

Knowledge society and collective intelligence. Factors in capacity-strengthening in African countries.

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Abstract—As we enter a world in which intellectual capital is fundamental, in which the central activities are no longer those aimed at producing and distributing goods but those that produce and distribute knowledge and information, the challenge for African countries is enormous. They must abandon the traditional systems organised like silos and make their capacities converge in order to create collective intelligence. As their natural assets are insufficient, the construction of a knowledge society is a necessary pathway on condition that compartmentalisation is removed so that their capacities can converge. In the specific field of scientific research, the data gathered in a large survey that we conducted in Algeria reveal the need to create synergy between research and development. It is therefore shown how the adoption of a intersectoral, national and regional pooling system can provide the critical mass required by research teams and help the countries of Africa to join forces in federative projects that address high-priority problems. This is therefore a deep-seated change in the way of thinking and in working methods (cultural and operational aspects) that will generate cross-fertilisation at the level of countries and the region.

At the international level, the federating by African countries of their capacities can contribute to strategic debates on energy, climate, sustainable development, food security, etc. that are eminently important for them.

Keywords—Africa – knowledge society – collective intelligence - pooling – capacity-strengthening – use of research.

I. INTRODUCTION

Knowledge has never had such a strategic position in human history. The countries that have chosen to invest in knowledge have understood that it must be organised in such a way as to be opart of development, knowledge pooling and collective intelligence. It is no longer sufficient for enterprises operating increasingly in very complex ecosystems to accumulate knowledge in order to succeed; it must be possible turn knowledge into know-how, methods and procedures. This

is what specialists call 'intellectual assets'¹ and consists of 'human capital and organisational and structural capital'²; this generates value from intellectual assets and achievements based on knowledge³.

The African continent is faced with serious constraints in the use of its own intellectual capital with regard to this context in which the organisation of knowledge becomes a source of performance and competitiveness. The work performed by its researchers has little visibility and is very scattered because of institutional compartmentalisation and the inadequacy of national memories, leading to loss of knowledge. At the international level, its absence of world-scale scientific heritage tends to result in marginalisation. The continent as a whole generates 0.4% of the content of the world-wide web and 0.02% if South Africa is not counted. This inadequacy had been identified by the scientists themselves.

In a globalised world in which the problems of the planet lie mainly in the South and where sustainable development involves first and foremost the distribution of wealth, the challenge faced by African countries thus has multiple facets. They must join the knowledge society to make up for the inadequacy of their natural assets. This in turn requires the appropriation of digital technologies in their various socio-cultural contexts; they must master technologies to enhance the dissemination of their scientific production with a view to placing it in international networks and using it in national

¹ OECD

² Edvinsson, L. and Malone, M. (1997). *Intellectual Capital: Realising Your Company's True Value by Finding its Hidden Brainpower*. Harper Collins, New York, p. 539

³ Edvinsson, L. and Malone, M. (1997). *Intellectual Capital: Realising Your Company's True Value by Finding its Hidden Brainpower*. Harper Collins, New York, p. 50

development plans.

However, it must be stressed that the knowledge society twinned with technology would be just 'orphans' unless they were supported by a strong pooling and sharing strategy. The gap between North and South can only be reduced by a critical mass of resources and capacities in the African countries. One can therefore ask two fundamental questions. What are the chances of a possible catching up in a world imprinted with competitiveness? Are institutions and, more generally, African countries ready to undertake a pooling strategy in order to benefit from collective intelligence?

The knowledge society: which constraints for African countries?

The world of research, which is at the heart of knowledge production and innovation, is a very favorable ground for the construction of the whole cultural dimension of sharing in African countries. In research centers in advanced countries, collaboration, co-production and sharing of resources have profoundly altered the practices of production and dissemination of knowledge. With the strength of their interactive networks, researchers are now working in laboratories "without walls" where everyone has the ability to interact remotely and share data or resources. Tools of communication and co-production enables them to coordinate access to resources often broken in various scientific environments. The culture of sharing is actually strengthened by technology.

In this production of knowledge that requires confrontation and cooperation teams, is added the distribution of content that are highly structured around different objectives : databases involving the full-text databases of expertise, projects ongoing research, search results ... this is what can produce information of high added value, since it becomes a source of innovation and development (transfer of research results), and source of planning Strategic Research (evaluation indicators).

However this wonderful world of technology is taking place on the line of the economic divide between North and South, causing a digital divide even deeper. To get to combine the knowledge society and information society, Africa must also include information as both a commodity and as a finished product of the activities of its researchers. It must come to build their own devices for using and sharing its research results into real vectors of development (knowledge transfer).

