
Economic and institutional aspects of the Doubly Green Revolution

Michel Griffon, Jacques Weber

The Doubly Green Revolution aims to increase agricultural production to meet societies requirements. This will be achieved mainly by increasing yields (Rosegrant et al., 1995). The new revolution must also avoid harm to the environment and ensure viable management of natural resources and bio-diversity, i.e. without jeopardising the development capacity of future generations. Last, its principal objective is to reduce poverty.

This is, therefore, more than just a technological revolution aimed at integrating ecological concepts into agriculture. The Doubly Green Revolution also calls for large-scale economic and institutional changes in order to meet future risks associated with growth in agriculture and related sectors.

The fight against hunger is not yet over

"The fight against hunger is as old as the world. It is not yet over" (Malassis, 1994). To feed themselves, societies undergoing demographic expansion have to choose between using more new land or intensifying exploitation of land already in use with intensification there is always a risk of harming the ecosystem's capacity for renewal and production. The maintenance and increase of this capacity for renewal requires new technology and knowledge. Therefore, agricultural history is a succession of evolutions and revolutions both techniques and in the patterns of social organisation connected to these techniques. Not all have been successful. The ancient civilisations of Mesopotamia and of the Yucatan in Central America, for example, were not able to prevent damage to land fertility. On the other hand, in many developing countries, there are agricultural systems which use ecosystems intensively and which enable societies with high-density populations to subsist.

However, hand in hand with population increase goes a constant increase in demands made on ecosystems, to a greater or lesser extent. In most tropical countries, the fast population growth and high population figures force societies to accelerate

the use of ecosystems in conditions which, in many cases, do not ensure their long-term viability.

In comparison with earlier agricultural history, the end of the twentieth century is marked by two radically new phenomena: the acceleration in the pressure of use of productive areas and the massive spread of this phenomenon in tropical and Mediterranean countries. The result is a number of risks, especially the most well-known recurrent risk of food shortages. This is associated with the risk of environmental damage.

The risks, as we see them today

After three decades of development aid, including structural adjustment, the world still numbers between 300 million and one billion people affected by food deficiencies. Around 150 million children have weights deficiencies and around half a million women suffer from anaemia due to iron deficiency. It is estimated that around 20 million children are born with low birth weights and 40 million suffer from vitamin A deficiency. Finally, one thousand million have iodine deficiency (Von Braun et al., 1992). This situation reveals, first and foremost, the incapacity of societies to reduce poverty and food insecurity, particularly in the poorest populations. Since any of the poor are agricultural and livestock producers, they are the first to suffer from food production deficiencies. Research studies indicate an impending increase in food shortages over the coming three decades, mainly in Sub-Saharan Africa, South Asia and South-East Asia (Alexandratos, 1995; Mitchell and Ingco, 1993; Rosegrant et al., 1995).

The least pessimistic forecasts show, for 2010, a demand for imports of 160 million tons from developing countries. This demand could reach 400 million by 2025, to which 210 million should be added in order to eradicate hunger and malnutrition. Total supply will doubtless not exceed 355 million tonnes resulting in large scale deficit and therefore no significant reduction in the number of malnourished people (Conway, 1994). Food shortage is a real risk.

The second risk is of an environmental nature. Population increases will inevitably result in the conquest of new land, and experience shows that in many cases this gives rise to regressive ecological evolution: rapid reduction in forest cover, changes in water patterns resulting in land desiccation, loss of fertility and biological diversity. In areas which have already been cultivated, population growth results in a reduction of fallow land which can also lead to decreases in fertility if not compensated by nutrient inputs. In both cases, there is no renewal of natural resources and of the productive capacity of ecosystems. Ecological risk is therefore high.

Finally, risks connected to rapid economic globalisation should be taken into account, particularly with regard to the agricultural economy. One cannot be certain that all the food-deficient countries will dispose of the necessary foreign currency to pay for their food imports. In some countries, moreover, one can no longer be

certain that basic food production can survive competition from lower prices imports. The risk of increased dependency and food insecurity cannot be excluded.

When faced with these risks, the Green Revolution, banking on earlier successes may still be seen as a satisfactory solution. Indeed, it aims to intensify land exploitation by using inputs to substantially increase yields quickly, and thus reduce food deficits. It also aims to create a modern agricultural system which can be economically competitive. But, in reality, the Green Revolution is no longer a sufficient response.

Limitations of the Green Revolution

The Green Revolution was born in the 1960s when it was observed that famine risk in Asia was recurrent, due to demographic increases and the limitations of existing production systems. It was believed that this food risk could lead greater social and political troubles. In order to avoid a spiralling situation of this sort, resources were devoted to developing technology for rapid yield increases. Now thirty years later, production levels are very high throughout irrigated Asia.

The Green Revolution is often presented as being the result of the introduction of high-yield wheat and rice varieties, together with high-level fertilisation and plant health protection techniques. Contrary to general belief, the Green Revolution involves mainly small agricultural holdings, which represent almost the whole of agriculture in Asia. The concept was spontaneously widened to include corn, particularly in Mexico and Zimbabwe (Eicher, 1995). It could also be enlarged to include other crops such as groundnuts and cotton which are not food crops but are grown on vast areas of small-scale agricultural holdings. In the case of cotton, one speaks of the White Revolution (Fok, 1995) and for rapeseed the Yellow Revolution (Dorin, 1994). Intensification of stock-farming on small-scale farms also comes under a similar approach.

In Asia the Green Revolution was also benefited from economic policies based on high incentives: agricultural prices which were both high and stable (at least throughout a period of start-up and installation of the technical change), subsidies for the purchase of fertilizers and plant health products, purchasing facilities thanks to the creation of large public departments for extension services, the provision of inputs, the sale of agricultural products and credit facilities for the purchase of inputs and equipment. The Green Revolution was therefore simultaneously a technical revolution (selected plant varieties and inputs), an economic policy (incentives) and an institutional policy (public departments).

In many cases, the Revolution saw only fleeting successes, either because the techniques proposed were unsuitable, or because prices were not lastingly motivating, or because producers had used the incentives provided to extend the land area used (increase in surface areas) rather than intensifying. This was notably the case in sub-Saharan Africa:

In place where a long-term intensification process established itself, the Green Revolution encountered other problems, mainly negative external effects: salinity, and waterlogging in intensively irrigated areas, pollution due to chemical inputs, decrease in fertility and erosion in rainfed agriculture. More recently, structural adjustment policies have contributed to

reducing incentives to use fertilizers and plant health products. In India, price increases for fertilizers provide part of the explanation for the reduction, and for yield stagnation (Pingali, 1994). Similarly, in Senegal, in the same situation, cotton producers have reduced their purchases of fertilizers and have attempted to compensate for yieldergo income losses by an increase in the surface areas given over to cotton, with a risk of rapid deterioration in fertility (Anon, 1993). The Green Revolution is therefore encountering limitations in its application at the same time as population increases are requiring continued performance improvements.

How can Green Revolution limitations be surpassed?

