deliveries to schools on time. In India, Bangladesh and Pakistan parents expect textbooks to be delivered to schools for free allocation to students on an annual designated 'Book Day' and if not received on schedule parents and media create pressure on education officials[4]. In the Philippines the *CheckMySchool* initiative involved community groups monitoring supplies and helping to reduce textbook losses[5]. The effective delivery of basic textbooks to every primary school student in every school every year clearly indicates that local MOEs in these countries have reliable data on schools and grade level enrolments. The textbooks are issued to students by the schools as soon as the book stocks are received so that there is no question of collecting data on school stock levels because schools do not hold any textbook stocks. There is a basic policy assumption that textbooks will have a one-year book life and will need to be re-supplied annually. Clearly, this policy assumption requires an annual country budget line sufficient to ensure the annual re-supply of basic primary level textbooks. The downside of this approach is that production standards are poor to reduce costs and that loss and damage rates can be high as a result. Thus, although it can be assumed that textbook:student ratios are close to 1:1 at the beginning of the school year there will be a steady decline in the ratios as the school year progresses and textbook loss and damage rates increase. Unfortunately there are no reliable data on typical ratios in urban and rural schools at the end of the school year.

In a research study[6] into LTM provision funding in 13 developing countries in the Caribbean, sub-Saharan Africa, the Indian Sub-Continent and South-East Asia only 3 of the 13 countries were attempting to fund more than just basic textbooks and teachers' guides and none of the 13 countries covered by the surveys were managing to achieve and maintain their own basic LTM provision targets even for the most basic level of textbooks and teachers' guides supply[7].

[3] **Umubyeyi M and Read T** 2016 Rwanda Global Book Fund Country Study Results for Development, Washington and International Education Partners, Windsor UK

[4] 2016 Draft Global Book Fund First Phase Report Results for Development, Washington and International Education Partners, Windsor UK

Da Guzman A 2016 Philippine Global Book Fund Country Study Results for Development, Washington and International Education Partners, Windsor UK

[5] 2016 Draft Global Book Fund First Phase Report Results for Development, Washington and International Education Partners, Windsor UK

[6] 2016 Draft Global Book Fund First Phase Report Results for Development, Washington and International Education Partners, Windsor UK

The case of reading books

One of the most disturbing conclusions emerging from recent LTM research is the very widespread lack of investment in the provision of reading books and reading materials for use in schools and the equally widespread lack of usable data on the availability of reading books in relevant languages at any levels in the education systems of most developing countries and particularly in lower primary and pre-school grades. Failure to provide suitable reading books to schools in adequate quantities is likely to be a major factor in undermining progress towards early literacy, which in turn will impact adversely on levels of student achievement in successor grades.

Failure to provide reading books into developing school systems also hinders the development of the reading habit among students and the under-investment in school and classroom libraries inhibits practice in student research skills. Very few developing education systems provide useful data for planning purposes on the provision, availability and use of reading books in different target languages. In practice school systems do not even provide useful guidance on target levels of provision and methods of usage in the classroom. To this extent most developing education systems and classroom teachers inside these systems are operating in the dark on the ways in which reading books and other reading materials should be used to best effect in school classrooms. Upgraded information on reading book availability in schools and use in classrooms should be a priority data collection target in all countries.

2.2 Schools and students

Many school systems in sub-Saharan Africa cannot provide even a regular, annual, comprehensive, reliable and up-to-date list of schools and their locations (ideally with individual school GPS coordinates to support easy distribution) with appropriate categorisations. Schools can be listed incorrectly - or even simultaneously - as both government and private schools and may be listed under more than one name and in more than one administrative unit. Main schools and feeder schools may be confused and some schools may not be listed at all. Nigeria, for example, is reported to have been unable to provide any EMIS data from the Universal Basic Education Commission (UBEC) and the federal MOE since 2003, and is regarded as a data poor country   so that the accuracy of primary school lists is dependent on the efficiency of individual LGEAs and primary enrolment data by grade levels is not available on a national basis[8].

An additional issue is the problem of different MOE departments collecting essentially the same data but in different formats for different purposes. In some countries enrolment data, for example, may be collected independently by several different MOE departments. This increases the administrative overhead of schools and the MOE and is obviously a waste of scarce MOE resources and signals the need for a more controlled data collection operation for agreed priority purposes.