In other words, it must develop its own strategy of collective intelligence.

In this context, the challenge for African countries is enormous and must include:

- build their scientific memory and make visible their research results;
- building a tool for monitoring and evaluating their research projects in order to build research programs and sufficiently coherent to support development;
- build bridges to transfer research results to the user sectors, considering the necessity of establishment of links in information processing in science outreach

programs.

A strategy and mutual tools to strengthen

The importance of electronic communication has completely changed the practice of production and dissemination of knowledge in the world. The transmission time information is not correlated with the distances, the Internet offers new indisputably logical exchange and sharing. In this immense opportunity to share information and co-production, research institutions in Africa often live in a large subdivision.

The installation of collaborative tools based on web technology therefore is affirmed as a critical need. To cite a few examples, the use of these technologies as a tool for sharing, may decline at several levels:

To build a strategy of mutualisation, as well for the level of the countries as on the level of under areas and/or the area, it is necessary for all to reduce the dispersion of the initiatives, the projects and the resources. To the methodological and technological plan, the integration of the domestic networks or regional, within a coherent framework will give rise to a federate space which will offer the visibility and the critical mass so much required. It is a question of making converge the national investments, the international supports on a co-operative information system regional decentralized, aiming at the consolidation and the complementarity of the existing networks.

This creation of federate spaces of visibility of projects of national and/or regional scale will make it possible to constitute a true regional memory. The production of contents with high added value rests certainly, on an important work of data processing, but it should well be stressed that on priority sets of themes for the development of the continent (such as food safety), the pooling of the supplies in hand is fundamental, if one wants to reduce the insulation of the countries under development.

Africa must thus develop its own contents and make them circulate. It is while making its researchers visible that it will be able to insert them in the global area networks as much as in the development process and of the innovation within their own countries or the area. To limit the improvement of the conditions d' access to scientific and technical information with a better technical connection to Internet network would make African the consumers of the information of North and would do nothing but worsen the North-South current gap.

Lastly, remote teaching also represents a real challenge for the access to the society of knowledge. It implies the installation and the control of interactive technological platforms, but it remains a means impossible to circumvent for the reinforcement of the capacities and the pooling of competences, in particular in certain priority fields for the development or in the case of insufficiencies of local resources of formation. The examples of success of virtual universities intended to support flows of knowledge and to reduce human flows, are numerous throughout the world.

From this viewpoint, new know-how in the teachers (novel modes of writing and transmission) and at the professionals of

information should make it possible to install new production process and diffusion of the knowledge. It is thus at the same time a technological, methodological and sociological dimension that it is necessary to integrate in this space of information and formation for high added value.

II. THE KNOWLEDGE SOCIETY: WHAT ARE THE CONSTRAINTS FOR AFRICAN COUNTRIES?

The world of research is at the heart of the production of knowledge and innovation and very favourable ground for the construction of the entire cultural dimension of pooling among African countries. In research centres in advanced countries, collaborative work, joint production and the resource-sharing have deeply modified practices in the production and dissemination of knowledge. Thanks to the strength of their interactive networks, researchers now work in laboratories 'without walls' in which everybody can be involved in remote interaction and share his data or resources. Tools for communication and joint production enable them to coordinate access to resources that are often scattered among different scientific environments. The pooling culture is strongly consolidated by technology.

To this production of knowledge involving comparison and cooperation between teams is added the dissemination of content that is strongly structured around different objectives: databases with full text, expertise databases, ongoing research projects, research results, etc. This makes it possible to generate information with high value-added insofar as it becomes the source of innovation and development (the transfer of research results) and a source of strategic planning of research (evaluation indicators).

However, this marvellous world of technology is becoming established along the line of the North/South economic divide, causing a digital divide that is all the more marked. To achieve the twinning of the knowledge society and the information society, Africa must also label information as both raw material and a finished product of researchers' work. It must succeed in developing its own facilities for the use and pooling of its research results in order to make them true development vectors (transfer of knowledge).

In other words, it must develop its own collective intelligence strategy.

African countries face an immense challenge in this context. They must perform the following in particular:

1. build their scientific memory and make their research results visible;
2. equip themselves with a steering and evaluation

facility to be applied to their research projects in order to be able to develop sufficiently coherent research projects that will support development;

3. create links for the transfer of research results to user sectors, while considering the need to set up links for the processing of scientific information in extension programmes.

A. *Strategy and pooling tools to be strengthened.*

The importance that has been gained by electronic communication has led to a complete change in practices in the production and dissemination of knowledge in the world. As information transmission times have little to do with distance, the Internet indubitably provides a new logic of exchange and sharing. In this context that is very favourable for data sharing and joint production, researchers at African institutions are often in strongly compartmentalised situations.