The challenge is not only to continue with the Green Revolution by resolving the problems which it is encountering in environmental terms; it is also to increase production in the many regions where no Green Revolution has taken place and where increasing demands are being put on ecological areas. In these areas, the risk of ecological damage is added to the food risk. Deforestation, followed by the installation on forest margins of annual crops or pasture land, can give rise to irreversible damage to water regimes and to the biological diversity of species. In savanna areas, shorter fallow periods, without investments for the renewal of fertility, may provoke erosion. In dry areas, risks of desertification may be amplified by unsuitable agricultural practices. Finally, densely populated areas where societies have for a long time been managing productive ecosystems in a viable manner, are not exempt from problems related to ecological fragility.

Therefore, most agriculture when heavily pressured by society to produce more, whether or not they have experienced the Green Revolution, are confronted to a greater or lesser degree with problems of renewal of fertility, natural resources, ecosystems and biological diversity. These agricultures must therefore find intensification methods which are viable in ecological, economic and social terms. All these necessary technical, ecological, economic and social changes taken have been together termed as the Doubly Green Revolution (Conway et al., 1994).

The conceptual bases of the Doubly Green Revolution

As indicated by the CGIAR Panel, entrusted in 1994 with proposing long-term directions for agronomic research, we must produce more without damaging the environment, nor violating the principles of social justice. The Doubly Green Revolution

therefore responds to the objectives of sustainable development, and the principle of equity is one of its main components.

The production objective

Food production is the principal objective. But food is not the sole aim of agriculture. Agriculture is the source of numerous industrial products, some of which respond to basic requirements which increase along with populations: textiles, timber, biomass, for fuel, recreation. Reflection must also be continued with regard to the future of agriculture and of the ecosystems cultivated for food purposes only, particularly as energy requirements could constitute an increasingly important outlet for agricultural production. Account must also be taken of the whole food subsector, manufacturing and upstream industries, support services and, more generally, all activities which relate to the development of rural areas.

Important gains in productivity are possible within the food chain, from agricultural production to the consumer's plate: reductions in harvest and storage losses (the largest source), improvements in technical efficiency for artisanal and industrial processing, reductions in wastage at the consumer level. However, it is still expected that future needs can best be met by growth in agricultural production.

Growth in production may be achieved by expanding cultivated surface areas and by increasing yields, through intensified exploitation of cultivated ecosystems. In each region, the relative contribution to growth resulting from increases in surface areas and yields will depend on available land, its productivity potential, the cost of access to resources and the cost of exploitation. It will also depend on the potential for intensification of cultivated areas and on the cost of intensification. Producer preferences for extending surface areas rather than intensifying production means that the cost of access to new areas probably constitutes a key variable in the choice between the two methods of production growth. Access costs are closely connected to the existence and state of transport infrastructures which depend almost entirely on public policies. The latter are very different from one country to another, and future developments may be extremely contrasted.

Conclusions as to the geography of agricultural development, based on past trends indicate that the proximity of large consumption centres contributes to lowering transport and transaction¹ costs, to increasing incomes of hinterland producers and therefore to an incentive to increase their production and yields since agricultural areas are limited (Von Thunnen, 1994; Ninnin, 1994). It is in the hinterland of cities that incentives to intensify should be the strongest, particularly since pan-territorial² pricing mechanisms have disappeared under the effects of liberalisation policies.

1 Transaction costs: set of costs which are necessary for a given exchange: costs of information on partners and prices, costs of negotiation, eventually costs of contracts design, control costs.

2 Pan-territorial price: single price in force across a national territory

One also observes that rapid deforestation on forest margins is often the result of a race to appropriate land rather than the result of a migration of populations arriving from high-density areas. In this latter case, the progression of the pioneer front is slower. Therefore, where governments do not incite populations to penetrate heavily forested areas through infrastructure and tax incentives, or indirectly by means of forestry exploitation, the progression of cultivated agricultural areas is slower because access costs are higher. Correspondingly, incentives to intensify in hinterland areas are greater.

There is, therefore, a geography to the Doubly Green Revolution, which is mainly centred on areas of intensification and pioneer areas.

The objective of respecting the environment

Intensification areas experience the same problems encountered in high-input farming, in industrialised countries and in areas involved in the Green Revolution: pollution of ground water tables, rivers and estuaries by nitrates, phosphates and chemical residues; flora inversion (invasion of herbicide-resistant weeds), drug-resistant pests, varietal sensitivity new diseases, salinity of badly-drained land, reduction in the diversity of ecosystems and countrysides. High-density stock rearing, particularly in peri-urban farms, also gives rise to large scale pollution. These external effects result in important social costs. Techniques used by the Doubly Green Revolution must "internalise" these negative effects.

In areas on the forest margins, the Revolution must limit risks of irreversible ecological damage. In zones with low potential, it should also limit risks of deterioration.

Overall, the respect of the environment, within the framework of the Doubly Green Revolution, prioritises fertility renewal, the functioning of ecosystems without affecting the potential for genetic diversity, and the avoidance of irreversible ecological regression.

The objective of social justice and equity

It is not enough for development to be ecologically viable, it must also be something humanly bearable³, i.e. something which is socially acceptable. This brings us back to the idea that wealth distribution, income and possibilities of access to higher living standards must be socially equitable. Beyond certain levels of inequality and wealth concentration, social consensus for development is not possible. It depends on the representations which the various social categories make of one another.

³ As indicated by J. Poly in 1982, one of the major future objectives of agronomic research is to propose development which is both viable and "liveable", something which "modern" agriculture has not succeeded in achieving.

Equity has therefore been put to the fore as one of the principles within the Doubly Green Revolution. A society which recognises the principle of equity is a society ready to recognise the rights of everyone. In extremely non-egalitarian societies, equity must lead public authorities to work using "positive discrimination" in favour of the poorest citizens. The level of acceptance of inequalities, or of the mechanisms of social redistribution therefore depends on the individual society. This makes it difficult to define a criterion for universal equity. The only principle of universal law that could be used comes from the Universal Declaration of Human Rights. It implies equality of rights, and therefore more equity in the distribution of wealth.

The respect of the environment and the principle of equity in fact go back to a more general principle: the principle of sustainable or viable development, which is itself based on the concept of viability.

The concept of viability

The viability theory (Aubin, 1994) describes living systems - and therefore ecosystems and societies - as being the result of different variables such as variables of state and regulation (*regulons*). In the systems' leeway in evolution is restricted by viability constraints. If these viability limitations are violated, the system exits from the domain of viability, goes into crisis and may evolve according to irreversible trajectories leading to states which may or may not be viable. This case excluded, systems may be viable and stable or undergo stationary evolution or tend towards greater viability.

The concept of viability applies to the domain of agriculture and to agricultural and rural development (Griffon, 1995). For ecosystems, viability implies functioning of all biological cycles in conditions that provide for continuous renewal of structures and functions, and in such a way that production potential is maintained and future production is not affected. The functioning of cycles results in balances which may be in equilibrium or in surplus. These balances concern resources and their uses for elements which define the state of the physical environment and those which define economic and social situations. The domain of viability of an ecological, economic and social dynamic is, thus, characterised being the whole range of states for which the renewal regime is assured for a given period of time. The group of viability states as a whole shows, moreover, the property of resilience⁴ to known exogenous hazards.