Similarly, grade level student roll numbers can be seriously inaccurate, exaggerated or diminished according to the perceived benefits or dis-benefits of inaccurate data recording. Exaggerated roll numbers are often used as evidence to justify increased levels of resource provision including increases in LTM supplies and even teacher postings to schools. Student enrolments often vary during the school year as a result of drop-outs and are typically more volatile in lower grades than upper grades. As an

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[8] **UNESCO**, (2014), Regional and Country Profiles, Retrieved 2016, from
http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=121

example of these problems, by 2013 the GEQIP 1 project in Ethiopia had achieved 1:1 pupil/textbook ratios in terms of the quantities of books supplied to *Woredas* when compared to EMIS grade level enrolment data. Unfortunately, follow-up MOE/donor review missions uncovered problems with widespread inaccurate EMIS enrolment data reported by schools and distribution problems between *Woredas* and schools, particularly in rural areas, that left many schools under-supplied while others were over-supplied with LTMs[9]. QEQIP 1 print runs did not include loss/damage allowances so pupil textbook ratios inevitably would decline every year. The successor project, GEQIP 2 now includes 8% loss and damage allocations to print runs to compensate. The Ethiopia example described above demonstrates the difficulties involved in establishing reliable textbook availability data.

Significant common problems are the reliability of the different methods of data collection, the difficulties and costs of cleaning, checking and verifying the data collected, the stability of grade level enrolments throughout the school year and the practicalities of delivering national school and enrolment data covering all schools according to required national deadlines for on-time decision-making.

2.3 Local languages as languages of instruction

A number of countries have policies that require or encourage different local languages to be used as LOIs, usually for the first 3 or 4 grades of primary school. Thus, Haiti specifies Creole in addition to French as an LOI, Niger specifies 6 local languages plus French and Namibia specifies 13 local languages plus English. In 2016 Uganda has approved 12 local languages as LOIs for lower primary grades. Even Bangladesh has approved several small population non-Bengali minority languages as LOIs to serve non-Bengali communities in mountain areas in the north of the country. Both Nigeria and Kenya have national policies that support the use of catchment area languages as LOIs for primary grades 1-3 with transition to English as the LOI in P4. Although these are national policies in both countries they are not widely enforced by the responsible MOEs and are widely ignored by individual schools. In Kenya only local language course materials in Kikuyu, Luo and Kikamba have been approved by the MOE out of more than 60 possible local languages. Similarly, Nigerian local languages as LOIs tend to be limited mostly to Hausa and Igbo out of the wide range of other available local languages.

A consistent measurement problem in countries with multiple local languages as LOIs is the lack of reliable data on the schools using different local languages as LOIs and the number of students affected at each grade level. Under these circumstances neither the MOEs nor publishers have good information on which to base their print run projections and the tendency generally is towards under-printing rather than over-printing as a result. In Uganda with 12 approved local languages as LOIs in P1-3 with English as a default LOI in cosmopolitan urban schools where there may be difficulties in agreeing a single LOI out of a number of competing local language possibilities, the currently available data on which schools are using different LOIs and the grade level enrolments for different languages make it difficult to calculate LTM print runs for different LOIs and the creation of accurate LTM distribution lists. The determination of reliable national textbook availability data clearly depends on the collection of accurate information on the annual supply quantities of all textbooks in different LOIs in comparison with established grade level enrolment data that covers both total national enrolment and the enrolment data for different LOIs. In these circumstances it is quite possible to achieve acceptable LTM availability in some languages and under-supply in other languages and perhaps a difficult to determine national failure to achieve acceptable levels of LTM availability.

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[9] **Woldetsadik G**, (March 2015), Provision of teaching and learning materials in Ethiopia: Achievement and lessons learned under General Education Quality Improvement Project 1, WB, Washington

Ethiopia lists more than 80 local languages. The donor-funded GEQIP 1 project (2009-2014) financed LTM supply to support the new curriculum in 5 local languages. Regional Education Boards were then expected to translate/adapt these materials into other local languages as required. As a result of this policy LTMs have been produced in around 40 different languages but the policy implementation suffered many difficulties that included[10].

- Difficulties in identifying qualified local language specialists to undertake high quality LTM translation and adaptation work
- Lack of editorial and publishing skills in Regional Education Departments
- Poor quality LTMs in terms of both content and production standards
- Poor LTM durability and reduced classroom life
- Local language teachers without mastery of their languages and in need of language training
- Fractionalised print runs leading to higher unit costs
- Increased distribution complexity resulting from LTMs in multiple local languages.

South Sudan probably achieves the current acme of local language difficulty. Current government policy is to use 37 local languages as LOIs for pre-schools and P1-3 but there is no local data as yet on which schools in which counties will use which languages and the grade level enrolments required for each LOI. Under these circumstances the mismatch between LOI-related LTM supply policies and their implications and the availability of reliable data to support the efficient implementation of these supply policies remains a serious problem in an increasing number of countries, particularly in SSA where the use of multiple languages of instruction in lower primary grades continues to be a growing objective.

