DRAFT - Discussion Paper

No. 99 - ?

Institutional Arrangements in National Agricultural Research

Application of concepts of the NIE to Agricultural Research in Developing Countries

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ISNAR / University of Hohenheim project on "Strengthening the Role of Universities in National Agricultural Research Systems in Sub-Saharan Africa" funded by BMZ, Germany

The author thanks Henning Baur, Govert Gisbers, Heike Michelsen, and Larry Zuidema for providing valuable comments in the earlier stages of the paper.

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Introduction

National Agricultural Research Systems (NARS) in developing countries are facing the challenges of a rapid changing environment. In fact, the changes in the agricultural research environment, globally and internally, are putting in questions traditional NARS concepts and models which mainly have been based on a government body of a National Agricultural Research Organization (NARO). Actually, theorists are beginning to see research being conducted not under one research body but in the context of many independent loosely connected actors. With regard to the existence and interaction of national entities involved in agricultural research the new institutional economics (NIE) constitute a field of thought which can fruitfully contribute to the understanding of the context in which National Agricultural Research evolves. However, the new institutional economics has an enormously wide scope including very different schools of thought so that it is difficult to find a common sense of application of NIE concepts to national agricultural research.

This paper uses some concepts of new institutional economics to explain the institutionalization of national agricultural research in developing countries and the interaction of entities involved in it. First, a definition of institutions and institutional arrangements is given and the objectives of NIE are outlined. Second, some general concepts of the new institutional economics are introduced including some reflections on the role of the state. In section three some applications to national agricultural research are presented. In section four a framework for analysis of institutional arrangements in agricultural research is presented.

1. The Perspectives of New Institutional Economics

NIE is taking a new perspective on economies and societies to better understand the behavior of actors. At the heart of institutional economics is the notion of institutions.

1.1 Definitions

"**Institutions**" are the product of collective human actions. Institutions can be taken as formal and informal rules. The formal rules include regulations, administrative frameworks and structures as interpreted by authorities. The informal rules are the shared beliefs about acceptable and unacceptable behavior. They are a result of socialization, and expected reactions of other members of the society. For a definition of institutions in a broad sense we can quote Ruttan (see below). Khan adds to this definition that sets of rules may be formal and informal and that they may not only govern but also constrain the actors involved in the institutions, i.e. the agents:

> "**Institutions** are a set of rules which govern a particular set of actions and relationships" (Ruttan 1993).

> "**Institutions** are a set of formal and informal rules which constrain and govern the interaction of agents subject to that institutions" (Khan, 1995)

Institutions can be distinguished in (1) institutional environment and (2) institutional arrangements. The concept of "institutional environment" goes back to Davis and North. Institutional arrangements can be defined appropriately according to Williamson or Lin and Nugent.

> "The **institutional environment** is the set of fundamental political, social and legal ground rules that establishes the basis for production, exchange and distributions" (Davis and North 1971).
>
> "An **institutional arrangement** is an arrangement between economic units that governs the way in which these units can cooperate and/or compete" (Williamson, 1991).
>
> "**Institutional arrangements** are sets of structures and rules which govern the behavior of actors in a specified domain" (Lin, Nugent, 1995).

We constitute that the institutional environment, or as Lin & Nugent (1993) the "institutional structure", builds a kind of macro-frame of activities in a society. Among these institutions we find the socioeconomic and political structure, state behavior, ethnicities, culture, national and global markets, and rules governing elections, property rights, and the right of contract."

The differentiation made between institutional environment and institutional arrangements reflects a distinction of the feasibility for a policy of change. Whereas change of institutional arrangements can be done out of the organizations themselves at a short or medium term the institutional environment can only be changed from a very high level of administration or through a cultural change in the society possible only in the medium or long run.

One particular confusion persists in the distinction of institutions and **organizations**. By organizations here we mean a set of structured and integrated activities (Kast, Rosenzweig, 1985) taking place in a framework which has been set up for this. In economic and management literature the term institution has been often used almost synonymously to organizations. In the NIE, however, we find a clear distinction between institution and organization. According to the school of NIE institutions as the rules of the game are supposed to be different from the organizations or economic units (for example firms, community groups, educational establishments, government departments) which are the players of the game. However, institutions do comprise, among other elements, also organizations since organizations provide a structure to human interaction (North, 1993). In the following we will distinguish between institutions as rules and organizations as players of the game.

1.2 The objectives of the New Institutional Economics

The New Institutional Economics (NIE) take as their starting point the assumptions of neoclassical perfect market competition (perfect information, homogenous commodities, no barriers of entry, no economies of scale, profit maximization) and modifies them to reflect more common, real world situations. NIE argues that the perfectly competitive world of neoclassical economics is a special case of a much broader set of economic scenarios. In this world there is no role for organization and management, the firm is reduced to little more than a production function in which factors of production are combined.

It is the aim of the NIE to describe the emergence, existence and change of institutions (positive) and to find out which institutions would be economically and socially preferable and attributed to higher economic performance (normative) (see North 1993, Khan 1995). In

normative NIE two types of institutional analysis have been developed. Khan (1995) distinguishes them as follows:

- Analysis of the performance of the existing set of institutions. This analysis draws on the analysis of rent-seeking and extends it to transaction cost. The approaches are not looking for an economical first best solution (for instance a laissez-faire which as unattainable is irrelevant) but for a comparison of institutions with higher and lower performance. For example, a failure in the existing institution occurs if it results in lower new benefits for the society compared to an alternative institution.

- Analysis of the efficiency (performance) of the process through which institutions are changed. Analysis here can be classified under (1) analysis of the objectives of the political leadership and in particular the time horizon compared to that of society, (2) analysis of errors of calculation of models used by agents including the political leadership, and (3) analysis of the costs of change.

Most of the NIE analyses are imprecise on the question through which mechanism new preferable institutions arise. On one hand it is assumed that more efficient institutions and governance structures evolve as the parties involved come to appreciate the new benefit-costs possibilities (Bardhan, 1989), i.e. better institutions evolve by itself. This argument supports application of laissez faire market analogy and competitive equilibria to the social choice of institutions. The fittest institution will survive. On the other hand due to collective action problems, e.g. free riding, rent seeking and principal agent relations socially non-performant institutions evolve. Transaction costs themselves, by raising barriers to entry and exit, reduce pressures from any social selection process, sunk costs and asset-specificity insulate internal governance structures form market forces. This argument calls for a transformation to higher performance through adjusting institutions to lowest transaction costs.

In the search for appropriate institutions implying low transaction costs the aspect of cultural integrity is important. Societies that adopt institutional arrangements of other societies will have to expect very different performance levels of those institutions than perceived in the society of its origin because both the institutional environment and the enforcement characteristics will be different. It can be taken for granted, that transformation of formal political and economic rules from successful developed countries is not a sufficient condition for good economic performance in developing countries. Furthermore, the approach to institutions should not be static but dynamic. The key to continuing good economic performance is a flexible institutional matrix that will adjust in the context of evolving technological and demoghaphic differences and changes.

2. Some Basic Concepts of New Institutional Economics

Different schools can be distinguished within the new institutional economics, namely the theory of the firm, imperfect information and missing markets, history, political science and institutional change (see Hubbard 1995). In the following, we will elaborate on some of this concepts which are found to be useful in their implication for the field of agricultural research institutions, namely transaction costs, rent-seeking, principal agents and role of the state.

