# Understanding the phenomenon of coordination and its role in integrated water resources management

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## 1. Introduction

Integrated water resources management will require a level of coordinated interaction between individuals, groups and disciplines such that they can collectively, timeously, wisely and cost effectively visit the consequences of their past, present and future actions. Calls for coordination are synonymous with water resource management which needs to be integrated. The plethora of policy and legal documents surrounding water resource and environmental management are saturated with the imperative of co-ordination. The 1998 National Water Act, Local Agenda 21, the National Biodiversity Conservation Act, the Integrated Development Planning system, the Strategic Development Initiatives and the National Environmental Management Act (NEMA) are some of the many which make this call for co-ordination. The mission and policy statements of every government department and most private companies, NGO and organizations and groups of all types, reflect the imperative of coordinated actions.

Co-ordination is a universal challenge in all fields of human endeavour and especially within and between organizations. We can learn generic lesson from a range of organisations who have succeeded in mastering co-ordination. This paper explores some of these lessons and their relevance to integrated water resources management.

Complex, dynamic challenges need innovative approaches One of the main purposes of coordination is to develop the ability to innovate in a systemic manner, within organisations. Chesbrough & Teece (1996) offer an explanation of systemic innovation as one whose benefits can only be realized in conjunction with related complementary innovations. They believe that systemic innovations pose a unique set of management challenges regarding information exchange, sharing and coordinated adjustment throughout the entire product system and often the organisation.

Coordination is about the collective efforts of individuals. Despite the clear benefits of coordination it is often incredibly difficult to achieve. Part of the reason for this difficulty is that the phenomenon of coordination and particularly the impediments to coordination are not well understood. This paper

explores the phenomenon of coordination in the generic sense with emphasis on its application in the integrated management of common water resources.

**2. Uncertainty**

One of the often neglected barriers to coordination is how we deal with uncertainty. Why does uncertainty form such a barrier to coordination and hence integration? According to Kreitner & Kinicki (1992), some of the factors that contribute to uncertainty are :-

- unclear objectives;
- vague performance measures;
- ill defined decision processes;
- strong individual or group competition or
- any type of change.

All these are strongly present in most integrated water resources management situations. This uncertainty in turn triggers politicking which creates severe barriers to the levels of coordination which are required for integrated management. The change from managing in compartments to managing in an integrated fashion is essentially a transformation process. Those who are involved in the transformation from the old water act to the 1998 NWA have experienced these difficulties. Tichy and Devanna (1990) write of the heightened levels of technical, political and cultural uncertainty in most transformation processes.

Coping with uncertainty is therefore vital for successful coordinated action. Vogt (1995) and Senge et al (1995) relate how Royal Dutch Shell coped with uncertainty. Leaders at Shell imagined a series of different futures and "practised" a strategic response to each of these highly uncertain outcomes. Once articulated Royal Dutch Shell resisted the normal human temptation to resolve ambiguity and instead developed the capacity to anticipate and respond to a wide variety of potential futures. The ability of individuals and groups to sense early and accurately and respond appropriately and in time helps to reduce uncertainty and hence enhances coordination.

In an environment of high uncertainty, trust is an essential element within relationships and hence for coordination. Trust is important because relationship building, practice, prototyping, culture, control, standards and many aspects of communication all require the building of trust. Trust is an essential pre-

requisite for open honest dialogue which underpins multi-disciplinary and multi-organisational systems thinking which are at the root of coordinated actions.

**3. Systemic innovation**

One of the main purposes of coordination is to develop the ability to innovate in a systemic manner, within and between organisations. Chesbrough & Teece (1996) offer an explanation of systemic innovation as one whose benefits can only be realized in conjunction with related complementary innovations. Furthermore, they believe that systemic innovations pose a unique set of management challenges regarding information exchange, sharing and coordinated adjustment throughout the entire product or service system and often throughout the organization itself. The complex socio-scientific challenges of integrated water resources management certainly require systemic innovation. Chesbrough & Teece (1996) maintain that coordinating a system innovation is particularly difficult when industry inter-operability standards do not exist and must be pioneered. The issue of inter-operability standards is discussed in more detail in Section 4. According to Chesbrough & Teece (1996) experience has shown that once a new inter-operability standard has been established then virtual organizations can manage further joint innovation quite well. These findings relating to systemic innovation are supported strongly by Upton & McAfee (1996) who reported on a number of innovative virtual factories which link across networks to have physical components manufactured at remote sites.