The use of multiple languages of instruction is not unique to SSA countries. After the break-up of the Soviet Union in 1991 most Central Asian countries adopted constitutions that enshrined multiple languages of instruction that reflected their linguistic/ethnic diversity into their education policies. Thus Uzbekistan had 7 official languages of instruction for both primary and secondary sub-sectors (Uzbek, Russian, Karakalpak, Kazakh, Kyrgyz, Tajik and Turkmen}, Kazakhstan had 5 LOIs and Kyrgyzstan had four LOIs. Unlike LOI policies elsewhere in the world there was/is no linguistic transition point to a common language of instruction and LTMs were supposed to be provided in multiple languages for all subjects in all primary and secondary grades. In Soviet times, with a common curriculum and education structure in each country, this approach was potentially affordable. For example, LTMs for Tajik and Kyrgyz minorities in Uzbekistan could be imported cheaply from Tajikistan and Kyrgyzstan because they were identical in content, presentation and production specifications to the Uzbek LTMs, but as country curricula diverged from the soviet norms and became more genuinely national each country had to produce its own LTMs for each of its LOIs based on its own national curriculum requirements. For small population minority languages this was very expensive. As a result, most of the Central Asian countries concentrated their LTM supplies on their own national language plus Russian, and minority languages were seriously undersupplied in consequence, which in turn caused linguistic tensions but also reduced national levels of LTM availability. In soviet times textbook availability was virtually 100% in every constituent republic but the changed circumstances after the break-up of the Soviet Union created severe textbook shortages in all of the newly independent countries. A research study in Kyrgyzstan in 2014[11]estimated that textbook availability had declined to less than 40% for Russian and Kyrgyz LOIs and to even lower levels for minority Uzbek and Tajik LOIs.

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[10] **MOE/WB,** (2014), GEQIP1 Implementation Completion Report
[11] **Read T** (2014) Issues in Minority Language Education in the Kyrgyz Republic IEP, Windsor UK for the ADB

The root causes of differential textbook availability and performance levels between Russian language schools and Minority Language (and Kyrgyz language) schools were summarised as follows:

- Priority in LTM publishing programmes was allocated only to Russian and Kyrgyz titles
- ML schools received fewer textbooks later in the school year than core language schools and thus ML students were provided with fewer and less timely learning support resources
- Because of limited print runs ML textbooks were more expensive than core language textbooks
- The translations of textbook content from Russian or Kyrgyz originals into Uzbek and Tajik minority language editions was problematic and often poorly performed through only semi-qualified translators with many errors so that the LTMs were frequently of much lower quality
- ML schools tended to have more serious staff shortages in maths, sciences, English language and ICT because teacher training universities did not offer teacher training courses in minority languages for any subjects
- 9 except language and literature.
- Most ML schools were located in rural areas where school financing was likely to be less than in urban areas

Although there are clearly many educational benefits in providing primary students with the opportunity to learn in familiar languages it is also clear that multiple LOIs can significantly increase the complexity and costs of data collection and that country measurements of textbook and reading book availability cannot be accurate and reliable unless they include all operational LOIs. Where multiple LOIs require multiple authorship/translation and typesetting costs and print runs are fractionalised the unit costs of publication can be increased considerably, which brings pressure to bear on the scarce financial resources available to support LTM production and provision. Fractionalised print runs can also reduce publisher interest in developing appropriate LTMs. Finally, multiple LOIs can increase the complexity and costs of LTM distribution.

2.4 Stock levels in Schools

There is no need to collect data on school LTM stock levels or loss and damage rates if
- the LTMs are supplied on the basis of a 1 year classroom life with the expectation that re-supplies will be provided annually e.g. India, Bangladesh
- the LTMs are supplied for student ownership and management rather than for school management

It is important to establish school LTM stock levels where physical production specifications are intended to provide extended classroom life and where LTM stock is accumulated in schools and loaned to students on an annual basis. Individual school LTM stock levels can be used to indicate national progress towards target levels of LTM provision. Many school LTM data collection systems are not designed to maintain accurate and up to date records of the LTMs supplied to schools and thus school LTM stock levels. This is a particular issue with manual LTM MIS systems where the maintenance of accurate LTM stock levels for thousands of schools is obviously likely to be a problem. National LTM management systems may have data on what is supplied to districts but frequently fail to maintain data on what has been supplied onwards to schools. In 2010 a district level LTM tracking survey in Ghana[12] reported among a number of other stock recording discrepancies that 29% of English

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[12] Ghana National Education Campaign Coalition, 2010, Tracking survey for textbooks, school uniforms, capitation grants, school infrastructure and teachers, Accra

language stock for primary schools supplied to the district could not be accounted for, including a loss rate of 57% for primary English Book 3. While the report noted poor record-keeping as a general problem in the district and commented unfavourably on stock accountability, it failed to record any stock levels in schools.

2.5 LTM classroom life

The widespread absence of well-performed annual stock-taking of LTM stocks within schools and the lack of regular external stock monitoring means that real loss and damage rates and actual classroom LTM life assumptions are not as widely known and understood within national LTM management systems as they should be and thus are often not properly taken into account in supply decisions and estimated LTM stock levels in schools. As a result there is a general tendency in many countries to assume levels of LTM classroom longevity that are likely to be greater than those achievable in practice. This typical outcome is reinforced by MOE budget considerations because longer classroom life leads to reduced procurement quantities and reduced expenditure on LTMs.