2.1 Transaction Costs

At the heart of the NIE is the making, monitoring and enforcing of contracts (Hubbard, 1995). Contracts, in this regard, are set in the frame of the prevailing institutions or, in other words, the institutions guide the way of contracting. The ease or difficulty of contracting, and the types of contracts made, are determined by the level and nature of transaction costs. Transactions necessarily involve implicit or explicit contracts specifying - to a greater or lesser extent - price, quality, quantity, timing of payment and delivery, penalties and rewards to encourage contract fulfillment and distribute costs of failure.

Like production costs, transaction costs are a catch-all term for a heterogeneous assortment of inputs. Transaction costs can be seen as costs for running the system; they do not incorporate the costs of inputs and resources itself but the costs for arranging these resources in order to produce output. Transaction costs may lead to allocations of resources other than according to the marginal rate of return of a production factor. Transaction costs include (a) direct costs of obtaining information, (b) costs of the negotiating among the parties to reach agreement on the provisions of the contract, (c) costs of communicating such provision to all the relevant agents, and (d) the indirect costs arising from the opportunistic behavior induced by the involvement of multiple agents and rent-seekers. Transaction costs add to the ordinary marginal costs of production factors.

Transaction costs can also be seen as costs of organizing institutional change. High transaction costs may prevent socially beneficial institutional changes from being implemented. Within the political system there occur political transaction costs. Those are costs of organizing the side-payments which allow institutions to be changed through a process of voluntary contracts (North 1990). Another cost category are transition costs which measure the political costs potential losers from a proposed institutional change can impose on the proponents.

2.2 Rent-seeking and Interest Groups

The rent-seeking theory constitutes a common ground between policy science, political economy and the NIE. The rent-seeking concept deals with explaining the prime movers and economical tradeoffs of interest group activities. Rent-seeking can be defined as all those interest group activities which focus on the access, the assurance and the enlargement of regulation rents. Through pressure of interest groups on the political process government measures (licenses, entitlements, authorizations) are promoted which improve chances of group members to increase their income. Other groups which will be affected negatively by such regulations may engage in rent-avoiding activities. Through rent-seeking activities particular institutions may prevail though evidence exists for their economic and societal non-performance.

The rent-seeking concept can be related to the notion of economic rents, particularly the one on producers rents. The producers rent is defined as the part of the profit gains which extend

the opportunity costs. According to allocation principles rents are obsolete. Necessary as incentive for a particular activity is only a remuneration which equals the opportunity costs. Producers' rents can occur temporarily and non-temporarily. Temporary rents are pioneer-rents for innovative and particularly efficient entrepreneurs. Profit-seeking, in this regard, contributes to growth and welfare. Non-temporary producer's rents occur if the offer is not elastic, i.e. if the producing factors are at least partly fix. Producer rents also occur in monopolistic conditions in which high prices of scarcity of goods are maintained artificially by the state. If for instance licenses are needed for a particular activity and if the amount of the product for which the license is issued is under the optimal market equilibrium then license holders will benefit from a regulation-rent. Therefore, high incentives do exist for interest groups to introduce and maintain regulations from which they will benefit.

Rent seeking activities are non-productive because they only redistribute rents between different groups of the society. Problematic effects of rent-seeking are particularly (Hennrichsmeyer, Witzke, 1994):

- The repeal of competition: Competition on markets designed by rent-seekers. The need for permanent adjustment to changing environments is reduced. Performance and creativity of actors do decline and the consumer is provided with a unsatisfactory product.
- The increase of regulation also in other domains: Successful rent seeking may give a signal to others to copy and intensify rent seeking activities. It becomes more attractive to invest in politic than in the economic market.
- The unproductive use of resources: Rent-seeking activities are costly (they increase transaction costs) and make use of resources which then can not be used for the production process.

In developing countries there often exists a particular role of the public sector in rent-seeking activities. Many individuals who are looking to make wealth pursue it through a career in the government bureaucracy - where they exercise power over existing economic activity and involve in rent seeking - rather than seeking to establish and develop risky private net wealth-generating activities themselves (Dorward et al., 1996).

Individuals in positions exercising rent-seeking activities depend on the support of influential social interest groups to maintain their power. North (1991) holds that it is the powerful groups in society who determine the institutional framework, particularly formal institutions. Other parameters being equal, the political width of social groups is related to the strength of their economic base. Olson (1965) states that the capacity of building and stabilizing an interest group depends particularly on its size. In small groups an individual can influence the decision making process. Lobbying for the interest group contributes to individual benefit maximization. The costs of collective action tend to be relatively high for large groups, especially when the members are scattered over large geographical areas and high costs of collective action reduce the political influence of a group (Eggertsson, 1990).

Interest groups and rent seekers draw on different means and powers to articulate their demands. White (1993) distinguishes four sources of power: (1) Power derived form the state through its defense of particular interests, (2) associational power, deriving from collective action by market actors, (3) power from market structures (e.g. monopoly), and (4) socially embedded power (deriving from birth and status). Due to the power and the rent-seeking activities of an interest group institutions may prevail which serve the interest of one group but which are contradictory to the welfare of the whole society. Also, established institutions may become the focus for costly distributional struggles between interest groups.

2.3 Principal-Agent Relation

The principal-agent model is most commonly used to analyze hierarchical relationships but is generally applicable to all forms of working relations and the exchange of goods and services in which interactions of individuals and organizations in the society occur. Eggertsen describes the principal agent relation as follows: In an agency relationship a principal delegates some rights (for example user rights over resources) to an agent who is bound by a contract to represent the principal's interests in return for payment (Eggertsen, 1990). The agent usually has more information than the principal about the details of individual tasks assigned to him and about his own actions, abilities and preferences (asymmetrical distribution of information). Each individual in a hierarchical structure, except at the ultimate levels, is simultaneously a principal and an agent when rights are transferred down the organizational ladder.

In particular, agents and principals may take dynamic steps that undermine efficiency and effectiveness of economic systems, pervert incentives and skew information (Klitgaard 1997):

- Agents distort activities toward those things easily measured at cost of those things not easily measured.
- Agents engage in influence activities: Distorting information, influencing evaluators of information, not revealing useful private information.
- If relative rankings of agents are used, agents may avoid useful teamwork or even sabotage others.
- Agents may avoid job transfers of the learning of new skills, for fear of losing bonuses attached to existing arrangements and competencies.
- Agents may act collectively to transmogrify performance bonuses into higher base pay.
- Principals, after learning more about the potential of production, move the goal posts, leaving agents worse off than before.
- Intermediate layers of the bureaucracy may simply lack incentives to undertake performance appraisal.
- In performance ratings, intermediate layers of the hierarchy collude with or extract rents from lower levels, undermining the system.

Opportunistic behavior imposes costs on the principal. The principal finds it in his interest to monitor an agent and structure the contract in a way this reduces the agency cost. A net reduction in agency costs can be achieved by designing contracts in which the interests of principal and agent overlap (e.g. sharing profits) or by introducing an efficient accountability system to monitor the agent's actions. Also, agents may find it to their advantage to offer the principal some collateral as a security against opportunistic behavior by them.

The principal agent theory can be seen as a branch of the transactions cost theory. A main idea is that the particularity of a principal-agent relation involves high transaction costs. To establish principal agent relations with preferably low transaction costs should be the aim of every institutional arrangement which is trying to improve performance in a particular domain.

2.4 The Role of the State

The reasoning for the state's engagement in the society is usually drawn from the theory of public goods. A good is a public good, as opposed to a private good, if its consumption by

one individual does not diminish the utility derived from its consumption by another. This implies that (a) the consumption of the good is non-rivalrous and (b) its provision is non-excludable (Bates, 1995):

- Non-rivalness implies that a good is equally available to all. This indeed is an essential attribute of agricultural information and knowledge. The use of a farming practice by a farmer is not hindered by the adoption of the same practice by other farmers. There is no capacity limit for its utilization.