According to Zachary (1994) the developers of Windows NT addressed the issue of coordinated systemic innovation in the following brutally tough but ingenious manner. Microsoft has many brilliant people developing individual components of software. They were however faced with the fact that standalone brilliance doesn't amount to much unless it is also consistent with the work of others. The core dilemma facing the Windows NT project leader and chief architect was how to achieve coordination without stifling creativity. His solution for the NT development team was to "ban" the use of the OS/2 operating system on which they had been developing and enforce a system whereby on a weekly basis the components created in that week would be added to the skeleton NT operating system and redistributed as the only operating system on which to build the next weeks code. The two major virtues of this tough management philosophy were :-

- the ultimate in bottom up disciplined systemic innovation in which integration of code was guaranteed;
- it created a fierce opposition to bugs.

The above strategy created the necessary balance between order and chaos, rules and serendipity, innovation and tradition.

**4. Inter-operability Standards**

In some circles the very mention of the word standards is enough to invite resistance. Such an attitude often stems from a misunderstanding of the importance of standards. There are areas in which standards are desirable and sensible and other areas in which they will inhibit the freedom to create. It is important that a conscious strategy be invoked to develop the wisdom and the humility to learn the where inter-operability enhancing standards are needed. Thereafter it often takes courage and energy from leaders to address the changes and the challenges that these inter-operability standards require. The rewards can be enormous as the examples below illustrate.

Inter-operability standards must evolve and not be decreed by committees. This philosophy is embodied in principles underlying a standards based approach to rapid applications development (RAD) which is being promoted by the SAS Institute, IBM, and their large user membership which includes inter alia Abbey Life Assurance, American Express, British Airways, Sun Life of Canada. These corporations integrated their efforts to assist the SAS Institute to create a Dynamic Systems Development Method (DSDM). The single objective behind the DSDM is the development and promotion of a public domain, de-facto RAD methodology. The abovementioned consortium subscribes to the following principles; which are also highly relevant to many forms of integrated development

* user involvement is essential,
* teams must be empowered to make decisions,
* satisfying business requirements is more important than operational characteristics (build the right product before you build it right),
* a whole product based view is more flexible than an individual activity based view,
* iterative development is a powerful way to develop systems rapidly,
* all changes are reversible,
* management of teams by motivation towards achieving business goals, rather than by assignment of tasks,
* testing is integrated throughout the cycle,
* estimates should be tight from the outset with frequent deliverables,

* during procurement, a co-operative approach from both vendor and the purchaser is essential.

Many of these principles could be followed by wise Catchment Management Agency Boards as they set out to develop and procure systems. There are further interesting aspects to this development. At first glance one would assume that both SAS and IBM are in the software business and therefore should see each other as competitors and hence "lock up their secrets", or at the very least lock them away from other companies, but no, this development is taking place in the public domain and with an open invitation to others to "join the party". Why ? It is because they have correctly defined their business as service towards software solutions and not software per se. The difference is subtle but the effect on strategy is profound, as the above example illustrates.

Computer giants such as Apple, Microsoft, Intel and IBM and many others form partnerships and alliances for integrated development ventures. The challenge in such projects is to exhibit the discipline and inter-operability standards on certain issues and innovation and entrepreneurship on others. The key is to possess the wisdom to recognise which is which and then the humility to accept those issues on which one is required to conform or "play second fiddle".

The highly successful micro chips industry provides us with another example which demonstrates the enormous value of inter-operability standards. One of the primary bases of the worldwide semi-conductor industry is application specific integrated circuits (ASIC's). The key to the success of these chips is that they are fairly standard across the range for the basal functions, which comprise 80 percent of the integrated circuits. The differentiating functionality, or the application specific portion, comprises only 20 percent of the product. In this manner the economies of scale are able to bring down the unit price on 80 percent of the products content. The result of this is that ASIC's so affordable and reliable that they play an integral part in our everyday lives. The application specific paradigm could be employed to great effect in the water resources modelling industry that will be needed to serve integrated water resources management.