Accurate LTM classroom life assumptions for different types of LTMs at different grade levels are important planning components in the effective management of LTM provision systems. Clearly if the LTM management system assumes that overall classroom life for lower grade textbooks is 5 years before replacements are required and yet the actual achievable classroom life is only 3 years then the costs of effective textbook provision will increase by 40% or there will be two years when textbooks are not available in classrooms.

Establishing accurate classroom life assumptions and associated annual loss and damage rates requires the maintenance of accurate school LTM stock records across a range of different schools in different urban/rural locations and measuring changing indicators of longevity based on prevailing LTM physical production specifications combined with the quality of school LTM management and security standards. Once again this is not a widely practiced discipline within MOEs and in most countries classroom life assumptions are based on little more than guesswork or wishful thinking.

3. Census and Survey-based Approaches to LTM Data Collection

There are two basic approaches to LTM-related information gathering. The first approach through which most countries aim to collect LTM-related data is by drawing information from every school and then consolidating the information gathered on a sub-district, district, regional and eventually national basis. The process is usually based on self-reporting by head teachers via the completion of EMIS questionnaires or by district or sub-district education officers working closely with schools that they know quite well. This is probably the commonest data gathering method.

The most basic school level LTM data required on an annual basis are typically:
- Grade level enrolment by gender for all schools
- Grade level stock of specified high priority LTMs (usually core textbooks, teachers' guides and reading books) if LTM stock is maintained in schools (see Section 2.4, above)
- Loss and damage rates over previous 12 months if LTM stock is maintained in schools (see Section 2.4, above)

The design of the data collection questionnaire is a critical first issue. Some national EMIS questionnaires can be more than 40 pages long and may pose supplementary questions that many head teachers may find difficult or even impossible to answer. The language of the questionnaire can also be a problem, particularly for primary head teachers if the questionnaire is written in an international language and uses technical terminology. Any data questionnaire that requires excessive head teacher time and work to complete is a risk. As a general rule the longer and more complex the data collection questionnaire the higher will be the risks of non-response or incomplete and inaccurate returns.

The verification of the data collected to determine the level of accuracy is another important issue that needs to be considered as part of the design of a reliable LTM-related data collection system. Most schools and head teachers are conscious that school EMIS data could be used as the basis for MOE decisions that could have an impact on their operational capacity and thus head teachers can be tempted to manipulate the required data to their perceived advantage. If the data collection system is well-established with easy access to previously collected school data then longitudinal school data comparisons and analysis can provide an indicator of school level accuracies. An alternative approach is random school data checking by check visits. Data checking by check visits to a percentage of national schools should provide an indication of the accuracy of the data collected although the check visits should take place according to a schedule that broadly reflects the urban/rural/remote national school location pattern. Check visits based on random sampling are likely to be a reliable way to verify the accuracy of data collected through self-reporting. Random sampling can also provide information on other aspects of LTM supply, including their presence and use in classrooms but there are obvious cost implications.

A cheaper and more convenient alternative to national data collection is the design and creation of a sample school survey covering perhaps 5% of national schools. The sample should be designed around a pattern that reflects as accurately as possible national patterns of urban, rural and remote schools. It should be noted that sample studies can be used to determine important LTM indicators within the school system, including loss and damage rates and levels and types of usage, but they cannot be used as the basis of a national LTM stock management and allocation system, which will always require full national coverage of schools.

The second approach to data collection is direct school surveying by trained interviewers who visit schools specifically for the purpose of data collection. The interviewers are often university students who may know neither the schools nor their localities very well. Where school surveying is the selected methodology there have been examples of surveyors not bothering to visit difficult access schools and submitting fictitious data instead. One solution to this problem is the use of tablets for data collection and online transmission where school GPS locations are known, which can be used to prove that surveyors have actually visited the schools concerned. This methodology was successfully used in Rwanda's 2013 audit of school ICT hardware and software, which unfortunately did not include the collection of data on hard copy LTMs.

In brief, there are problems associated with fulfilling national LTM Information needs, which require the collection, verification, analysis and the storage and maintenance of reliable data covering schools, students, teachers, subject options and quantities, price and condition details of the LTMs maintained as part of school stocks. An ideal basic information collection system would also provide some level of usage monitoring and supervision information and the ability to vary target supply ratios as required plus the ability to provide forward budget projections to ensure sustainability.

Most LTM system financing in low income countries is based on more or less arbitrary annual financial allocations rather than financing aimed to ensure that specific LTM supply targets are achieved on a regular, sustainable and predictable basis, which should also take into full account annual loss and damage rates and school enrolment growth rates. As a general rule the MOE staff employed to run the kind of LTM information collection system described above will not be specialists. India and Bangladesh represent radically different financing methodologies because in both countries annual budgets are calculated and made available to ensure the provision of full textbook stocks to all primary students but on the basis of poor quality books supplied on a one-year book life basis..