- Non-excludability implies that it is impossible for private producers to appropriate through market pricing the full social benefits arising directly from the production of the good. It is difficult to exclude from the utilization of the good those who do not pay for it (Free-Rider Problem).

The state has to provide those services and goods which due to their character of non-excludability and non-rivalry will not be provided by private entrepreneurs in a sufficient quantity. Furthermore, without the state, its institutions, and supportive framework, high transaction costs would paralyze complex production systems, and specific investments involving in those long-term exchange relationships will not be forthcoming. The state's role from the NIE perspective is twofold:

(1) Protection and maintenance of the (formal) **institutional environment** and the processes through which they are changed. As Eggertsen (1990) states: The set of legitimate contractual arrangements is defined by the state, giving the fundamental rules of the game, assuring law and order and protecting property rights.

(2) Engagement in particular **institutional arrangements** participating either in the funding or directly in the generation of a public good or service through its organizations.

However, that the state should undertake an activity does not necessarily guarantee that it will be able to do it efficiently. Behavior of rulers, ideological rigidity, heavy bureaucracy, rent-seeking of political interest groups and interest group conflicts may be contra-productive to economic and societal performance. A key question of normative NIE is in which way the state could involve in the institutional environment and in institutional arrangements in order to maximize economic and societal performance.

(1) With regard to **institutional environment** North (1995) sees the interrelationship between the state, property rights, and productivity as follows: The stock of knowledge in society and the endowment of resources determine the technical upper limits for productivity and output, the economy's technical production frontier. For each structure of property rights there is a structural production frontier, which is reached by selecting, from the set of feasible organizations, those structures that minimize costs and maximize output. There are differences in societies, some create incentives that place the structural production frontier close to the technical production frontier; others do not. Usually, a political change is required to move the structural production frontier closer to the technical production frontier. Modern technology creates the potential for very high levels of productivity. These high levels of output cannot be reached without elaborate specialization in production and complex exchange relations among unrelated individuals, extending across both time and space. In general we can say that the more advanced the technology, the more complex the transactions, and the higher the transaction costs of utilizing the technology. Appropriate institutional arrangements are needed to reduce transaction costs of advanced technologies to manageable levels, and the state has a relative advantage in supplying the required structure. North argues that there is overwhelming historical evidence that states typically do not supply structures of property rights that are appropriate for placing the economy close to the technical production frontier.

(2) With regard to the role or the state in **institutional arrangements** many authors argue that the transaction costs of an institutional arrangement involving many players, particularly the state, tend to be higher than those of simple, private arrangements. During the last decade, a tendency has emerged to draw back the state's engagement and influence in institutional arrangements. Structural adjustment and privatization campaigns can be seen in this context. To shade more light on this question of preferable institutional arrangement in relation to the prevailing institutions approaches involve in calculating transaction costs (including cost of information, costs of linking and costs of contracting).

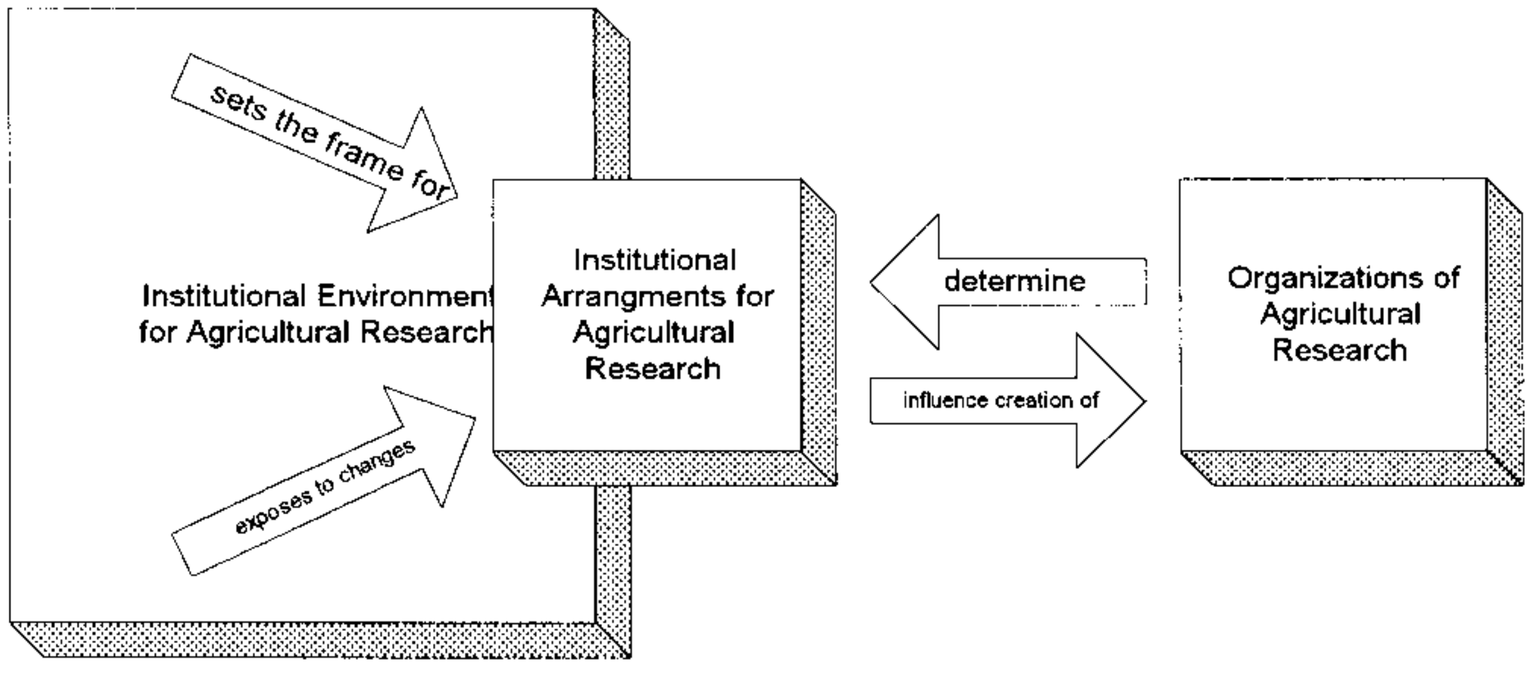
3. Institutional Arrangements in Agricultural Research

In the following we consider (according to the definition of Lin and Nugent) agricultural research as a particular domain. We so apply some concepts of the NIE to agricultural research. The actors (players of the game - as North puts it) are the organizations involved in agricultural research including the researchers affiliated to them plus the specific environment of the agricultural sector including farmers, farmers interest groups, extension services, agri-business companies and government bodies. As research organizations we may consider government research organizations, universities, parastatal research organizations, and private, non government and cooperative organizations which involve in activities of agricultural research. Defining an institution in agricultural research we state:

> "Institutions in agricultural research are sets of rules which govern (a) the behavior of researchers and other staff of agricultural research organizations and (b) the decisions of administrators regarding structure, organization and management of agricultural research."

Institutions for agricultural research can be described by (written) rules, decrees, and laws (e.g. funding guidelines, program guidelines, statuses, curricula, a.o.). A distinction has to be made between institutional environment, institutional arrangements and organizations. Institutional arrangements influence the creation and existence of organizations of agricultural research and their respective interactions and linkages with the institutional environment. The organizations on the other hand influence the existence of prevailing institutional arrangements for agricultural research. The institutional environment is both setting the frame and exposing changes for the institutional arrangements. Diagram 1 is drawing a simplified scheme of that relation between institutional environment, institutional arrangements and organizations in agricultural research.