The system is viable if, at any given time, its state allows for later renewal, i.e. if its evolution does not result in a tendency to leave the domain of viability and to enter into more or less irreversible deterioration trajectories. The pressure of requirements

⁴ Resilience: capacity of returning to initial state after external shock.

which the growth in human populations exerts on ecosystems is therefore continually calling the viability regime into question. The concept of viable development must therefore integrate the necessity of transforming systems (under the exogenous constraint of having to increase production) in such a way as to continually enlarge the domain of viability and its possibilities for future development, whilst preserving a capacity for resilience to known exogenous hazards.

This representation of systems as a group of uses-resources cycles and balances does not allow for the inclusion of "social acceptability". However, one may attempt to define indicators with regard to key areas for equity within the agricultural field: indicators of capital concentration (*capitalis*), be it in terms of real estate, finance or equipments, or conditions of access to natural resources, land, credit, information, education (*capabilis*), and indicators of knowledge as capital (*capacitas*) on which depends the possibility for accumulating the other forms of capital. Viable development must encourage relative redistribution over time of these three types of capital to the advantage of those who lack them more, and this must be undertaken in a socially acceptable manner. Let us note that any redistribution process is doomed from the outset if the parties to it reason in terms of acquired positions, in a no-win situation, whereas, on the contrary, it may succeed if one negotiates in terms of future positions, jointly sought, within the framework of an out-to-win situation.

This representation of ecological-economical systems does not prefer ecological viability over social viability, or vice versa. No hierarchy is established in the creation of viable states. Viability is not divided into sub-groups according to scientific disciplines.

Application of the concept of viability in the Doubly Green Revolution

The variable which provides the essential direction to the evolution of systems is demography. The need to extract more products from ecosystems is the element which determines the necessity of introducing replacement elements which will ensure the renewal of cycles and of modifying the ecosystem's structures (agricultural plans) in order to maintain their viability. Another key variable is poverty which may cause populations to damage ecosystems because they have no other choice in order to survive. Here, poverty should be understood as being insufficient capital, insufficient access to resources and production factors and insufficient knowledge (see above).

The Doubly Green Revolution must therefore guarantee ecological viability (viable intensification of exploitation of the ecosystem) together with the economic and social viability of the societies concerned (eradication of poverty). One must therefore endeavour to define techniques which will ensure ecological viability (Picard, 1995; Griffon, 1995).

Agricultural techniques in the Doubly Green Revolution come under a new concept of agricultural optimisation. Normally speaking, modern agriculture consists of setting up production systems which are partial substitutes to the ecosystem which harbours them. This substitution triggers feed-back effects on the production system: pressure of earth land-based parasites, sole crops invaded by weeds, etc. These effects bring about the introduction of corrective techniques, e.g pesticides, herbicides, to contain external pressures on the production system. Similarly, since the land had been transformed, nutrient cycles, water cycles and cycles relating to soil structures are modified. The maintenance of viable functioning of the soil-crop system necessitates recourse to fertilizers, tillage and, if required, modifications to water flows (irrigation, drainage). The use of inputs (fertilizers, chemicals, irrigation water) may give rise, in turn, to pollution and other external effects.

In the Doubly Green Revolution, agriculture aims to manage the ecosystem as a whole and not to transform it except where necessary and therefore, only very gradually. A production system no longer replaces an ecosystem; the ecosystem is exploited using its own law of functioning. In theory, one is therefore no longer subject to the negative effects of a barrier between the production system and the overall ecosystem. And external effects no longer exist, since they are internalised by the method. Where fertility was insufficient, fertilizers were added; now, on the contrary, better management of nutrient cycles will be sought. Where crops were attacked by pests, chemical products were used; now, one will seek to limit treatment within the framework of an integrated pest management (IPM) and by the use of plants' genetic resistance. Formerly weeds were destroyed in order to protect pure crops; now through inter-cropping it should be possible to obtain better ground coverage and water retention, thereby increasing fertility by means of selected plants. Agriculture was mechanised for better control over cropping operations, but this required more energy. Now emphasis is on saving energy, particularly by means of minimum tillage. Gradually, IPM is being achieved in the form of integrated management of soil fertility, water, diseases, weeds, etc. One could use the term total or holistic management. Simultaneously, therefore, the "production system" is leading to the "production ecosystem concept".

Contrary to the Green Revolution, which was interested in areas with high productivity potential, the Doubly Green Revolution should be interested in all areas where the risk of non-viability exists. It should therefore be interested in a great variety of situations, particularly those which are ecologically fragile. It will be interested both in areas where the intensification of the use of the ecosystem has become inevitable and where it has not taken place, in areas where the movement towards intensification has started but where it is not viable, and lastly in high-input Green Revolution areas where a different intensification concept needs to be used.

Repercussions on directions taken in agronomic, genetic and crop protection research are enormous. In agronomy, important research should be concentrated on

integrated fertility management, particularly in rainfed agriculture, and in systems which are marginal in agronomic terms. In genetics, the accent will be put on the adaptation of plants to more difficult environments. Rather than maximum yield in optimum conditions, one will seek to obtain satisfactory yields in environmental conditions which are subject to variability. One will also concentrate on "orphan plants" and on animal species which have as yet seen very little improvement. In terms of crop protection, IPM, which is nothing new, has a real place within this new logic. The holistic concept for the management of soil fertility, water, the pathosystem, breeding, the work calendar and the necessity of finding operational methods for production ecosystems with sufficient resilience, will lead researchers to strong interdisciplinarity which will include reasoning from economic and institutional angles.

The institutional conditions for a Doubly Green Revolution

The diversity of agricultural situations and the complexity of the phenomena involved prevent any centralised concept for public management of a policy to encourage and accompany a Doubly Green Revolution. Faced with this diversity and complexity, in a context of liberalisation which, in addition, deprives it of power, the State is no longer in a position to conceive and manage the transformations which wherever needed. State decentralisation, its de-concentration, privatisation of activities which are not at all public, and the internal liberalisation of the economy are conditions which are necessary for viable national and local development. The Doubly Green Revolution presupposes deep institutional changes. In many countries, they are already happening and indicate the direction to be taken by economic evolution after the structural adjustment phase.

The State : from implementor to facilitator

In terms of agricultural and rural development, in many countries the State initiates the development which it carries out and manages. By means of administrative bodies, state-owned companies and projects, the State has become all-powerful and has left very little room for the civil society, which has often sought refuge in activities seen as being informal since they resist fiscal influence and State.

The Green Revolution and attempts at Green Revolution have often been undertaken in a centralised context: national equipment policies for irrigation, public services for the provision of credit and for trading, public extension services, price regulations, etc. These centralised public mechanisms were coherent with the fact that the Green Revolution was a standard model which could be used by a very large number of producers.