4. Computerised LTM Information Systems

National LTM information collection remains largely uncoordinated, inaccurate and ineffective in most developing countries. Under these circumstances a custom-designed computerised LTM data collection and management system is more likely to provide reliable annual information on schedule than manual systems. Unfortunately, effective computerised systems are typically expensive to design and install and in 2016 very few developing country education systems have invested in them.

Effective LTM provision requires reliable information on a number of different activities and inputs that have to operate efficiently in sequence. This sequence of activities is often referred to as the *book chain*. If one of the links in the chain is dysfunctional then there is a risk that the whole system will function ineffectively or inefficiently – or both. The basic links in the textbook chain that determine LTM information requirements are:

- Curriculum and syllabus design (including the specification of the grade level Minimum Profile of Required LTMs to deliver curriculum objectives);
- Supply assumptions (student/LTM ratios, book life, loss and damage rates etc.);
- Financing policies (essentially "who pays and how?");
- Pricing (How much control over pricing is required and how is it applied);
- School management and conservation;
- Usage at home and in the classroom;
- Supervision and monitoring of implementation.

There are a range of different policies and practices that can be applied to each of the links in the textbook chain specified above and these variables will have an impact on LTM information needs and LTM costs and the difficulties of data collection. The combination of large numbers of schools located in different regions and districts, often with radically different facilities and operational environments, with large numbers of LTM titles supplied in differing quantities based on grade level enrolments and supply assumptions and potentially in different languages is very difficult to manage on a manual basis with non-specialist managers and manual systems.

Investments in more sophisticated computerized information management systems are recommended wherever possible to ensure that good decisions can be made quickly based on good information, sound future planning and adequate financial allocations to maintain textbook, teachers' guides and other essential hard copy LTM supplies equitably at target levels for every school and grade level in the country.

Accurate on-time data collection and effective data management are the basis of proper planning, as well as the key to the proper monitoring of the use of funds and supplies. Standard EMIS systems should be able to provide accurate data on schools, teachers and grade level students, but often they only provide approximate or incomplete data on total textbooks per subject per grade level by school. Most MOEs fail to record textbook supply data by individual schools based on actual orders from schools or on MOE allocations to schools or stock delivered to schools. This is frequently a simple problem of data system design but where annual school orders or MOE stock allocations or delivered stock are accumulated year on year to form indicative school stock levels then other factors have to be taken into account. If accurate and well performed annual LTM stock taking is available then total school stocks will need to be adjusted accordingly.

However, this is an unlikely scenario in most countries and most accumulated school stock records will need to be adjusted downwards using realistic classroom life data and annual estimated loss and damage rates. Care is also needed to ensure that stocks of old and redundant textbooks retained in school stores are excluded from current school stock records. This is obviously much easier and faster using a computerised system. Core data should include electronic records of at least:

- the orders submitted to distributors (date submitted, book titles, grade level quantities, schools)
- books delivered to schools
- the accumulated inventory of each title in each school in the country,
- textbook allocations granted by the region to each school and spending on textbooks

A good LTM information database should provide the basis for the control of the learning and teaching materials supply processes and should provide annual budget projections to enable MOEs to meet their supply targets. It should provide the basic information on school LTM inventories in order to identify schools with high levels of loss and damage. It can be designed to provide a wide range of specialist reports for planning and management purposes according to system needs.

5. Two Examples of Computerised LTM Management Information Systems

Rwanda has a fully operational computerised LTM MIS and Namibia has a system in the process of design and development.

5.1 Rwanda Learning and Teaching Materials Management Information System (LTMMIS)

In 2009 the Rwandan Education Board (REB) with assistance from DFID, BTC and UNICEF developed a computerized Management Information System (MIS) to look after national LTM provision for all schools in Rwanda. Due to the success of the system after implementation in 2009/10 two further versions of the MIS were developed. The Rwanda MIS manages national publisher orders, school deliveries, management of stock (lost and damaged, LTM life, student/teacher/subject ratios) as well as providing MOE and donors with financial and other indicators for future budget allocations.