Diagram 1: Institutions and organizations in national agricultural research



Institutional environment and institutional arrangements in agricultural research include a vast set of rules and structures, for example research contracts, research program guidelines, master and sector development plans, research mandates, contracts for provision with information and research results, linkage arrangements with other research organizations and users of research, and management. Diagram 2 is classifying some research institutions.

Diagram 2: Classification of institutions in agricultural research

	Institutional Environment	Institutional Arrangements
Formal	Examples: - National (sector) development plans - Ministerial structure (MINAGRI, MINREST) - Research coordination (by research councils, ministries, others) - Accountability schemes - Funding structures - Linkages to users - Linkages to global research - Markets for research results - Property rights - Agricultural and price policy	Examples: - Mandates - Research planning - Research programming (including program structure) - Research management conception - Research organization schemes and hierarchies - Incentive systems - Monitoring and evaluation systems - Internal linkages - Research Contracts
Informal	Examples: - Culture, ethnicities - State behavior and governance - Relations to users	Examples: - Organizational culture and philosophy - Hierarchy - Organizational governance - Motivation schemes - Internal relations

What is the significance of the concept of institutions to the domain of national agricultural research? Each of the institutions in diagram 2 may appear in a wide range of different shapes. Speaking with the words of North (1995) institutions are made up of formal rules, informal norms and the enforcement characteristics of both, and it is the admixture of rules, norms and enforcement characteristics that determine economic performance. The way institutions are shaped determines performance for the society and in our case, performance in agricultural research.

3.1 Transaction Cost Approach in Agricultural Research

The main transaction of concern in agricultural research is the "delivery and/or the exchange of research results as a public, semi-public or private good from a research organization to its users". Theoretically this transaction is based on a contract between the farmers (principal) and the state (agent). The national research organization (agent) is acting on behalf of the state (principal).

Transaction costs in agricultural research can be considerable. Obtaining project approval, obtaining funding releases from donor agencies, seeking government clearances, especially when more than one organization is involved, and maintaining participation of research user groups can be a difficult, costly exercise. Equally important is the negotiation of roles and responsibilities, as well as the exchange of information needed to maintain the vitality and effectiveness of partnerships. Furthermore, time is an important cost component of transactions in agricultural research. Lack of understanding among researchers and farmers of who is agent and who is principal, missing linkages between farmers and researchers due to financial and organizational reasons, and inefficient bureaucracies and hierarchy add to the picture.

3.2 Rent-seeking and Interest Groups in Agricultural Research

Working as an administrator or researcher in a national research organization is a privilege and is rendering, through salaries, allowances, status and other benefits, a rent. This is particular true to developing countries societies where the living status of a researcher is mostly way above that of the average population (it may be meanwhile way below of political and business elite, or to colleagues from developed countries or the CGIAR). Researchers and research administrators seek or preserve their rent. Structures and rules which guide the behavior of a research body and its staff, namely funding, freedom of research, and accountability schemes may be object to those rent-seeking activities. Distortion in political decisions may occur either through changes maintaining interest of rent seekers or through opposing change. For example, members of a government research body may involve in influencing policy makers to not allow opening up of channels of government funding to other research organizations in the private sector because that would lower their resource base even if the overall performance of this new institutional arrangement would be higher than that of the prevailing one.

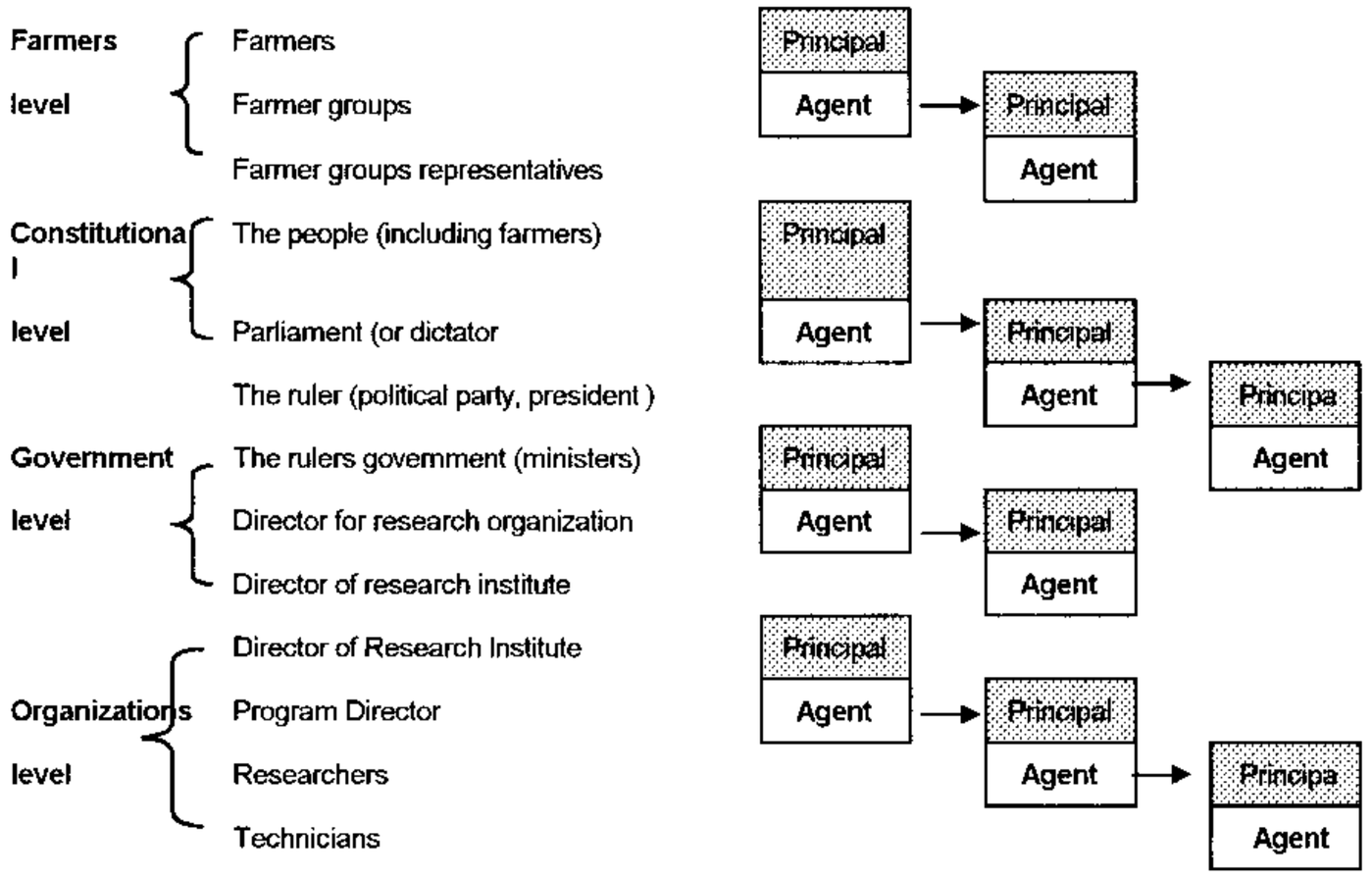
The agricultural sector has been always considered to be object of powerful interest groups (Baland and Kotwal, 1998). Farmers, consumers, food processors, agri-business, import-export lobbyists, marketing boards, government tax departments and, recently, environmentalist are all holding an interest stake in the agricultural sector. Those groups are hence interested in the results of agricultural research as they are supposed to enhance development of respective domains of the agricultural sector.