There are numerous other examples of productivity and creativity increases in the information technology industry which have been brought about by the wise use of inter-operability standards to assist the co-ordination of integrated endeavours. One of the more well known examples involved the information technology sector of the European petroleum industry. Greenbaum (1995) explains how 5

giant competitors turned huge budget costs into revenue centres by adopting wise standards on pre-competitive issues involving integrated IT systems. Co-ordination does pay.

## 5. Control

The issue of control is important for coordination. Rogers (1995) cited in Tristram (1995) believes that fear of losing control is at the heart of reluctance to engaging in efforts which require co-ordination between organisations. Fear of loss of control is one of the most deep-rooted but least acknowledged barriers to integration. Why should this be so? In general integration represents a major change. Jick (1993) states that for most people one of the negative reactions to change is related to control. Most managers are comfortable with the control, which they perceive they have over their sub-ordinates at present. Moving to larger, more integrated management system in which their group is going to be only a component instead of the whole is a change involving loss of direct control, which is threatening to most.

The forms of control required for coordinated integration must be both intrinsic and extrinsic. Intrinsic or self-imposed control is essential for creativity and extrinsic control is necessary for other reasons. The sub-sections which follow, deal with various forms of intrinsic and extrinsic control. For example, feedback and limited but wisely chosen inter-operability standards impose a suitable form of extrinsic control for coordination. Autonomous yet integrated teams are essentially alliances and Kanter (1994) believes that alliances cannot be controlled by formal systems but require a dense web of interpersonal connections and internal infrastructures that enhance learning, alignment and shared vision.

### 5.1 Control through feedback and interrelatedness

Often, control is perceived as being analogous to the handbrake in a motorcar, which has the function of stopping the car from moving. In integrated developments the strategic objective should be to enhance movement, co-creativity, coordination and empowerment, in other words to speed up the process and this is analogous to the accelerator and the steering wheel.

Sproull and Kiesler (1991) emphasise the importance of communication feedback as a means of control in conditions of high uncertainty. They point out the organizational design aspects of generating feedback are to broaden the base of participation and push responsibility and authority further down the organization.

If horizontal integration is pursued then control through feedback and interrelatedness is built-in. Control in the authoritarian sense is diminished in horizontal integration. but control in terms of feedback is greatly improved. In a complex and uncertain world such feedback control is, of major strategic importance. It is less likely that one will "dig a perfect hole in the wrong place" whilst following a strategy of horizontal integration. One's partners will inform one, because if you fall they will be pulled down as well.

### 5.2 Control through standards

Standards are used as a form of extrinsic control. If balanced integration is the desired outcome such standards should be employed to enable and not to restrict per se. This is in keeping with the governing paradox that standards, rules and discipline are the very foundation of freedom. They enable individuals to have the space and time to create and hence to control their destiny to some extent. To allow co-ordination endeavours to become so embroiled in constant and time consuming battles with formats and non-standards, turns that so called freedom into bondage. The makers of nuts and bolts know this.

### 5.3 Control through alignment

Alignment is an intrinsic and looser form of control which is usually employed between autonomous groups of responsible people in intelligent enterprises. The importance of control through alignment when coping with change in any complex business which demands initiative from a multitude of people is stressed by Kotter (1990).

Stacey (1992) speaks of conditions of bounded instability, which are similar to the concept of alignment. This enables participants to manage the inevitable tensions between creative developments and operational imperatives in innovative autonomous groups in which feedbacks and feed forwards are distinctly non linear. Paradoxically, control in these circumstances may mean actually provoking conflict around issues, encouraging divergent cultures and presenting ambiguous challenges. As Stacey (1992) stresses in such situations individuals have to learn to challenge and be open to challenge. They also have to develop the ability to learn with others in complex, sometimes threatening ways.

Control through alignment is emphasized by Falla (1996) when he discusses outsourcing. The same alignment issues would apply in seeking horizontal integration partners in the development of any

coordinated systems. Henderson (1994) write of challenges of alignment in the pharmaceutical research industry which has many generic similarities to the integrated water eco-systems management industry.

### 5.4 Control through vision

The issue of change is central to the move from compartmentalised to coordinated efforts . One of the essential processes for motivating and controlling change is developing shared vision. Sharing a common vision is arguably the strongest form of intrinsic control in highly uncertain integrated strategic endeavours. The concept of vision, like co-ordination is a widely used but often misunderstood phenomenon. Quinn (1992) (pg 258) offers some sound advice regarding the components of a vision. He believes a vision should embrace:-

i) what we do for the world (our mission)
ii) what we are best at (our core competency)
iii) our basis for differentiation
iv) the heart of our philosophy.