The Rwanda LTM MIS contains comprehensive data on:
- Every Public, State Aided and Private school.
- All Pre-schools, Primary, Secondary, Combined schools (primary and secondary), VTC (Vocational Technical Schools) and TSS (Technical Secondary Schools).
- GPS location data is available on almost every school on the database and is provided to publishers on their school delivery forms.
- Individual school enrolment data (boys and girls) is collected and updated annually.
- Teacher employment data by subject
- Student enrolment data by subject for those grades where elective subjects are specified
- Procurement budgets
- SEN enrolment data by grade, subject and disability
- LTM Approved catalogue
- Approved Publishers
- Annual School Orders
- Annual Deliveries to Schools
- LTM Technical Specification Data
- Target supply assumptions
- Late Deliveries
- Publisher Payments

The LTM MIS can provide the following information to REB:
- Individual school LTM stock levels which can be aggregated to provide cell, sector, district, regional and national data
- Loss and Damage Rates per school, sector, cell, district and nationally
- Book Life Projected vs Book Life Achieved, although REB has not yet collected the data to enable the system functionality to be applied
- LTM to Student ratios by subject per school, cell, sector, district and nationally
- LTM to Teacher ratios by subject per school, cell, sector, district and nationally
- LTM ratios by subject per school, cell, sector, district and nationally

- Financial projection system – forecasting future budgets based on projected ratios
- Successful/Unsuccessful Deliveries

From 2009 to 2014 additional tools were developed on the MIS to provide the MOE with the ability to:
- manage a school demand-based supply system.
- plan and manage the system cost effectively and efficiently;
- strengthen the links between schools, districts and the MOE;
- provide the inspectorate with reliable information to undertake school stock inspections. Feedback from inspections provided the basis for assessing school levels of usage, stock management, loss and damage rates, management practices, levels of conservation and should be a key factor in bringing the loss and damage rates in schools under control and thus reducing costs and improving supplies;
- generate reports to provide detailed and customised data split into national, regional, circuit and school's sections

From 2016 REB has decided to change the model for a school demand and order-based system to a government supply based system, which will require:
- enrolment data collection (independent of EMIS, which is not scheduled to provide the information required by the MOE at the time required for LTM allocations)
- a system to enable REB to allocate LTMs equitably direct to individual schools
- Monitoring of deliveries – Completed, Incomplete or incorrect deliveries

The Rwanda LTM MIS is accessed via a website URL. Users are provided with a username and password so that, for example, every school with internet access can view its own inventory and place its own orders. Publishers and distributors can download consolidated national and regional orders, print completed delivery certificates for school signature and stamping as the basis for payment claims and view customised order, delivery and payment reports. The MOE can view and monitor the progress of every aspect of the supply cycle. Thus, the MOE is now able to monitor the process of LTM provision from collection of enrolment data, to school ordering/REB allocations, publisher deliveries to distributors and regional distributor deliveries direct to schools.

From 2010 to 2013 almost USD27 million was allocated successfully to schools for them to select and order the LTMs they needed using the LTM MIS system. In the 4-year period USD1.6 million of this budget remained unused but USD1.4 million of thIs was incurred in the first year of operation of the LTM MIS. In the subsequent 3 years underspend amounted to only USD185,000. The reason for the large underspend in 2010 resulted from schools and REB not being familiar with the new ordering processes. When schools received their 2010 order form they did not order up to the budget allocation provided by REB. In subsequent years a threshold setting was applied within the LTM MIS that flagged any schools not ordering up to 90% of their budget allocation. REB were able then to see which schools were not ordering correctly, made contact with the schools via the districts and provided additional support to the affected schools in the ordering processes.

Not only was the LTM MIS able to guide and support REB in the allocation and ordering processes of LTMs but the MIS tracked deliveries of ordered books to the schools. Publishers were only paid on schools providing a "Confirmed Delivery Certificate" (CDC) to the REB which was signed and stamped by both publisher and school. With the delivery data entered onto the MIS the calculation of the success of publisher deliveries to schools was made possible. In 2010 an excess of LTMs were delivered by publishers to schools and in each of the following three years the LTM MIS managed to achieve delivery success rates direct to schools exceeding 99% of LTMs ordered. Even more important, the REB knew every year the status of its own progress towards meeting its own LTM supply targets.

The Rwandan Education Board (REB) having successfully used the LTM MIS since 2009 decided in 2015/16 to upgrade the LTM MIS for a third revision. The LTM MIS is currently being developed to include a "Supply Based Distribution Model". The MIS will be able to centrally allocate LTMs to schools using enrolment data and LTM/student class ratios when required.

In 2014, after 4 years of MOE-funded supplies, the LTM MIS provided detailed accurate national information on progress toward the pupil textbook ratio targets for each subject at every grade level. This is provided below. This information was also available in disaggregated form by districts, circuits and cells. A summary of this data is provided in the table below. The PTR indicates the number of students sharing one textbook.