Traditional conflicts between those groups are well known; like for example the conflicts between rural producers and urban consumers, between farmers and marketing boards, and between farmers and food processing companies. Those conflicts feature also in the institutional arrangements for agricultural research. Due to the influence of some particular interest groups (mostly not farmers) performance in agricultural research may be below optimum (technical feasibility). Some areas of research may be over and some underrepresented.

3.3 Principal-Agent Problems in Agricultural Research

In 2.3 we found that as agents of the ruler, actors have personal interests that differ from both those of the ruler and those of the ruler's principal, the people (Lin, Nugent, 1995). This relation can extrapolated to the system in which agricultural knowledge evolves. Diagram 3 shows a multilevel principal-agent relation applied to a national research organization.

Diagram 3: Principal - agent relations in a government research organization



The above diagram illustrates the complexity of multiple principal agent relations within the agricultural research system. The large distance between the farmers as the users of agricultural research results and the agents to carry out the research, i.e. the respective researcher, can explain high costs of contracting and low performance in research.

3.4 The Role of the State in Agricultural Research

New information or knowledge resulting from research has been throughout endowed with the attributes of a public good. It is one of the characteristics of the agricultural sector that products of research at the applied end are characterized by non-excludability. Protection by patent laws is either unavailable or insufficient. The nature of agricultural production to be conducted in an open space makes it difficult to keep the know-how secret. However, in some domains (for example biotechnology and seed varieties) agricultural research results can also attain a semi-public or private good character. Due to the dominating public good character of agricultural research findings a rational consumer of agricultural knowledge will realize that his contribution to finance the generation of agricultural knowledge has no perceptible impact on its availability, he would not involve in any support to agricultural research. He would rather tend to free-ride and participate from agricultural knowledge generation financed by others without paying for it.

This situation calls for an engagement of the state in the production (generation) of the public good "agricultural technology". However, this does not necessarily mean that the state has to conduct research within its own body. It can also deliver this task to contractors and involve in its funding. Meanwhile there is also some research of a non-public good character which can be conducted and financed by private organizations and interest groups. Research of

the private good character can be outsourced to other appropriate private research organizations.

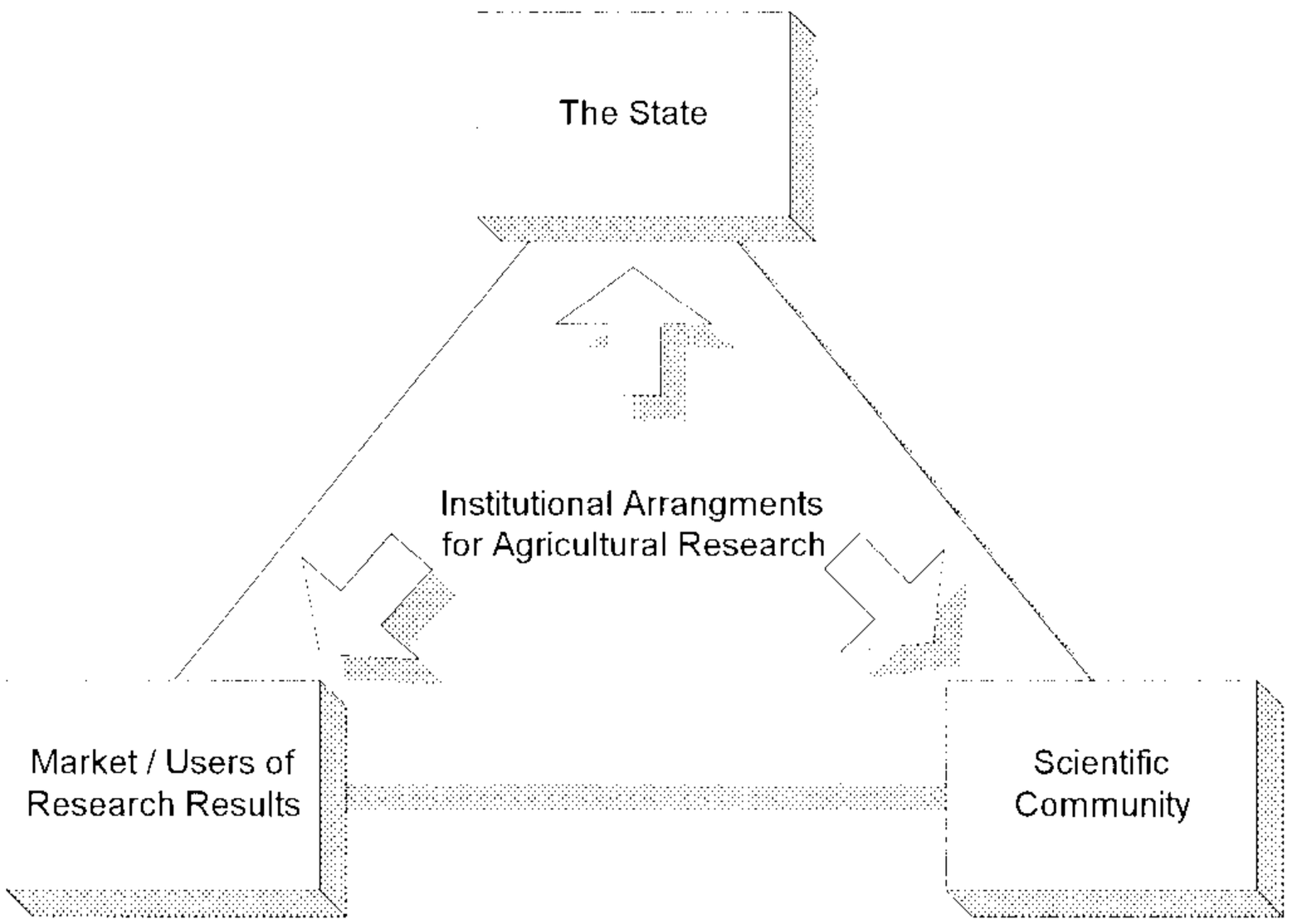
We perceive that, agricultural research, particularly in developing countries, is continuing to be generated mainly by government research organizations or organizations which are at least partly controlled by the state. However, the states most important role (according to the NIE) is in setting the institutional environment for agricultural research (namely market conditions, price settings, import-export regulations, a.o.) as they are continuing to hamper the performance of the national agricultural research domain.

4. A framework for Analyzing Institutional Arrangements in Agricultural Research

In the following we will introduce a framework which allows analyzing institutional arrangements for agricultural research along the lines of institutional issues as exposed above, i.e. transaction costs, rent seeking, principal agent relations, and the role of the state.

The framework is based on a concept which assumes that different institutional forces are influencing the shape of institutional arrangements for agricultural research. It assumes that due to the influence of institutional forces specific choices of institutional structures are made (compare also Landry and Amara, 1998). With regard to institutions of higher education the Burton Clark Model (Clark 1983) and suggests that not only the state and markets influence, but also the scientific/academic community (academic oligarchy). We transpose this model to the context of agricultural research and consider the above three institutional forces to influence agricultural research (see diagram 4). Further references to the triangular shape of influences on agricultural research can be found with Gerrard (1997).

Diagram 4: Institutional forces influencing the shape of institutional arrangements in agricultural research



1. The state: Many research organizations are state run. Administrators from for example the Ministry of Agriculture and other government bodies influence those organizations directly through job decisions, funding or indirectly through administrative laws and decrees. Meanwhile the state is also influencing non state organizations though providing them with funds for research, relating those to certain expectations, and by imposing laws and decrees. In the sub-Sahara African context, it is often presumed that the scientific community is largely influenced by the state, directly and indirectly.