Such a centralised system functions properly and has functioned in countries where a centralised administrative culture has been in existence for a very long time - in Asia for example - and where, over time, the authorities have been able to create a real expertise. However, in spite of these successes, there is a permanent risk, and malfunctions are inevitable. Centralised decisions can never be based on sufficient information since the cost of data collection is high. They may therefore be in contradiction with general interest at a local level. For this reason, centralised public decisions which have local consequences can rarely be optimal. Moreover, the existence of empowered State officials who lack precise capacity for social control, creates conditions that favour corruption and abuse of power.

Everything combines to suggest that a top-down conception of the State should be replaced by a bottom-up conception, where the State creates the frameworks for action, defines incentives, and facilitates initiatives, but is no longer implementor or manager. Initial application would involve the functioning of the agricultural marketing.

Facilitating market functioning

Internal liberalisation of economies must lead to less State participation in trade, and to fewer obstacles to the circulation of goods, particularly local taxation, whether the result of legal corruption. Liberalisation measures usually take their inspiration from the model of perfect competition which functions under the following hypotheses: trading partners identify each other, prices are always transparent and inter-connected markets form a complete system.

In many developing countries the reality is very different. Market channels are geographically segmented, e.g. cereal crops; it is often difficult to get surpluses to the areas in deficit. Prices are not transparent, and States are frequently opposed to their publication. Information is therefore asymmetric and detrimental to the interests of agricultural producers. The various markets are poorly inter-connected, e.g. African cereal markets are rarely connected to rural financial markets or to livestock markets. The fact that fluctuations in one market are not therefore absorbed by an other market, contributes to maintaining unstable prices and income levels. Finally, the State or private agents are often in a monopoly situation.

State withdrawal from trade and price setting, will not be sufficient to create a satisfactory situation *ipso facto*. Some necessary preliminary conditions must be in place to ensure correct functioning of the markets. One of these conditions is the existence of a public information system, that is accessible to all concerning markets and prices. Producers, intermediaries, manufacturers and consumers will then have information concerning the distribution of margins among agents within a sector, and on individual expectations.

Price-fixing conditions must be equitable, i.e. powerpull on markets must not be asymmetric. Confrontation between fragmented supply from agricultural produ-

cers and oligopsonic demand from traders or processing companies has always been to the detriment of the former. Where producers are organised in order to negotiate transactions collectively, the market force becomes more equitable. The same is true of consumers, with their segmented structure, when faced with the oligopolistic supply from trade and food industries.

Competition for shares of margins within a sector may create group situations which are not necessarily optimum, particularly where there is asymmetry of information coupled with adversity among agents. In this case, the risk of market failure is increased. Here the loss of earnings can be much greater than coordination costs.

Recent examples show that information on prices and markets widely distributed amongst agents within the sector, efficient representation of the interests of the various agents, and consultation - in many cases negotiation - between them can greatly reduce market risks, bring about synergy of expectations and, last, considerably reduce transaction costs (Bourgeois, 1995).

Improvements in market functioning, their fluidity and efficiency are often obtained through coordination between agents: public information systems and inter-professional bodies for coordination and negotiation. These types of coordination are sometimes called quaternary services to the economy, because they allow other sectors to perform more efficiently, particularly the services sector. Quaternary transaction costs are inferior to the transaction costs for market imperfections and to the loss of earnings which these imperfections cause the economy as a whole.

It should also be recalled that the reduction in transaction costs is facilitated by the construction of transport and communications infrastructures which connect complementary economic areas. In every country there is always a geography of transport infrastructures which is often characterised by export (sometimes import) requirement and by the need for communication between towns and their hinterland. The rapid increase in urban populations will create an increased requirement for transport, on the one hand between towns and their hinterland, and on the other hand between the towns themselves. This evolution should lead to integrating areas of urban economic influence into single economic areas and thereby progressively limit unitary transport costs. This phenomenon should be of particular importance to spontaneous regional integration in West Africa (Snrech, 1994).

An institutional policy which aims to improve market functioning, other than being highly encouraged by an appropriate transport and communications network, must be based, *inter al...*, on the distribution of public information on markets and prices, the structuring of producers into organisations to defend their own interests, and the existence of bodies for consultation and mediation between all concerned. This is only possible if business laws and conventional forms of trade guarantee satisfactory conditions for agents to exercise their activity. Actually the improvement of market efficiency implies progressive implementation of agree-

ments⁵ which is only possible in a climate of mutual loyalty. Further more the State, except for its natural role as a provider of public goods and services, must limit its role to that of facilitator.

What can be public, what can be private

Is privatisation necessary for the creation of an institutional environment which is favourable for the Doubly Green Revolution? This question concerns above all the services activities in the agricultural sector. It is asked because of the poor performances in numerous countries in supply, commercialisation and credit services, and in terms of quality of service. It should be noted, however, that these services have not always been poor and that in the past they have kept with important technical and economic changes in agriculture and continue to do so. The necessity for economic stabilisation plans and for State financial equilibria leads to the question, for the future, of what should be public and what should be private, what are the various possible types of public and private bodies and, lastly, what are the conditions for the correct functioning of these services.

First, it may be considered that there are enough satisfactory criteria to establish the public or private vocation of a service (Petit, 1994). A service can be public when it has the nature of a public good (indivisibility of consumption, non-restrictive access), when it produces external effects, and when by its very nature it could be the object of fraud with regard to quality. One may also consider that it may be of public interest to help create a service by allocating public funds to its start-up phase (infant industry). All of these criteria allow for correct distinction between services of a public or private nature. However, the public nature of a service does not necessarily imply that the entity which performs it be public. For example a vaccination in the public interest may be performed by private veterinarians surgeons. Reciprocally, a state-owned company may, in some cases, offer private services; this is the case with research. The public aspect of a service may also be reduced to a simple role of inspection (for example, quality control of seeds, seed production being private), or regulation (setting vaccination schedule). In all, it is not always easy to draw the line between public and private, particularly if one takes account of another criterion, that of the institutional culture of societies.

Some societies have an institutional culture which provides public services with a great deal of efficiency, particularly those where the State has long experience in organisation. In this context, it is not shocking to retain certain services within the public domain, where quality and efficiency are equivalent with the private sector. Similarly, some societies have a highly deficient institutional entrepreneurial culture since it has only recently come into being. In this context, it is difficult to pri-

⁵ Agreements: relations between partners in economic exchanges based on routines or traditions or customs in trading practices, mutual expectations, near-contracts or more formal contracts.

vatised some services rapidly. The rate of transfer must be dictated by the obligation not to break market circuits unless credible private alternatives can take over. It takes time to ensure that efficient, stable commercial networks exist and that competition can exist without difficulty.

The main problem is access to credit. The disappearance in many countries of agricultural banks or projects which ensured credit functions, is leaving producers to face traders with limited lending potential and high interest rates. Intermediary costs charged in banks in the formal sector are so high that loans are only extended to the richest, most credit worthy farmers. Various forms of credit are appearing little by little to meet the needs of small-scale producers: local banks with very low intermediary costs and mutual credit organisms. These new credit institutions are not unlike institutional bodies found in rural financial markets: mutual guarantees in townships, family-backed guarantees, local loans guaranteed by trust between lender and borrower.