Subject	Grade Level	Enrolment	PTR Ratio
Biology	S1-S3	333,068	2.12
Chemistry	S1-S3	333,068	1.73
CS	S1-S3	333,068	2.69
Dictionary	P1-P3	1,563,255	63.85
	P4-P6	811,195	12.54
English	P1-P3	1,563,255	3.54
	P4-P6	811,195	1.94
	S1-S3	333,068	2.37
Entrepreneurship	S1-S3	333,068	2.81
Geography	S1-S3	333,068	1.65
History	S1-S3	333,068	2.54
	S4-S6	121,370	11.63
Kinyarwanda	P1-P3	1,563,255	2.83
	P4-P6	811,195	1.9
	S1-S3	333,068	3.22
	S4-S6	121,370	2.61
Maths	P1-P3	1,563,255	3.6
	P4-P6	811,195	2.24
	S1-S3	333,068	1.91
Physics	S1-S3	333,068	1.91
	S4-S6	121,370	10.46
Social studies	P1-P3	1,563,255	4.75
	P4-P6	811,195	2.4
	S1-S3	333,068	3.49
SRM	N1-N3	115,903	2.56
	P1-P3	1,563,255	17.98
	S1-S3	333,068	157.4
STE	P4-P6	811,195	1.45
	S1-S3	333,068	7.85

Source: Rwanda LTMMIS 2014

An analysis of this date suggests that GOR LTM funding, although provided reliably on an annual basis, is still insufficient to achieve its 1:1 PTR targets for all subjects at all grade levels. The data also

suggests that schools are often prioritising textbooks at secondary grades over primary grades and at upper primary rather than lower primary. Reading books at lower primary were supplied at an average of 1 book per 18 students but in lower secondary the provision ratio was only 1 book per 157 students. In pre-schools 2.56 students shared a reading book.

5.2 Namibia Learning Support Materials Management Information System (LSMMIS)

Hard copy print materials are called learning support materials (LSM) in Namibia. Namibia developed a somewhat different approach to a computerised LSM data management system in support of its own reforms of its LSM supply chain, which required it to be more efficient and cost effective, while decentralizing ordering and procurement activities to the school and regional levels respectively. The decision to design a sophisticated management Information System (LSMMIS) was central to the reforms and followed the Government of Namibia's policy to update computerisation wherever possible in both the public and private sectors.

In 2015 the Millennium Challenge Corporation (MCC) commissioned the development of an LSMMIS to coordinate the ordering and distribution of almost 1 million textbooks and readers. The MIS was developed and implemented and all but 497 units were delivered to the correct schools, on time. Namibia uses a set of regional distributors to deliver LSMs ordered by schools through Regional Offices from Publishers. This adds a degree of additional management complexity in the book chain but it has been incorporated seamlessly into the LSMMIS. The Namibian LSMMIS provides the tools for the school system to:
- Manage a school demand-based supply system incorporating.
    1. EMIS enrolment data collection
    2. School capitation grants
    3. School LSM orders from an approved LSM list
    4. Ministry redistribution of unused funds
    5. MIS consolidation of publisher orders
    6. Distribution schedules for regional distributors
    7. Monitoring of deliveries – completed, incomplete or incorrect deliveries
    8. Publisher payments and late delivery/non delivery penalties
- Plan and manage the system cost effectively and efficiently;
- Strengthen the links between schools, circuits, regions and the MOE;
- Provide the inspectorate with reliable information to enable it to undertake school inspections. Feedback from inspections will provide the basis for assessing school levels of usage, stock management, loss and damage rates, management practices, levels of conservation and should be a key factor in bringing the loss and damage rates in schools under control and thus reducing costs and improving supplies;
- Generate reports to provide detailed and customised data split into national, regional, circuit and school's sections to support national system management

The Namibian LSMMIS has only completed one year of supplies to date and is awaiting additional finance to cover future supplies. However, the system ensures that the MOE knows the exact number of schools in Namibia, has up-to-date data on grade level roll numbers and, eventually, will know exactly where each school is located. The LSM MIS calculates also the annual LSM budgets that individual schools can spend on LSMs and it provides an accurate inventory of all LSMs in each individual school which, combined with the additional information on the LSM MIS, gives unparalleled information about Namibia's education system and its needs and enables the MOE to calculate for 5-10 years ahead the budgets needed to meet MOE textbook and LSM targets.

The LSMMIS also manages the supply of textbooks and supplementary books by monitoring school orders to publishers and deliveries to schools. Thus the system will identify if suppliers have missed their delivery deadlines to schools and if publishers have failed to meet required durability standards, thus enabling the MOE to apply penalties and to improve the efficiency of the whole supply process

The LSMMIS is accessed via a website URL. Users are provided with a username and password so that, for example, every school can view its own inventory and place its own orders. Publishers and distributors can download consolidated national and regional orders, print completed delivery certificates for school signature and stamping as the basis for payment and view customised order, delivery and payment reports. The MOE can view and monitor the progress of every aspect of the supply cycle. Thus, the MOE is now able to monitor the process of LSM provision from collection of enrolment data, to school ordering, publisher deliveries to distributors and regional distributor deliveries direct to schools.

The current MOE Education Management Information System (EMIS) and the new LSMMIS are connected through a custom Application Program Interface (API), enabling EMIS data to be accessed, analysed and reported in the LSM MIS as it is entered onto the EMIS. With a single sign-on dashboard a user is then able to access LSM supply, the EMIS Annual Education Census data and the School Register of Needs.