2. Market demands (the users): There exist market forces promoting technological change within an economy. Those forces, guided through entrepreneurship and the search for economic rents, try to make use of new technology. They articulate their demands on technologies to generate through various mechanisms like lobbying, funding, and job decisions. The forces articulating those demands recruit from the users of agricultural research findings, like particularly farmers. Often farmers demands are channeled through farmers cooperatives and associations. As well food processing and marketing (agribusiness) and exporters articulate their demands towards research.

3. The scientific (academic) community: It can be seen as the self organizing force in science involving in the assurance of the quality and the choice of research projects. The scientific community sets the atmosphere in which new knowledge is created (freedom of research). The scientific community tentatively prefers the absence of a formal ruler or ruling body. Rules should rather be guided through scientific standards. The scientific community arguments that if norms of freedom are not protected from market and state interference new knowledge cannot be generated as openly and the quality of research cannot be assured. However, the scientific community is only to a limited extend able to respond to problems of accountability.

Often another force, the international donor community, is mentioned to influence on the research agenda. Indeed, the international influence on research operations, most of all in Sub-Saharan Africa, is preponderant. However, international players would use one of the above channels to articulate their interests. We may cite, for example, World Bank projects aiming on holistic restructuring of public agricultural research organizations which use the state for channeling their objectives. Efforts of bilateral donors to increase participation of farmers in research planning sometimes use the market for channeling their project objectives.

It is straightforward to assume that conflicts may arise between the institutional forces regarding their views on how the institutions should be shaped. We could imagine the example that a state interferes with the academic freedom of research organizations (in the past a case at many African universities) and may be in favor of a funding system which allows financing of research projects along personal criteria of board members of a research finance council headed by the Minister of Agriculture. Or, researchers consider their freedom to be cut down through the demands of big companies who provide funding for research only for very specific interests (for example influence of cash-crop exporting companies on the research agenda in African cocoa, coffee and tea producing countries) and provide a special research unit with equipment.

4.1 Shaping of Institutional Arrangements for Agricultural Research

The actual shaping of an institutional arrangement is determined by the influence of the three institutional forces on them. The equilibrium of interests is set by the rent seeking power of each of the institutional forces. While analyzing the shaping of institutional arrangements it is useful to distinguish the levels on which they function. They may be valid on the level of the individual, a research unit, a research organization, a research network or on the national level. In the following we want to distinguish between two levels, (1) the level internal to an organization and (2) the level external to an organization (can be assumed as the national level).

We assume that the main parameter determining the behavior of an actor in agricultural research is the institutional arrangement. Institutions, as factors which guide the behavior of actors in a system, may relate to the following characteristics:

Internal characteristics of institutional arrangements:

a) Bureaucracy

b) Internal hierarchy

c) Organizational culture

d) Program structure

e) Incentives and penal systems

External characteristics of institutional arrangements:

f) Authority

g) Accountability

h) Linkages to users

i) Coordination with research community

j) Funding

In Diagram 5 shapes of institutional arrangements are shown. It is important to note that the shapes are based on the assumption that the institutional arrangement would only be influenced by one institutional force – a situation which does not occur in the real world but which is important for analytical purposes (in order to distinguish the antagonistic influence of the different institutional forces. In the real world, we would perceive institutional arrangements shaped according to the respective equilibrium of powers of the three institutional forces.

Diagram 5: Shaping of institutional arrangements at research organizations according to institutional forces

Characteristics of institutional arrangements of agricultural research	Shaping of institutional arrangements according to Institutional Forces		
Institutional Forces	State	Market	Academic/scientific community
Internal to the organization			
(a) Structures and rules of bureaucracy	bureaucratic	management like	collegial
(b) Structures and rules of internal hierarchy	top down	mixed	participatory
(c) Organizational culture	agency like	cooperate like	partnership like
(d) Program structure	programmed	commodity/ production system based	disciplinary
(e) Structures and rules for incentives and penal systems	status driven	monetary driven	driven by academic reputation
External to the organization			

(f)	Authority	attached to laws, decrees	attached to performance	attached to grants
(g)	Structures and rules of accountability	accountable to state authority	accountable to performance criteria	accountable to academic guild
(h)	Structures and rules of linkages to users	Formal	Demand driven	Informal
(i)	Structures and rules of coordination with research community	planned	competitive	guided by scientific discourse
(j)	Structures and rules for funding	Priority driven	Demand driven	Curiosity driven

a) Bureaucracy

Bureaucracy can be seen as emerging from the needs of effective administration of large, complex organizations. If authority in an organization evolves into organized administrative staff it takes the form of a bureaucracy. Within this bureaucracy each member of the administrative staff occupies a position with a specific delineation of power. Social science considers bureaucracy existing along a continuum rather than being in an absolute sense either present or absent (Kast, Rosenzweig, 1985).

Bureaucracy styles in agricultural research are controversial since they conflict with the autonomy of the researchers. Due to the influence of the above mentioned three institutional forces we may distinguish three shapes of bureaucracy structures: bureaucratic (state), management like (market/users), and collegial (scientific community):

(i) **Bureaucratic:** Bureaucratic means based on the rule of law. This implies that an organization is governed by impartial rules, equal for all, rather than by orders from superiors which can be implied individually. Often, the state is particularly used to govern organizations through this (bureaucratic) rule of laws and decrees. This also leaves scope for bureaucrats to undermine or sabotage the policies of their rulers in order to safeguard their own interests. The same is true to non administrative staff of the organization, who may undermine the rules of the administrators.

(ii) **Management like styles**: Markets and users of research results call for management like bureaucracies. Management of an organization can assure that organizations exploit business opportunities and adjust their orientation towards needs of research users (Niklasson, 1995). The legal statue determines the mode of management which is subject to control of market trends, approvals, mobilization and implementation of budgets and the disbursement of funds to ensure the execution of research programs (Kola Cisse, 1992).

(iii) **Collegial styles:** Collegial style can be favorable to the well-being of the scientific community. Aspects of its internal life are possibly decided by consensus and logic procedures. Matters of opinion are solved by argument rather than by superiors' orders (Bjoerklund 1993, cited in Niklasson 1995).

b) Internal hierarchy

Usually agricultural research organizations involve in a sort of administration of their operations. The various parts of administration are usually organized in a certain hierarchy. A hierarchy can be seen as a ruling body which is organized into orders or ranks each subordinated to the one above. Those hierarchies determine the behavior of actors. Due to the influence of the three institutional forces we may distinguish three shapes of internal

hierarchy: top down (the state), mixed (market/users), and participator (the scientific community).

(i) **Top down:** Top down hierarchies are based on centralistic organizational schemes in which authorities from higher levels guide the activities on lower levels with few integration or feedback from lower levels. They are supposed to be very inflexible. The may impinge ownership and motivation. They suppress creativity and create injustice due to wrong decisions. They also may become very costly. However they serve in situations were powerful guidance is needed. In developing countries hierarchies with a strong influence of the state tend to be top down.

(ii) **Participatory:** Participation in internal context means involving all members of the organization in decision finding and making. Internal participation gives scope to feedback from lower levels of the hierarchy. Participatory hierarchies may be costly due to the time and effort involved in consulting the actors on all levels. But they may motivate actors, give them ownership in activities, and allow accumulation of a wide range of internal knowledge.