For the credit function, as in all other areas of service to agriculture where traders cannot offer a sufficient level of service, producers have to create groupings to take on these functions. However, an authentic cooperative, mutualist sector can emerge if it is free at direct State authority. This movement would doubtless be all the more forceful if an association to defend producers' interests emerged in parallel to it. For this to be possible, States must allow freedom of association and freedom of collective, private economic initiative.

Decentralising ownership and management of natural resources

In many countries, particularly in Africa, the State owns the natural resources: land, forests, water, fauna. In fact, State ownership coexists with customary law which offers wide scope for joint ownership, whilst a nascent market for land and land tenure may lead to private appropriation of land.

In reality State ownership creates free access situations. Costs of administrative control are far too high for the State to ensure easily that regulations are respected. This results in free access, particularly with regard to the cutting down of forests, the use of pasture land or access to non-colonised forests. Moreover, the few guards paid by the State are of course readily corruptible by those seeking access to natural resources.

As a reaction to this situation, the idea of privatising land areas was born, based on the principle that it is in the owner's interest to apply viable, durable management techniques. This proposal mainly concerns Africa. Many examples taken in areas on the forest margin contradict this principle. They show, on the contrary, that owners "race to take land", in order to affirm their right of ownership, and that their agricultural and stock rearing methods cause rapid deterioration of environmental fertility. Moreover, in Africa, rapid generalisation of private ownership in areas where many farmers live on small areas of land may cause the latter to sell their

rights to large scale operators. In this way very large estates were constituted during periods of drought in the Sahel. If such a movement was extended, it would create the basis for a high degree of social injustice similar to that which results from major disparities existing in Latin America between the *latifundio* and the *minifundio*. Is it necessary to recall that these inequalities are the source of the enormous rural poverty on that continent, numerous social disturbances and important limitations to economic growth due to the large number of insolvent households?

There is without doubt no need to privatise. Customary law is applied to agricultural land and rangelands in the major part of Africa. As these are common resources, there are institutions which regulate access. They do not ensure full long-term viability of environments and societies, but they constitute the basis for an entitlement which no public reformer can afford to ignore.

States do not have the capacity for correctly managing local resources, and since the latter can be more easily managed locally, States are decentralising ownership to the local level. Initiatives of this kind have been made in numerous countries. In Niger, for example, forests are managed by villages which, thus control tree felling, collect taxes and assign this income to forestry renewal (Bertrand, 1944).

Decentralisation follows the principle that resources can be better managed by their closest users than by distant public decision-makers. Being close to the resources, they have more precise and fuller information regarding the state of resources. They are in a better position to make decisions. The resources are owned by them jointly, and in their position as direct users they have an interest in managing them in a viable manner (Weber and Reveret, 1993; Bertrand, 1995)

Generalisation of this principle results in the definition of subsidiarity. This principle states that resources are to be managed by the public authority which has the geographical jurisdiction closest to that of the resource involved. Thus, for example, forests used by villages are managed on a village-scale, forest areas which govern the hydrology of several areas must be managed at the level of an equivalent public authority, and forests of national interest must be managed by the State.

In conclusion, rather than State ownership, it is without doubt customary law which must be the source of future laws since it provides for decentralised management using the principle of subsidiarity as applied to public natural resources.

Poor producers' access to resources

Impoverished producers have limited access to natural resources, credits, inputs and education.

Local public ownership or common ownership can provide a guarantee of access to natural resources (agricultural land, grazing lands, wild animals, irrigation water), for the poorest members of the community. However, where the regime of individual ownership is established, it is very difficult for society's poor to become owners or to

increase the size of their farms except by migrating, and where possible, occupying land on the pioneer fronts. In other cases, reduction of rural poverty involves redistribution of land to the poorest members of society. Such redistribution often gives rise to conflict. In many cases (particularly in Latin America) it has led to increased political instability and civil war. Land reform therefore is no longer the order of the day. It will, however, be indispensable to return to it, but methods of redistribution must be found which do not cause major social upheavals but which could have expeditiously positive economic effects. To achieve this, land reform must be permanent mechanisms and not simply splirts of hyperactivity. It must allow for very long term financing for the purchase of land which is little used, and resale under highly concessional terms to small scale owners. Fresh capital and incentives could encourage sellers to invest in growth sectors.

However, in many cases poverty in rural areas is such that people do not automatically have the capacity to modify their farming practices, to progress from subsistence farming to market-oriented production, and to learn new methods. The transfer of land should be combined with a transfer of knowledge and the capacity to obtain access to credit, markets and information.

Decentralisation of public choices

Decentralising the State is not just transferring part of public ownership of natural resources to local authorities. It is also the transferring management of certain locally important public services. Here again, reference must be made to the principle of subsidiarity.

Many locally useful public services can have a strong effect on agriculture: education, health, the legal system and the police (for minor transgressions of local regulations). Decentralisation must be used to bring these services closer to users and citizens. The state education system in rural areas, for example, could be better directed towards specifically local requirements in the fields of ecological planning, economics and civic affairs.

However, most decentralisation must be focused on public choices. Each village must be in a position to collect local taxes and to assign the income to local uses of general interest. The amount of tax and the choice of allocations is everyone's concern; these are public choices. The method of choosing must therefore be such that public interest is respected, whether it involves direct consultation or a decision delegated to a representative, whether it involves a decision-making method by majority vote or by consensus. The existence of a local public decision implies the existence of a democratic local decision-making processes. Democracy is one of the main conditions for ensuring that decisions are fair.

Local decisions can play an important role in terms of economic development and environmental protection. They involve road and communications infrastructures and thus the structure of costs and prices. They involve water supply lines

and purification (which play an important role in health) and production infrastructure (irrigation, landscaping such as terraces, hedges, reforestation, and erosion and desertification control, etc), which play a decisive role in local production, food security for households and villages and local employment.

The end of administrative projects

Agricultural and rural development projects have always been relatively large and have brought together a group of service functions: supply, trade, credit, extension work, construction of equipment, etc. Integrated projects added numerous other functions: the construction of infrastructure, education, health, etc. In any case, these operations contributed to the creation of public authorities at local level. The power of these bodies came from the State and since the State had large powers, nothing obliged them to negotiate with populations. Decisions were generally imposed. Projects concentrated initiatives and some time later sought the participation of the main beneficiaries. They therefore often replaced local capacity for decision-making and initiative, and at times forced local populations into a kind of active or passive resistance. Project managers were often badly informed and did not understand the complex realities surrounding their actions. By offering simple ideas to complex environments, these projects only rarely achieved their objectives or generated lasting results all the more so since they were short lived by nature, and depended on international aid which is, by definition, unsystematic. These types of projects therefore are not permanent institutions.