McCracken as quoted by Prokesh (1993) " If people are going to think for themselves, managers must create a vision and encourage everyone to buy in. Otherwise there will be anarchy".

Numerous other authors raise the theme of control through vision, for example Senge (1990a); Richards and Engel (1993); Rose (1990); Galvin (1993); Spector (1989); Carroll (1993) reporting on a speech by IBM CEO Akers in a speech to senior IBM management; Tichy and Devanna (1990); Kanter(1994); Quinn et al (1996); Stacey (1992) and many others. The controlling and motivating power of vision is real and is essential for any meaningful co-ordination.

### 5.5 Control through relationships

Control in the conventional sense which can be built into the contractual arrangement is important. However, control which is exercised through the relationship is far more important.

Spence (1994) writing on the subject of creating conditions for innovation in an environment of relationships, stresses the importance of achieving control through internalised behaviour which manages the relationship. Prokesh (1993) reports in an interview with McCracken that Silicon Graphics control *inter alia* through relationships and trust. Kanter (1994) emphasises the importance of relationships in alliance building and relationships in integrated teamwork.

Browne, CEO of BP, cited in Prokesh, 1997, Pg 154 puts it more strongly, "*You can't create an enduring business by viewing relationships as a bazaar activity."*

Browne explains the key points to business relationships and managing ideas.

> *"First, the most important part of any relationship is understanding what your partners hope to get out of it and to work hard to help them achieve that goal. This is the key to transforming a contractual relationship into genuine collaboration. Second, you have to deliver on your promises reliably and consistently. Third, you build a relationship between people, not between your organisation and a company or a government. Fourth, all relationships worth anything are open and flexible. Fifth, you should approach an opportunity (which should be the basis of every relationship) with humility. In BP's case they learn from competitors Mobil about operating refineries and marketing lubricants, from Shell about deepwater drilling, from Intel about managing incredibly rapid change and surviving on ideas; from the US army about capturing and sharing knowledge and from the automobile industry about procurement. Sixth, you build relationships for the very long term. How? You reject the notion that it is a commodity business. Finally, focus is vital. You cannot build a strong relationship with everyone."*

## 6. Culture

Culture is a key aspect of behaviour and can greatly influence the pattern of interactions between individuals, disciplines, groups and organizations. In the process of developing the necessary communication, relationships and trust required by coordination, the issue of culture is a major factor.

Quinn (1992) believes that knowledge systems have certain peculiar properties that can be managed to advantage. He explains that a large portion, but not all, of an organization's knowledge resides in three human reservoirs:-

i) the cognitive understandings
ii) the learned skills, and
iii) the deeply held beliefs of individuals.

Such deeply held beliefs form an important component of culture. Rall (1995) explains that culture is a pattern of basic assumptions that a group has invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration. This pattern of assumptions must have worked well enough to be considered valid and therefore to be taught to new members as the correct

way to perceive. Culture involves rituals, myths, ideologies, norms, values and ordered systems of thinking.

A number of aspects of our culture raise barriers to coordination. For example :-

- rugged individualism associated with a spirit of pioneering;
- the *"not invented here"* syndrome;
- the pride and rewards related to evaluation systems;
- protectionism;
- a culture of strong central authority where the decision process has been top down;
- there is limited subscription to the culture of working hard beyond the limits of bureaucratic control;
- deeply ingrained in our current culture is that errors are something that you just don't make rather than something that you learn from.

In the knowledge and information age, the culture which is emerging in virtual products which need coordinated innovation, is one of sharing early and often incomplete information and responding to the feedback it engenders.

A cultural value that often affects coordination in development projects is the status that companies accord different disciplines according to Leonard-Barton et al (1994). The dominance of a given discipline can create a powerful capability, but it can also lead to arrogance, which results in the capability becoming a dangerous rigidity. True integration counters the development of this culture. The effects of this culture often have serious financial implications as Leonard-Barton et al (1994) quote the example of DEC marketing people who discovered an important feature that customers wanted but lacked the stature and self-confidence to persuade the powerful engineers to include the feature. By the time the engineers discovered the need the project schedule had slipped 4 months. DEC later went out of business.