(iii) **Mixed:** With regard to the influence of the market and users it can be assumed that neither top down approaches (favored by the state), nor participatory approaches (favored by the scientific community) will come to existence. Users may put their influence towards mixed hierarchies which reflect elements of both top down and participatory approaches in order to assure centralized planning and integration of ideas.

c) Organizational culture

The school of organizational culture has wide scope. However, of interest here is the culture and philosophy with which research organizations respond to demands of the different institutional forces. In this regard we can distinguish agency like (the state), cooperate (market/users), and partnership like(scientific community) organizations[1].

(i) **Agency like:** An agency is responding particularly to the tasks of a principal. Assuming that the state (e.g. the Ministry of Agriculture) is the principal an agricultural research organization would respond directly to the state's curricula, guidelines and agendas. The organization's performance would be measured against the way it meats the criteria set by the governing state body. The state would prefer any type of organizational culture which is close to an agency because this would reflect easy articulation of its demands.

(ii) **Company like:** A research organization with a company philosophy is aiming to respond most satisfyingly to the demands of its users and stakeholders. Client satisfaction may be the most important organizational goal. The users of research would prefer a type of organizational culture which puts highest preference on meeting their demands.

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[1] Related to the organizational culture is the perception of researchers of the character of the research product they produce. Research operations determined by the state tend to produce public goods. Research operations initiated through a demand from users tends to produce private good. The scientific community is promoting both public and private products but additionally also may involve in producing club goods. Those goods are jointly consumable but outsiders (not having the scientific comprehension) may be excluded from its benefits. Club like goods face both eternality and free-rider problems but often manage to control them (Lin, Nugent, 1995).

(iii) **Partnership like:** Partnerships are collaborative relationships between individuals and/or organizations which usually manifest themselves in complementary or joint action of those involved (Baur and Wuyts-Fivawo, 1998). Partnerships do usually avoid centralized structures for their organization but depend on the willingness of the partners involved to cooperate. It is the form of organizational culture many scientists prefer because it reflects their needs in terms of freedom of research.

d) Program structure

Research is usually organized along the lines of scientific topics, thrusts or themes. This is true for either basic or applied research. Different concepts of research program structure exist. Due to the influence of the above mentioned three institutional forces we may distinguish three shapes of internal hierarchy in agricultural research: program based (the state), commodity/production system based(market/users), and disciplinary (the scientific community).

(i) **Program based:** Most research organizations carry out planning exercises for agricultural research. Often those exercises involve the different stakeholders of agricultural research and the state has a strong ownership in it. Once settled, those plans provide the structure for research organization, the so called programs. Mostly programs are long term structures which are not subject to dynamic changes required by problems emerging at the short run. Programs can either be disciplinary, multidisciplinary, program based or production system based. Mostly they are structured according to sectors and agricultural commodities.

(ii) **Commodity/production system based:** Users of research would usually demand answers to particular problems which occur in particular production systems or related to a specific commodity. They would therefore also prefer research to be conducted along the lines of commodities or production systems.

(iii) **Disciplinary:** Scientists usually have a strong relation to the disciplinary background in which they have been trained (e.g. genetics, plant biology, sociology, economics). Often, researchers do not match because of the different schools of thought of the disciplines they belong to. The scientific community tends to organize itself along disciplines (particularly at universities).

e) Incentives and penal systems

Institutional incentives include not only financial rewards and penalties. They are the positive and negative changes in outcomes that individuals perceive as likely to result from particular actions taken within an established set of rules, and laws (Ostrom et al., 1993). Incentives operate on different levels (e.g. departmental, organizational, national, international). Seniority-based promotion, pay based solely on position, and career paths only vaguely linked with rewards, are characteristics of non-peforming incentive systems preponderant in many developing countries (Klitgaard, 1995). There exists a wide range of possibilities to institutionalize incentive and penalty systems in research organizations ranging from scientific awards, salary increases, opportunities for distinction, prestige, and personal power; desirable physical conditions in the workplace; pride in workmanship; and conformity to habitual practices and attitudes. We may distinguish incentives related to the status to monetary benefits and to scientific reputation. Due to the influence of the three institutional forces we may distinguish three shapes of incentives: Status driven (the state), monetary driven (market/users), and driven by scientific reputation (the scientific community).

(i) **Status driven:** Scientist in a research organization which is state driven centralized, bureaucratic, and top down may be particularly concerned about their position and their status in the organization.

(ii) **Monetary driven:** Scientists in a research organization with an important influence of users of research would most judged according to their response to users demands. In case of high performance management of company like research organizations tries to provide the researchers with monetary benefits.

(iii) **Driven by scientific reputation:** The scientific reputation determines the position of a researcher in the scientific community. It is an incentive to a researcher to improve his scientific merit and acquire more reputation among his colleagues internally and abroad. The scientific community, in this regards, favors merit based recruitment and promotion.

f) Authority

The concept of authority is closely related to the idea of the legitimate exercise of power (Kast, Rosenzweig, 1985). Authority provides for the establishment of formalized transactions between institutional forces and research organizations. External authority structures, in our case, refer to the hierarchical dependence of the research organization towards the environment. The authority structure provides the basis for assigning tasks to the organization and developing control mechanism to ensure that these tasks are performed according to plan. The performance of authority structures depend on the willingness of the subordinated research organization to cope with certain directives of supervisors. A well designed structure and positioning of participants in a hierarchical arrangement facilitate the exercise of authority. Due to the influence of the three institutional forces mentioned above we me distinguish authority structures which are attached to decrees (state), to performance (markets/users), or to grants (scientific community).

(i) **Decrees:** The state, in the past, has imposed its authority particularly through the application of decrees and orders. Decrees actually constitute an easy way to channel authority. Its efficiency however is not always assured as control mechanisms are difficult to apply and controversial. In recent years the state is also becoming involved in other measures of authority imposition as for example performance measurement.

(ii) **Performance:** Assessing performance is usually the way clients impose their authority upon organizations which provide services. Assessing performance may imply that users may check on some quality parameters. It also can involve the application of entire performance evaluation and quality assurance schemes as for example used in some donor project evaluations.

(iii) **Grants:** The scientific community promotes authority schemes which give greatest freedom to its research operations. Granting of a research operation to a researcher or a researcher group including the provision of funds and physical resources would be the most preferred arrangement because it would provide almost no ex-post control mechanisms to the authority.

g) Accountability

One means of exercising authority is through accountability schemes (van Vught, 1991). Being accountable means having to provide a justifying analysis or explanation to an authority. Accountability reduces the freedom in research operations. It meanwhile can improve its performance. If good accountability systems are established and performance criteria are met relations between institutional forces and research organizations can result in

fruitful cooperation. Also, providing a larger accountability to both government and external donors may be seen as a way of regaining institutional autonomy to research organizations (George, McAllister, 1995). We may distinguish research organizations which are accountable to state authority (state), to performance (markets/users), or to the academic guild.

(i) **State authority:** The state would influence research organizations to be accountable to state authority. In public research organizations, through accountability schemes, the state assures to society that certain research operations leading to the production of public goods are carried out as required.

(ii) **User criteria:** Users may try to influence researchers to be accountable to criteria which meat their demands. Organizations which are efficiently managed may introduce internal performance criteria to meat demands of different clients.

(iii) **Scientific guild:** The scientific community would attach accountability schemes to scientific truth and innovativeness. Peers may be able to judge if research operations have led to favorable results.

h) Linkages to users

It is expected that within an institutional arrangement the benefits from research linkages to users are beneficiary when they outweigh its transactions costs (Castillo, 1996). Users of research results are themselves a force influencing the shape of institutional arrangements. However, linkages may be influenced also by other institutional forces. Due to their influence we may distinguish three forms of linkages to the users: formal (state), demand driven (market/users), and informal (scientific community).