Since micro-projects obviously have far less ambition they more readily give over control to local populations. However, the same shortcomings are possible, although with a lesser degree of influence. NGOs which perform micro-projects may also act as substitutes for local authorities by means of extensive intervention in decision-making processes. They become lasting economic operators and accumulate powerful functions to the detriment of existing public authorities, whereas NGOs are supposed to be private bodies.

Clarification is therefore necessary. A new institutional landscape may be born of liberalisation and privatisation on the one hand, and decentralisation on the other. Private operators working in associations should distinguish themselves clearly from public bodies and from municipal management. These bodies should be in a position to take the initiative necessary for managing local development.

This does not exclude projects, however. It is useful to introduce a player to facilitate local transformation: encourage private agents to take initiatives (investment, organisation), inform local players of the consequences of their decisions, and encourage them to be permanently aware of the criteria of equity and viable management of resources, facilitate the functioning of trade and markets by mediation between the various interests, facilitate achievement of a consensus in public choices, and mediation between interests, systematically propose a view of the future in or-

der to enlighten today's decisions. Projects could play the role of quaternary institutions, that contribute to efficiency in economic and social functioning. Thus, projects would form part of the trend towards liberalisation and decentralisation, and could remain timebound.

Local knowledge as a basis for change

Like projects, research has also for a long time been organised according to the "top-down" theory. The Green Revolution in principle made all agricultural transformation depend on one scientific innovation - high yield varieties - together with related technology. This inevitably encouraged the notion of the transfer of technical knowledge between research centres and producers placed in the position of users. Extension services aimed to persuade producers, and projects supplied the necessary support services and motivations.

The problem-oriented approach of the Doubly Green Revolution reverses the situation. It will be applied to areas and conditions which are extremely varied from an ecological, economic and institutional point of view. It will be impossible for researchers to develop only one mode. Each situation would have to be analyzed in all its ecological and social complexity in order to propose solutions which will also be complex and lengthy to develop if the usual sequence was to be used: on station tests, followed by multi-location tests and then on-farm trials before the extension phase. We have long known (Tourte, 1978; Benoit-Cattin, 1984) that this process is only suitable for specific situations.

In order to save time in the diagnosis and development of solutions, research must be based on local ecological knowledge. This knowledge, reinterpreted by researchers, will enable rapid access to a detailed knowledge of the resilience and other properties of the production ecosystem, the constraints under which producer decisions are made and the steps in intensification to which they intend to give priority. On these bases, research has hypotheses to test on station or with producers in their fields. If farmers are involved with experimentation they are all the more interested by the results. Research can accompany trends in local evolution, bring out related risks, anticipate future problems and questions, and seek new methods. This way of operating redefines the linkages of disciplines in agronomic research by connecting them to specific local situations. This presupposes an approach which one may qualify as eco-regional (Manichon, 1995) and which may be inspired by the eco-regional idea put forward by the CGIAR.

The economic conditions for a Doubly Green Revolution

Most of the poorest in society live from farming and are therefore the first ones to be concerned by under-nourishment. One should therefore start from the principle that

agricultural policies must deal with the problem of rural poverty. Access to land, access to credit and access to knowledge cannot be resolved by institutional measures alone. Economic support measures are also required. The same is true for the adoption of the techniques involved in the Doubly Green Revolution. Economic motivations must encourage intensification in the use of production ecosystems without hindering their capacity for renewal. This is the definition of a multi-faceted agricultural policy for which the internal coherence and coherence with economic and social development policies must be specified.

From extensive to intensive growth

In many countries with abundant natural resources (thick forests, oil, ores), economic growth is encouraged by exploitation of natural capital. Exports feed the State's budget which, through spending, creates the impetus for the functioning of trade. The same growth phenomenon created out of the consumption of resources is observed in rural areas where agriculture is developing extensively and projects are pouring in money which only generates a small amount of capital creation. Extensive growth results in the use of resources for consumption only; very little is saved, and none is invested (Naudet, 1994). In reality, natural capital is consumed. In agriculture there is loss of fertility, loss of forests, loss of water resources; other sectors, lose stocks of fossil resources.

On the other hand, intensive growth is characterised by a preference for saving and investment in comparison with consumption, resulting in capital creation and productivity increase. The State stimulates economic functioning more by means of investment flows than by the distribution of income.

Intensified farming can be traced back to limitations in natural capital that force societies to produce more, on smaller areas, with less labour, and less chance of producing a surplus. In agriculture, societies with fast growing populations, limited by geographical space, have invested their workforce in transforming the environment and making it more productive. The stock of physical capital and knowledge acquired for the transformation of ecosystems can be considerable: irrigated terrace farming, complex mixed wood and pasture—"bocage" in french—ecosystems, agro-forestry ecosystems, etc.

In many developing countries, the switch to intensive growth has become inescapable. When a State has very large debts, can no longer rely on external capital flows and must greatly reduce its current spending, it becomes unable to support extensive growth. This is the result of economic stabilisation policies. Moreover, structural adjustment, by changing relative prices, reduces household consumption, particularly the consumption of imported products. Consumption then falls back on domestically produced goods, thereby stimulating local production. This switch to intensive growth only occurs if recourse to extensive growth has become impossible or if one can dissuade its promoters. For example, currency devaluation

may relaunch massive timber exports and encourage candidates seeking land to colonise forests. They will do this faster if they do not have the means to control weeds because of high prices for herbicides, and will inevitably be forced to compensate by moving on and clearing other areas more quickly. Depending on its political will, the State can assist or arrest this trend (Castella, 1993).

Structural adjustment, by increasing the price of fertilizers, can also cause producers to reduce amounts used and to compensate for decreases in yields by an increase in the surface area cultivated or by a decrease in fallow land, which risks dangerously hindering fertility reproduction. Intensification is inescapable. The alternative is a decrease in fertility, which may be irreversible. Ratios between agricultural prices and fertilizer prices may, in this case, play a determining role in making production ecosystem viable again.

Finally, in addition to stabilisation and adjustment policies, liberalisation policies also affect intensive growth dynamics. This is the case in particular with the disappearance of administered pan-territorial prices established by geographical compensation mechanisms. Producers located close to trading areas benefit from advantageous transport costs for their inputs and can sell their production at attractive prices. On the other hand, those who are further away are penalised by transport costs for their inputs and have to sell their output at lower prices. The discontinuation of pan-territorial prices concentrates supply and collection areas. Those in the first category will be motivated to intensify production: the market makes demands on them, and margins enable them to invest in order to improve land productivity since there is no other choice for increasing production due to dense land occupation. There will therefore be more intensive growth in peri-urban zones and the hinterland close to market and consumption centres. Producers further away have to continue extensive farming or, seek ways of reducing transport costs and for transaction costs, or work more to compensate for loss of income.

Overall, the State must remain highly attentive to changes in producer behaviour during periods of changing relative prices. Although in certain cases economic policies encourage farmers to go in the direction of more intensive growth, and although this movement is inescapable due to the limitation of wealth issuing from natural resources, it is nonetheless true that the poorest producers and those the furthest away from markets will spontaneously tend to draw on natural capital reserves.