The setting up of collaborative working tools based on web technology is thus a crucial requirement. To give just a few examples, the use of these technologies as a tool for pooling can operate at several levels.

A reduction of the dispersion of initiatives, projects and resources is required for building a pooling strategy at country, sub-region and/or regional level. From the methodological and technical point of view, the incorporation of national or regional networks in a coherent framework will give birth to a federated area providing the visibility and critical mass that are so earnestly sought after. National investments and international support must converge on a decentralised cooperative regional information system aimed at the consolidation and complementarity of existing networks.

This creation of federated areas of visibility of projects of national and/or regional scale will make it possible to develop a regional 'memory'. It is true that the production of content with high value-added is based on substantial information processing work but it must be stressed that the pooling of existing resources is of fundamental importance in the case of priority themes for the development of the continent (such as food security) if it is desired to reduce the isolation of countries resulting from under-development.

Africa must therefore develop and disseminate its own content. Making its scientists visible will make it possible to incorporate them in both international networks and the development and innovation process in their own countries or the region. Limiting the improvement of conditions for access to scientific and technical information to better technical connection to

the internet would make African consumers of information from the North and would further worsen the present North/South divide.

Finally, distance learning is also a true challenge for access to the knowledge society. It involves the setting up and mastery of interactive technological platforms but is still a necessary facility for capacity-strengthening and the pooling of competences, especially in certain fields that are of high priority for development or if local training resources are inadequate. There are many examples in the world of the success of virtual universities aimed at enhancing flows of knowledge and reducing flows of humans.

For this, new know-how among teachers (new modes of writing and transmission) and information professionals should make it possible to set up new procedures for the production and dissemination of knowledge. A technological, methodological and sociological dimension must therefore be integrated in this high added-value facility for information and training.

III. FEDERATING RESEARCH AND ECONOMIC PRODUCTION. THE RESULTS OF A CASE STUDY.

African researchers face a two-fold difficulty. The inter-institutional compartmentalisation of research teams resulting from a lack of mechanisms adapted to exchanges does not favour resource sharing and joint production (collaborative work). Their results lack visibility and give insignificant support for development. With regard to this point, 75% of Algerian researchers think that one of the weak points of national scientific production is the absence of mechanisms for its transfer and 86% consider that this is practically inaccessible, for lack of adequate referencing.

Because of the importance of this observation—made by both decision-makers and scientists—we wished to obtain measurable data in agriculture, a sector that is particularly important for the Algerian economy. The farming world has its own know-how (traditional knowledge); it uses its own communication networks for the exchange or transfer of knowledge and uses several forms stemming from its own cultural heritage⁴. It also has access to an organisational institutional information facility providing technical information, funding and subsidy mechanisms, the landholding regime, etc. How does it integrate these two complementary forms of information when we know that 'a new item of

information is only received and assimilated, only becomes appropriable and memorisable when the receiver has succeeded in putting it in form in his own way.⁵

In addition, do the institutional facilities take into account the various facets of the transfer of knowledge and/or information: response to individual demand, the creation of social networks, pooling and collective intelligence? Here, specialists emphasise the degree to which extension must not be perceived as an action limited to 'the breaking down of the technology package into a set of themes that the farmer should be made aware of. With the latter considered as a passive receptor via which transits information considered to be assimilable.'⁶

The whole knowledge base generated by scientific research is added to this institutional information facility organised around agricultural extension services⁷. The basic question raised is that of knowing how to transform scientific and technical representations to provide a broader and clearer view of a number of principles. Scientific capital must therefore be managed to handle transfer to the economic sector and make it a tool for innovation. Do agricultural advisors as intermediaries provide the production sector with information that matches requirements? In their position as interface between two sectors, they must 'repackage' research results with a view to their incorporation in production.

Our questions lead to the problem of institutional decompartmentalisation with the aim of creating a favourable environment for collaborative work and the pooling of knowledge in an organised framework. In a key sector for the national economy, synergy and the notion of cross-fertilisation between all the stakeholders are a source of development.