(i) **Formal:** In order to involve stakeholders and users of research results the state would promote that linkages are established formally so that they can be controlled. The constitution of formal fora is often lacking participation of certain users and stakeholders.

(ii) **Demand driven:** The direct line of linkages from the user of research to the researcher is that the user articulates his demand directly upon the researcher. However, due to poverty, illiteracy, resource scarcity and culture the articulation of demands of resource poor farmers is often inefficient.

(iii) **Informal:** The research community has been often called to be an ivory tower producing its research results only for self-interest without relation to the needs of the ordinary user. In recent years also the research community became concerned about linking to the users community, particularly small scale farmer. However, the research community tends to reject formal imposed relations to users preferring to maintain its own informal relations to them.

i) Coordination with research community

It is crucial for researchers to link with the external research community in order to get the necessary state of the art scientific inputs which are needed to produce new knowledge. There are particular distinctions of how researchers maintain relations to the research community abroad. Alternatives which are thought to be influenced by the three institutional forces are planning (state), competition (market) and guild control (scientific community).

(i) **Planned:** The state may impose planned linkage mechanisms on researchers and also be able to control them.

(ii) **Competitive:** Management like research organizations (in case of existence) may leave the activities of their researchers open to competition. Competition is ought to increase quality but also the amount of options for researchers.

(iii) **Controlled by guild:** Under guild control we understand that professional norms which guarantee quality are maintained by the scientific community. Scientist not meeting the norms are subject to exclusion from the community and penalties. Guild control can interfere with market demands and political priorities.

j) Funding

Funding arrangements usually provide the donor with power vis a vis the recipient. As agricultural research usually does not generate high incomes out of its operations it is mostly depended on outside donation from either the state, the private sector, cooperatives and non-governmental organizations and from external donors like international organizations. Often we perceive a high complementarity between public private and international donor investment in agriculture research in developing countries. But mostly the public under-investment acts as a bottleneck for research operations. The

different donors of agricultural research funding provide their donations according to different objectives. In this regard we may distinguish funding arrangements which are priority driven (state), demand driven (market/users), and curiosity driven (scientific community).

(i) **Priority driven:** The state would allocate its funding resources according to the priorities set in the national or organizational plan for research.

(ii) **Demand driven:** Market forces and users of research results may follow purely funding schemes with which they expect that their demands will be met. This applies also to bilateral and multilateral international donors which do not use the funding channel of the state.

(iii) **Curiosity driven:** The scientific community tends to be guided in its funding decisions by scientific curiosity. However, funding is available to the scientific community only at disposition by donors. It depends on the scope of freedom which the donors provide whether the scientific community can make funding allocation decisions according to scientific curiosity. Some donors provide funding according to own scientific curiosity.

4.2 Improving Institutional Arrangements

We understand from the above that institutional arrangements have different shapes according to the institutional forces imposing their influence on them. The proposed framework helps to understand the context in which the behavior of researchers evolves. Analysis of agricultural research operations in a particular domain in country X could, for example, reveal the following:

> Example country X: Researchers are guided by a bureaucratic, top down structure, organizational culture comes close to this of an agency with the aim of producing public goods, research programs imposed by the state are commodity based, incentive systems are informal and based on status, authority is imposed by laws and decrees, researchers feel accountable only to the academic guild, linkages to users are informal to almost non-existent, links with the scientific community are competitive and the funding, almost exclusively provided by international donors, is driven by market forces. (One could imagine that the above description is following the lines of situations in many sub-Sahara African countries.)

In the search for alternative institutional arrangements this analysis already gives a baseline. In the search for more appropriate institutional arrangements one now can apply the rule of the thumb to maintain an equilibrium between the influence of all three institutional forces. A situation that one institutional force has no influence on the shaping of an institutional arrangement can be regarded as inappropriate. Further rules questions to be dealt with in the definition of appropriate institutional arrangements are:

- Are structures and rules resilient enough to remain viable when challenged by various types of institutional forces, i.e. what prevents them from breaking down. (focus on sustainability)

- Are structure and rules correspond to the specific cultural environment? (focus on cultural integrity)

- Do the structures and rules assure the quality of research output and its relevance to users and do they contribute to overall agricultural development? (focus on effectiveness)

- Do structures and rules enable efficient use of resources and knowledge ? (focus on efficiency)

If going further then the above qualitative perspective analysis of institutional arrangements has to involve in some sort of quantitative measurement. Performance indicators will support such a type of analysis. The differences in performance can be interpreted as being related to the different levels of costs of the institutionalization, i.e. different transaction costs. Transaction costs can be deducted from the total costs of the production of a unit of research output minus the values of all inputs as human, financial and physical resources and costs of priority settings and planning exercises. Such a transaction cost term would comprise the costs of the entire institutionalization of the system. In comparing transaction costs of different institutional arrangements one may deduct which one is more efficient. However, to establish the difference in transaction costs of one particular institutional arrangement would require two pure examples with all other characteristics remaining constant, a situation which is most unlikely to occur. The transaction cost approach is thus rather to be used to choose among whole sets of institutional arrangements, i.e. whole system of agricultural research. This is nevertheless useful because characteristics of institutional arrangements are mostly interrelated and occur jointly. In this respect institutional analysis can also be seen as a tool of system analysis.

As experience from other field of the NIE show analysis of institutions is often conducted qualitatively but there is still methodological and data problems involved in establishing the transaction cost analysis. This is also true to the field of agricultural research where yet, to our knowledge, no study has comprehensively evaluated transaction costs. It may be due to forthcoming research to shade more light on the issue which institutional arrangements are appropriate in which institutional environment.

Conclusions

The new institutional economics, though traditionally applied to other fields than the public sector and agricultural research, constitutes a vast area of fruitful approaches to understand who national agricultural research evolves. Though there are no ready concepts to improve performance of agricultural research in general NIE may suggest some areas of concern which can improve the understanding of mechanisms which lead to higher performance. Particularly the notion of institutional arrangements opens a window to a new view on the NARS concept, a concept which has proven to have difficulties in maintaining appropriate performance in research and integrating other partners of research as for example the private sector, Universities and NGOs.

Institutional arrangements for agricultural research are dynamic, they determine the existing research organizations and are influenced by various interest groups attached to them. The institutional environment sets the frame for the institutional arrangements of agricultural research. In analyzing institutional arrangements it is important to identify which relevant characteristics of institutional arrangements exist, which institutional forces are imposing their influence on institutional arrangements and how the actual shape of the institutional arrangements is. Institutional analysis does not refer to an analysis of the resources supplied, i.e. human, financial and physical, but how those resources are used, arranged and exploited. A basic framework for such an analysis could include three institutional forces: the state, market (users) and scientific community; and ten characteristic institutional arrangements related to the dimensions of bureaucracy, hierarchy, organizational culture, program structure, incentives and penal systems, authority, accountability, linkages to users, coordination with research community and funding.

Change of prevailing non-performance institutions has to be induced from the in- and outside of the institutional arrangement. However, institutional arrangements have to be in harmony with the institutional environment in order to attain performance. In the search for optimal institutional arrangements for agricultural research the transaction cost approach may be appropriate. Rent seeking, interest group conflicts, principal-agent problems and the role of the state add to the picture and can be appropriately approached using the transaction cost theory. Empirical work on transaction costs in agricultural research is almost in-existent and should be object of future efforts in the domain of agricultural research management and organization.

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