Culture is a major factor in coordination as Peck (1994) explains. He says that if culture is not taken fully into account in the design of a merged organization the lack of coordination induced *inter alia* by cultural differences is often a major cause of failure in the merger. Kanter (1994) also reports similar experiences, which relate compatible cultures and good coordination as key requirements for successful alliances and mergers.

## 7. Prototyping

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> *" Knowledge and learning cannot be transferred but must be socially reconstructed through experience, language and practice".* These are the thoughts of Vogt (1995)

If we accept this statement then it beholds a discussion on coordination to explore the concept and practice of prototyping and indeed the concept of practice itself.

Prototyping is invaluable for learning and coordination because one is able to see the consequences of ones choices, immediately. A prototype model provides a safe environment in which to make mistakes. The value of this safety is enormous for communication because it enables people in the stakeholder groups to lower their defenses, to be more honest and more open. Peck (1990) stresses that safety is a fundamental pre-requisite to good communication and good communication is fundamental to coordination. Argyris (1994) wrote of defensive reasoning which blocks learning. People resort to such reasoning when they feel unsafe.

According to Dearnley and Mayhew (1983) prototypes by their very nature are potentially discardable and thus may be viewed as a waste of money. Persuading people to use them is also a problem. When dealing with skeptical or awkward users, care must be taken to ensure that these people do not latch on to a relatively crude prototype and use it as ammunition against the proposed system. Despite these and other disadvantages outlined by Dearnley & Mayhew (1983) they stress that the nearer to the beginning of the development process the first prototype is built the greater the reward in terms of information gathered. Research by Leonard-Barton et al (1994) strongly supports this view. They showed that decisions affecting 85% of the total cost of the product (including its manufacture, use, maintenance and disposal) are typically made during the first 15% of a development project. They also found that changes that are made late in the project invariably upset the sought-after balance among product features, cost and quality. Thus delays are caused and often solutions then become sub-optimal.

Also supportive of this view is Tate (1990) who states the primary reason for prototyping is to buy knowledge and thus reduce uncertainty and increase the likelihood of success of a project. Especially in a complex multi-disciplinary subject such as integrated systems development much of the uncertainty arises from incomplete knowledge of what is required or how to achieve it.

A good prototype is one that has the right balance of simplicity and reality at an acceptable price.

Dearnley and Mayhew (1983) are strongly supported by a number of other authors who similarly believe in the value of prototyping as a process. Stacey (1992) stresses the importance of the patterns of thinking which are stimulated when one tries and fails. He believes that support from the top in projects involving high levels of uncertainty and requiring innovation must include permission to fail and the prototype is the ideal place to learn this. Rayport and Sviokla (1995) credit prototyping with the fact that in many instances virtual products (of which integrated systems models are an example) were able to engender product concepts that were outside the bounds of conventional thinking.

Senge (1995) warns that whilst increased access to information may be a step in the direction of enhanced learning, more information is not always better since it can place greater control in the hands of information systems designers who might not necessarily have the best understanding of the business issues. Prototyping, which involves vigorous interaction with the user as discussed above can counter this danger.

The research findings on group decision-making presented by Kreitner and Kinicki (1992), indicated some disadvantages to group decisions. In their discussion Kreitner and Kinicki (1992) make mention of the positive role of prototyping in group decision making.

Leonard-Barton et al (1994) explain that effective development teams build prototypes, often and early, to learn rapidly, minimize mistakes and successfully integrate the work of the many functions and support groups involved in the project. They call prototypes tools for learning and integrating and they go on to list the virtues of prototypes, as :-

* providing a common language and focal point for people from a wide variety of disciplines;
* helping each group understand how its work affects the work of other groups;
* enabling the team to spot problems that require cross-functional solutions;
* providing a powerful mechanism for focusing a development team's efforts;
* enabling management to review progress, assess what remains to be done and consider what alternative paths should be taken to complete the effort;
* enabling products to be developed and launched more quickly;

* enabling the development of products that are both higher quality and more effective in fulfilling their intended purpose in the market place.