We therefore wished to find out through our survey whether the functional and cultural conditions exist for the creation of collective intelligence. Starting with farmers' requirements, we measured the degree of matching of what is available, also taking into account the potential requirements of the agricultural production system as a whole. User participation in the designing of the service for Jean-Michel Salaün is a contraction between 'service' and 'production' to indicate the moment at which user and producer combine their energy to produce the service. François-Yves Le Coadic has a user-oriented approach in which 'the user's status changes from that of end-user to that of fully-fledged partner in information systems' and is a reminder that to analyse information requirements 'you have to get data at workplaces ..., the user

⁴ Edvinsson, L. and Malone, M. (1997). *Intellectual Capital: Realising Your Company's True Value by Finding its Hidden Brainpower*. Harper Collins, New York, p. 539

⁵ Michel de Certeau. *Cultiver la technique*. Paris, Dalloz, 1984

⁶ Mohame Benfrid. *Schémas et mode de fonctionnement du système de vulgarisation dans les filières avicoles et bovines en Algérie*. Cahiers options méditerranéennes, vol. 2, n°1, 1997, p.124

⁷ 600 agricultural extension agents active in Algeria, 1 national agricultural extension institute (INVA) and technical development institutes by agricultural sector.

must be perceived in his professional environment⁸.

For Florence Muet⁹, the objective of a study of the requirements of a public lies in the need 'to identify and understand the relations that individuals have with information and knowledge. This means knowing how and why information is incorporated in the activity of the persons to be served, followed by reflection of the way in which the information service can intervene'.

In line with our objectives, the survey whose results are presented was run in four regions close to Algiers from January to April 2007 under very difficult field conditions. It was made possible by the strong contribution of more than a hundred (152) farmers representing the three types of farm found in Algeria¹⁰ and working in areas that are representative of the Algerian farming sector: grain crops, vegetables, orchard crops and livestock.

A. The contribution of institutional information

Keen on accompanying farmers confronted with a very complex environment and the target of frequent reforms, Algeria has set up a large-scale support facility consisting of professional organisations and production support institutions. However, farmers do not feel that they are receiving effective support from the latter; they do not give any of these institutions a score of more than 25% for performance.

These inadequacies perceived by farmers are summarised in the following data that indicate marked institutional compartmentalisation:

- 73% consider that they have not been informed about the programmes of the agricultural technical institutes;
- 72% cannot benefit from the opinions of experts (researchers and extension agents) concerning agricultural problems that arise on their farms;
- 72% of farmers do not know the journals published by the technical institutes providing support for production;
- 46% do not mention the title of any Algerian publication on agriculture;
- 83% do not know, for example, the technical sheets published by the Institut technique des cultures maraîchères et industrielles (ITCMI).

The weight of these data is aggravated by the following features:

- the absence of tools for locating information;
- the very small number of extension documents put into circulation;
- the weakness in information in comparison with farmers' preoccupations;
- the slow replies to farmers' requests for information.

These institutional inadequacies enhance informal exchanges between farmers; 29% discuss their technical problems with family members and 28% discuss them with other farmers. Discussions with experts are more limited at 14%.

The least that can be said is that the knowledge transfer process to the economic sector should be entirely rethought.

B. Relations with the administration

Farmers also experience constraints in access to administrative information. More than a third of the farmers mentioned this problem. To handle this, they have to find compensatory solutions in which they must use their own funds and sacrifice working time. Our data show the solutions used to obtain such information:

- personal trip: 52%
- telephone: 36%
- internet: 2%

The absence of a federative approach is one of the major constraints mentioned by farmers; the problem is raised in the following proportions:

- no grouping of farmers: 80%
- the need to travel to obtain information: 28%
- no telephone network: 14%
- no network for access to the internet: 14%

The figures above clearly express the poor capacity of the agricultural administration to set up technological levers to improve communication with farmers. They also highlight the gap between a plural, diversified population of farmers characterised by different appropriation of information and the standardised means of communication of the administration. Use of the internet can provide the various stakeholders in farming with interactive modes of communication and put an end to the inadequacy of the present information system.

C. Provision of information: for what objectives?

Actions for support for production aim at accompanying farmers in development operations on their farms. However, according to the data gathered during our survey the extension system tends to be concentrated on providing new knowledge:

- 30% consider that the documents provided do not help to solve problems at farm level;
- 70% say that the television messages broadcast are inappropriate;
- 70% consider that the replies to their questions are inappropriate;

These inadequacies in the information available result in the same development of informal networks and individual

⁸ François-Yve Le Coadic. *Le besoin d'information: formulation, négociation, diagnostic*. Paris, ADBS, 1998

⁹ Florence Muet. *Analyser les besoins d'un public cible Oui, mais comment? Documentaliste: sciences de l'information, n°1, février 2008, p.40*

¹⁰ *Individual farm, collective farm, private holding.*

solutions: 75% of farmers talk to people they know and 62% call on another farmer.