Language of Instruction	Grade	% of enrolled students with textbooks
Afrikaans	1	22
	4	44
English 1st Language	1	43
	4	23
English 2nd Language	1	37
	4	46
JuA'hoan	1	77
	4	103
Khoekgoegovab	1	21
	4	38
Oshikwanyama	1	37
	4	53
Oshindonga	1	37
	2	39
Otilherero	1	31
	4	47
Rukwangili	1	18
	4	31
Rumanyo	1	48
	4	43
Silozi	1	31
	4	43
Thimbukushu	1	21
	4	37

Sourc:e Namibia LSM MIS 2015

The table above provides details extracted from the Namibian LSMMIS of student/textbook ratios for grades 1 and 4 for the different lower primary LO1's. It should be noted that all schools select and order the books that they want from their school per capita budgets using the national approved list maintained by the MOE. The data above applies to Language textbooks only and does not include textbooks for other curriculum subjects but language textbooks generally represent school priorities – particularly in lower primary grades. In Namibia funding allocations to schools for LTMs assume that the target ratio of 1:1 for all textbooks will be achieved over a 4-year period as stocks accumulate with regular funding and ordering. An analysis of grade 1 data indicates that different languages have achieved levels of supply of between 20% and 40% after just one ordering cycle with JuA'hoan achieving 77%. On this basis all LOIs should achieve a !:1 student textbook ratio within 3-5 years if current levels of textbook financing are maintained. For Grade 4 language books levels of supply after the first ordering cycle range from 40-60% so 1:1 student/textbook ratios should be achieved for all LOIs within 2 or 3 years, once again on the assumption that current LTM budgets are maintained and that loss and damage rates are well-controlled. It is interesting, and perhaps significant, that Namibian schools, as in Rwanda, prioritise upper grade textbook purchases over lower grades.

5.3 Conclusions from the case studies

Both of the computerised LTM/LSM Management systems described above have provided national MOEs and donors with the capability to manage LTM supply and distribution effectively, on time while maximising the use of available finances. Accountable delivery has reduced wastage in the distribution process in both countries to less than 1% per annum. MOEs are able to see student/teacher/subject to LTM/LSM ratios in schools, districts/regions and nationally. Data has begun to be shared between MOE departments enabling Inspectorates to target poor performing schools or schools that can be highlighted with poor school LTM/LSM wastage levels. Levels of financing will have to be improved (Rwanda) or maintained (Namibia) if 1:1 textbook targets are to be achieved and maintained. A significant increase in financial allocations for reading books is required in both countries

None of the benefits listed above would be possible without computerising the supply chain process. The success of the implementation of a digital supply chain highlights failures elsewhere in the education system.

6. Simplifying LTM Information Collection

Although bespoke computerized information management systems probably represent the way ahead in terms of the reliable annual provision of accurate LTM-related data they are expensive and there are immediate changes that can be introduced at lower cost, which will improve the usefulness of the data collected. In most countries a review needs to take place to ascertain exactly what data needs to be collected, how often and in what formats different MOE departments require this information. This review should be accompanied by a plan for reducing the duplication of work and district/school administration overheads and improving the reliability and accuracy of data collection methodologies.

Where there is an objective to provide LTM data, which can be used to compare the performance of national LTM provision between different countries, one of the most important variables is the difference in national curricula and in particular the difference in the specified number of required compulsory subjects at different grade levels. For lower primary grades the variation in the number of subjects requiring textbooks can range from zero (Uganda for the local language thematic curriculum) to two, four or even eight subjects. When schools provide data on their current grade level textbook stocks as part of annual LTM information returns it is critical that this data is closely linked to official national specifications on the number of required subject textbooks. In practice in most countries certain subjects, typically language and maths, get more priority than other subjects in lower primary grades. Lower primary learning objectives increasingly emphasize the early achievement of literacy and numeracy so the concentration of LTM data collection on language and maths textbooks is also a national policy option.

The first priority is the establishment by all MOEs of the key "norms" that will apply to their own LTM supply systems. Examples of typical "norms" are:
- Priority LTMs – textbooks, teachers' guides, reading books etc
- Target student ratios of required textbooks, teachers' guides and reading books by grade levels
- Target numbers of reading books per student by grade levels
- Target/assumed annual LTM loss and damage rates (to be determined by sample studies)
- Target LTM classroom usage rates (to be determined by sample studies)

Most of the norms listed above are MOE policy decisions and will require little additional work, but the norms are important so that data returned by schools can be accurately analysed both at a national level and internationally for country comparison purposes. When the norms have been agreed and specified the annual data collection profile can be agreed. Simple, limited data collection profiles are recommended. These could be:
- An accurate and comprehensive annual list of schools with agreed categorisations
- Grade level enrolments by gender provided annually by a specified date
- Stocks of priority LTMs by grade level – language and maths textbooks could be highlighted within this data if so desired.
- Loss and damage rates by grade level
- Classroom usage levels by grade level