A system of food supply at reduced costs

The main dilemma faced by agricultural and food pricing policies is that the problem of the rural poor and the urban poor has to be dealt with at the same time. Therefore high prices paid to farmers have to be reconciled with low prices charged to urban consumers.

Providing poor urban consumers with tickets to buy food at low cost is a common solution. It has the advantage of alleviating the problem over agricultural prices. However, it also has disadvantages. Firstly, the supply of tickets is a source of illicit trading and corruption. Further, this solution can only be envisaged if the number of urban poor is limited, which is rarely the case. Moreover, it is useful for both growth and development to have food prices lowered so that some urban income is spent on other consumer goods thereby stimulating growth in other sectors and providing urban employment. Treating poor farmers with "positive discrimination" also raises major problems when the poor are in contact with others. It is easier when exceptional measures cover whole areas. However currently, in the majority of countries, the State can no longer intervene in pricing policies since it is no longer a buyer. Aid must be limited to inputs (subsidies), credit (bonuses) or to the work force (distribution of food for work). This aid may also, however, lead to trafficking and corruption. Moreover, ensuring that agricultural prices are high in order to guarantee sufficient income for the poorest producers would present the major disadvantage of limiting diversification of urban consumption and the possible boom in other sectors. In addition, since most of town-dwellers' incomes go to food, high prices for food would maintain a high price for work, thereby limiting the competitiveness of manufactured goods for export (Delgado, 1991). On the other hand, high agricultural prices may, in some circumstances, bring about an accumulation of capital in the countryside and growth in productivity and employment (Mellor, 1993).

The conclusion of these observations is that State intervention, which aims to influence prices by applying special measures to certain populations, must be limited as far as possible, even though such intervention often remains inevitable and indispensable. The result is that two classically opposing development strategies are possible. One is based on a rapid transformation of the economy in the urban environment, by means of a low-cost urban work force and urban consumers who have potentially diversified spending power. This strategy is facilitated by low food prices and therefore limited agricultural prices. It tends to maintain poverty in the countryside and to condemn part of the rural population to remain excluded from growth, except by migrating to towns, (rural exodus), or migrating towards more prosperous agricultural regions. The other is based on agricultural growth made possible by satisfactory agricultural prices, creating growth in productivity and therefore, in the longer term, a decrease in food prices, which in turn will facilitate economic diversification. This strategy encourages rural populations to seek prosperity in the countryside and not to swell the mass of insolvent urban populations. This second strategy is often favoured by agricultural development economists.

Every developing country encounters this pricing dilemma and has to make choices between the two methods of capital accumulation, urban and rural. Decisions made depend of course on local conditions. Indeed, the success of the "rural method" depends fundamentally on the response capacity of producers to price ri-

ses, in terms of agricultural productivity and ecological viability. In some cases, price increases may bring about a stagnation in production, particularly if the market functions badly due to a lack of possibilities for purchasing consumer goods (Berthelemy, 1989), or if the market economy is in its infancy, and producers do not seek greater gains once assured of food security through their own production. In this case, prices have no effect on the growth of productivity. Conversely, it may happen that a slow decrease in prices causes producers to improve productivity in order to maintain their production and income levels. This was the case, for example, over a long period with cotton production in Mali. As for the "urban method", this is fundamentally based on the existence of real dynamics for industrial diversification and diversification within consumption. If these dynamics do not exist, the relative lowering labour costs permitted by the lowering of food prices will have no effect other than drawing ever more rural poor into towns. The urban economy, in particular the informal economy, has a real capacity for receiving poor people (Cour, 1994) but it is limited because it depends principally on the extensive growth of the urban economy. Furthermore urban growth entails major costs: the marginal cost of urban equipment increases with its size ⁶ together with social costs linked to environmental damage.

There is a method of reasoning which partially reconciles the two strategic directions mentioned above. First, account should be taken of the fact that growth linked urbanisation is greatly limited by economic stabilisation policies which, in many countries should curb the rural exodus and benefit agricultural and rural development. It should also be recalled that many poor people are from rural areas and failure to deal with rural poverty potentially adds to urban poverty. Hence the main objective of a policy which modifies the terms of trade between the rural and the urban worlds, particularly an agricultural and food pricing policy, must firstly benefit agricultural prices and then ensure that food prices do not increase too sharply. This leads one to seek maximum reduction in transport costs by means of an infrastructure policy, and in transaction costs by means of an institutional policy which facilitates market functioning (see above). In view of producer behaviour with regard to prices, agricultural prices must provide a signal that encourages farmers to produce more and to increase productivity by facilitating investments financed by own resources. The difference between urban food prices and what the urban poor can afford to pay for their food could then be covered by food-aid.

In regions where agriculture is marginal, where populations seek to survive rather than produce for the market, prices have no signalling effect. To stem the rural exodus and capitalise gradually on production capacities (rehabilitation of damaged environments, construction of infrastructure...), will require social transfers and aid programmes. Recourse to the work force being absolutely necessary, food-aid distri-

6 Ancy, 1991. Cit. in: L'avenir de l'agriculture dans les pays du Sahel. Actes du XI séminaire d'économie et sociologie. Montpellier, CIRAD-Mission d'Economie et Sociologie.

bution in return for work has, in this context, an important economic effect: capital formation, production and productivity growth.

Agricultural growth based on national and regional demand

Food requirements, on the one hand, and consumption increases population growth on the other, make up the basis for growth in the agricultural sector. The increase in the urban/rural population ratio implies increased production per rural worker and contributes to the creation of lasting agricultural growth. Food supply improvements for the poorest in society also contribute to increased demand (on condition that adequate policies are implemented). Last, diversification in food demand, a major phenomenon in Asia and noteworthy in Africa, constitutes another stimulating factor.

Food demands made on agriculture, livestock production, and other indirect rural productions have repercussions on the productive system in terms of effects created by demands. These linkages must be maintained through appropriate economic stimulations (Delgado, 1994).

The first linkage involves employment. Doubly Green Revolution techniques require work and create new activities: the use of supplementary fertilizers and chemicals increases the demand for inputs; in peri-urban areas, the demand for urban waste compost should see an increase, as should demands for products issued from livestock production wastes. These activities create employment and generate income.

Other activities may also be stimulated. The demand for meat, particularly white meat (poultry and pork) should encourage the offer from non-land based animal farms close to towns, which will then increase their demand for animal feed, particularly cereals roots and tubers (cassava) and oilseed-protein cakes (groundnut, cotton, soya). The price of local grain crops therefore must not be too high for it to be used in animal feed. The demand for fodder grains entering into competition with the demand for food cereals should also be avoided as this brings about an increase in price. When cereals, roots, tubers and cakes supply the local meat production sector, the multiplying effect of the demand for meat on agricultural demand is extremely large. This is one of the main growth impetus links in agriculture.