D. Information sources

On questions of feeding livestock, 34% of farmers talk to a family member and 30% to another livestock farmer; 33% consult a veterinary surgeon. It can thus be seen that farmers' local roots tend to favour discussions within the community, whence the need to formalise and supervise these exchanges. However, in spite of the weight of tradition in which oral communication is dominant and in spite of the low level of education, farmers express very well the position that they award to other means of access to knowledge, including printed documents (30% use these).

The choice of source of information also varies according to the professional context: it is related to each phase of farm management: diagnosis of the holding, planning, applying techniques, carrying out work on the farm and supervising the various operations. When seeking information for decision making and where investment is involved, in addition to their own knowledge, farmers use a validated source of information that gives them more confidence: documents, a vet or another farmer.

E. Reply times are a limiting factor

The information process is often successful when there is a match between the choice of suitable context and respect of the time taken to supply the information. In our case, farmers found the slow response of the extension system to be a true constraint. For 82% of them, not enough time is devoted to the broadcasting of messages on the radio, causing a problem of understanding the content. Similarly, the time taken to disseminate technical documents in relation to the farming calendar is considered unsatisfactory by more than 70% of the farmers.

F. Extension services: professional integration or passive consumption?

Performance in the information dissemination process is measured by the level of adoption of the information by users. In our study, the information that reaches farmers is not incorporated in the production and development process of the farm. The following figures are sufficiently significant:

- 53% do not use any documents in the management of their farms;
- 63% do not apply the content of messages broadcast on the radio;
- 64% call on the extension agent, but with certain reserves (reference to the experiences of other farmers, the competence that the agent is thought to possess).

Although a large proportion of the farmers (84%) watch the news on television, 63% do not use advice broadcast on the radio and 48% rarely apply the messages broadcast as radio and TV spots. The reasons given by farmers include 'I prefer to use the techniques that I know' and 'the solutions are

expensive', showing the need for an extension approach that matches farmers' socio-economic conditions.

G. The new information technologies

Our results show that 78% of farmers do not communicate via the internet. Access to this would be a solution to the constraints resulting from farmers' isolation and remoteness from sources of information. The internet can also be an excellent tool for exchange, pooling and collaboration work involving all the stakeholders in the sector: farmers, researchers, extension agents and suppliers.

For the internet to have the position that it should have in this sector, production support services must anticipate farmers' requirements and work on the promotion of awareness to reduce the factors that currently limit its use:

- socio-cultural blockage;
- poor knowledge of the services that it can provide: access to financial aid, to distribution markets and mastery of private sector supply on the basis of comparative studies;
- lack of training in the use of the internet;
- cost of the equipment and the subscription.

Even though they cannot be generalised to all contexts, the interest of these results is that they can be used to measure the extent of compartmentalising between two sectors, that must naturally be complementary, as it is accepted and recognised that research feeds innovation of the economic sector. In order to undertake this process, the Observatoire de la recherche agronomique en Algérie, currently being set up, aims at centralising on a single platform the knowledge base of all the institutions in this key sector for the national economy. In addition to managing and steering research, this facility developed with the contribution of CIRAD in Montpellier aims at federating all the various stakeholders (political, economic, university, etc.) to focus on the strategic objectives of the sector.

IV. CONCLUSION

The development of scientific research and that of information and communication technologies (ICT) has given birth to our knowledge society. Like raw materials, intellectual capital is a source of development and innovation on condition that it is organised via mechanisms to prevent dispersion, to enhance the emergence of collective intelligence. However, compartmentalisation—whether between institutions in the same country or between different African countries—is one of the brakes to be removed in order to federate and strengthen capacities. The results of the survey that we conducted in Africa draw our attention to the scale of compartmentalisation that is not favourable for pooling and exchange between the research and production sectors. In this context, the Observatoire national de la recherche agricole, in the process of being set up, will have a full role as a federator.

At the regional level, knowledge pooling initiatives have rarely resulted in the impact and benefits expected. Isolated

and hence dispersed in their turn, they have not benefited from a concerted strategy with an integrated view of needs and the target objectives that would lead to decompartmentalisation and pooling. Together with the strategic view, the operational aspect is based on the development of new mechanisms capable of supporting the implementation of federative projects for development. Other regions in the world have adopted this approach, with a set of positive experiences. It is not a question of performing a 'North/South copy and paste' operation but one of finding our own mechanisms, constructing our own geography of sharing and knowledge pooling for development.

V. ACKNOWLEDGEMENTS

This work is based on reflection conducted within the framework of the Algeria-France cooperation project to create an Observatoire de la recherche agricole en Algérie. Warm thanks go to the Algerian and French parties that have supported the project.

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