Tate (1990) citing Boehm (1987) states that finding and fixing a software problem after delivery is 100 times more expensive than finding and fixing it during the requirements and early design phases. This has been a major driving force in focusing integrated industrial software practice on thorough requirements analysis, prototyping and simulation to avoid costly downstream fixes. Brooks, (1982) the renowned IBM software engineer states categorically that it is impossible to get a software system right first time. Whilst Lehman, (1989) says that software must evolve, undergoing continuous adaptation and change. Lehman (1989) maintains that software must be treated as an organism continually undergoing change and not like a once off artifact.

Davis (1992) describes what he terms operational prototyping which has evolved to address the shortcomings of throw away prototypes which work well for isolated small, relatively static problems. Attempts to apply them in more dynamic situations have failed. Operational prototyping interacts more with the user and develops longer-term relationships.

Prototyping often has to include potential business partners. Leonard-Barton et al (1994) report that since prototyping was done in house for the DEC3100 , there were only 20 applications which could run on it when it was released to the market. Technically inferior competitors who coordinated their efforts with external third party writers had approximately 500 applications, which could run on them. The DEC3100 was a market failure !

Davis and Botkin (1994) maintain that use and feedback in knowledge industries which require co-ordination is vital. This reinforces the importance of prototyping, for as Davis and Botkin (1994) point out :-

* the more one uses knowledge-based offerings the smarter the offerings become;
* the more one uses knowledge-based offerings the smarter one becomes;
* knowledge-based products and services adjust to changing circumstances;
* knowledge based businesses can customise their offerings;
* knowledge-based products and services have relatively short life cycles;
* knowledge-based businesses enable customers to act in real time.

Bowen et al (1994) reflect that a prototype of a development project is a microcosm of the whole organization and hence can test the coordinated functioning of the whole organization.

One further vital element remains to be discussed, that of practice.

## 8. Practice

In sport, it is unthinkable to speak of developing coordination without practice. Why then do we believe that in business and in science that we can achieve coordination through a few meetings and perhaps by passing around some documents? We do it all the time, much to the frustration of all. Why do we not break out of the cultural rut of trying in vain to achieve coordination in the manner described above? The answer to this question is elusive. However, if we are going to achieve the coordination required for progress on integrated systems developments in which various organizations and specialists participate then we are going to require practice.

Why is practice so important?

Senge (1990b) provides a succinct answer to this question. He states that there is overwhelming evidence that human beings have cognitive limitations. However, we have enormous capacity to deal with complexity at the subconscious level that we do not have at the conscious level. What is interesting is that through practice the subconscious can be trained. According to Senge (1990b) all learning involves a interplay between the conscious and the subconscious that results in training the subconscious. Examples are driving a car whilst listening to the radio and holding a conversation; playing tennis whilst mentally working on the match tactics; playing music in an orchestra. The fascinating power of the subconscious is that, it is not limited by the number of feedback processes that it can consider. Senge maintains that for any meaningful inter-play of conscious and subconscious, practice is essential. It is also interesting to note that the sub-conscious is programmed in many ways, *inter alia* through culture, beliefs, and language in systemic loops rather than linear progressions. The opportunities which modelling offers for heuristic learning are consistent with the requirements for practice.

Ferreira (1995) notes the strong trend towards cross functional and self managing teams, self control, peer control and customer control. These forms of control result in organisations which are capable of developing more responsiveness to changes in their environment and simultaneously achieving more

stability and coherence in their sense of identity, purpose and vision. Higher productivity and creativity are also achieved. Such forms of control are central to the success of the modern computer industry in which it is not uncommon to have up to 1000 engineers and scientists from, widely separated organisational units working with precise control and breath taking creativity at the same time.

## 9. Conclusions

It is evident from the above that whilst co-ordination is imperative for integrated water resources management, it will not simply happen because we place the words in policy documents. Coordinated action requires that we study and understand the phenomenon of coordination in its many facets. Furthermore that we have the discipline to carry out certain actions which will create an environment in which coordinated actions are much more likely to emerge. The right environment is so important because it provides us with the key leverage point to realize coordinated actions. On the subject of the right environment it is instructive to draw an analogy with the growth of a maize plant. It is conceivable that a maize plant could be "grown" cell by cell, fibre by fibre, in a laboratory by artificial means. This would take huge resources, time and money. A simpler way to grow maize is to plant the seed in the right environment of warm, moist, fertile soil and let the sunshine and the rain do the rest. This paper has outlined what such an environment might look like if one wants to grow coordinated activities to serve integrated water resources management.

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