Meat may also come from draft animals, confined stock (pork, mutton, goat) and grazing herds (beef, mutton, goat). The creation of a sustained supply of beef would be facilitated by better interconnections between the cereals market, rural financial markets and the livestock market (see above). In the Sahel area of Africa, animals are often seen more as a means of saving than as productive capital. They are often sold during intercrop periods when food is difficult to obtain, thereby pushing sales prices down whereas recourse to borrowing, which would be easier if savings were in monetary form, would be more appropriate. Animals could then have an essen-

tially productive role. Food requirements for fish are rarely satisfied. Fish farming should also be stimulated by demand and play a dynamic role in the cereals supply. Lastly, new breeds may perhaps see the light of day, such as the agouti in Africa, deer, or flightless birds.

Food diversification also includes pulses and leguminous plants, fresh vegetables and fruit. Production is mainly peri-urban but may also involve supply areas which are further away (for example onions from Niger are sold in the Gulf of Guinea and cowpeas from the Sahel in Nigeria).

Food processing can participate efficiently in the reduction of product preparation costs. Increasingly in Africa, large processing plants can be replaced by village units: rice and oil mills, cotton ginning. New techniques can be offered for drying and dehydrating products. It is in these processing sectors, just like at the farm level, that important efforts can be made to limit storage losses.

New productions may also be envisaged, e.g. energy from biomass, methane from harvest waste, alcohol and above all biomass fuel oils in relatively landlocked areas where they are competitive with imported oil products. In some countries, agriculture also becomes a source of timber, using fast growing species to meet large urban demand.

Giving incentives to economic agents who open new product markets is an essential element of support for internal growth in the food sector. Incentives of an institutional nature are also needed to sustain the new trade channels.

Growth in the agricultural and food sectors, together with connected activities must not be considered on the urban scale only, although towns are the main-spring of diversification in their hinterland or the country as a whole. Very often, the geography of communications determines regional market areas which extend beyond national borders and as the seat of productive dynamism, is pur growth through increased demand. For this reason, and in view of the effects of comparative regional advantages, customs tariffs should encourage the regional integration of agricultural markets.

Internal growth should not be thwarted by imports

In Africa and the Middle East, competition between national production and imports mainly involve cereals. The substitution of wheat or rice for local cereals, tubers and plantain in African consumption is gradually unifying the market for starch products. Therefore, over many years, cereal exports subsidised by the European Union and the United States were able to compete with African products. Competition also exists for meat in these regions, to which the European Union has, for a long time, exported low-grade quarters of red meat and towl carcasses, and in Asia where meat production is increasing but remains insufficient to cope with demand. Competition also exists increasingly among oilseed crops due to interchangeability of oils used in

cooking. Therefore, soya production in Asia is in competition with imports from the American continent.

The protection of national production is therefore necessary in some cases. However, this must not become a rigid dogma. Although designed as the prelude to a national growth policy there is a very great risk that protection has no stimulating effect on national production (lack of satisfactory productive response). It then penalises growth since food prices remain too high, and it slows down the growth rate of productivity in agriculture. Over time, other countries may become more competitive, which makes agricultural producers bring all their weight to bear to maintain protection in order to avoid competition and the subsequent crisis. Moreover, States which protect their agriculture by imposing taxes may have an interest in maintaining protection for as long as possible because of the resources which it procures for the State budget. Here again, the inescapable market liberalisation is postponed, thereby increasing the size of the potential crisis.

Protection must be the last means used to preserve national productive systems, applied only after all measures have been taken regarding the reduction of transport costs (infrastructures), the reduction in transaction costs, the fluidity of market functioning (institutions) and increased productivity. Protection may be useful where it preserves and supplements growth dynamics.

Protection can be justified where competition with national production results in such a volume of imports that it creates dependency and strategic vulnerability for the country. Too great a dependence on external markets can result in food insecurity. There is a risk of price rises should international food stocks decrease, or increased value in the currencies in which purchases are paid for, or in interrupted supply lines, particularly for landlocked countries.

Protection may also be considered where international prices are so low that, in order to resist competition, national production would have to lower its costs such that it would endanger the renewal of its natural resources, particularly land fertility.

Finally, protecting cereal sales was understandable for a long period during which international prices were maintained abnormally low export subsidies granted by the European Union and the United States.

Regional integration of national agricultural economies could teach the national agricultural sector how to avoid getting too far behind in productivity and competitiveness. One may hope that regional protection, in the same conditions as those presented above, could then have the effect of a stimulant. However, in conclusion, evolution towards greater commercial freedom in the world should lead governments to think in terms of controlled liberalisation rather than protection, even if the latter is only residual.

Agricultural exports as the subsidiary driving force for growth

Agricultural exports constitute an important source of income for countries and may strongly stimulate growth. However, growth based too exclusively on exports puts the agricultural economy at risk for various reasons.

First, it is frequently observed that the State obtains an important share of national added value, either through export taxes or by being a monopoly operator itself. International agreements on products with national quotas have for a long time encouraged this State presence in export circuits. Consequently, producers often only received a small part of the total added value. This practice can lead to extensive growth in production, and damage to ecosystems: accelerated deforestation in order to set up coffee and cocoa plantations, extension of cotton production (West Africa) or cassava production (Thailand). Experience in Côte d'Ivoire, for almost 25 years after independence has, shown however how a favourable farmgate pricing policy (high and stable prices) was able to create strong growth.

Another danger is that of the succession of booms and crises tied to international prices and variations in exchange rates. The result is "stop and go" movements which penalise growth and development. With the end of international agreements on price stabilisation, growing instability in exchange rates for major currencies, and the disappearance of national price stabilisation mechanisms in many countries, price fluctuations will probably be even greater in the future. It should also be added that ever keener competition between exporting countries will force the national production sectors to invest in improving competitiveness and productivity.

Such instability leads one to believe that export earnings cannot be counted on as the basis for lasting growth. Such income, however, can constitute an important subsidiary driving force for growth, but as such it must be used to finance priority investments which in turn support lasting sources of growth in agriculture and the food industry, i.e. finance growth in productivity.

The pricing system: the main incentive in the economic policy

The pricing system must permanently aim at a large number of objectives: encourage sustainable intensification in agriculture, ensure that the food prices continue to trend downwards, maintain terms of trade which favour agriculture in order to trigger agricultural growth, facilitate relays of growth within the sectors concerned, protect agriculture (without excess), whilst helping it to fit into the regional economy, encourage products for regional consumption and, subsidiarily, export. Such controls will always be sophisticated, and have to be based on-going, clear information as to the action taken by those involved, permanent consultation with them and clear messages from the State to the agents. Tools which simulate the effects of pricing policies on the various sectors and types of agents will be very helpful to the decision-makers. Indeed, the combined overall effects of the detailed sectorial decisions concerning taxation, subsidies and credit bonuses, investment

aids, interest rates and the foreign exchange policy should be measured. It is less and less possible to isolate the agricultural policy from economic policy choices.

Another major pricing characteristic should be relative stability. It is known that as concerns the effects of agricultural prices on farmers' behaviour, variations over time have often had more influence than variations in levels (Boussard and Gérard, 1991). For farmers to accept important technical changes, a certain degree of price stability is necessary, or at least a limitation of instability. On the other hand, prices which are too stable prevent producers from learning how to adapt to demand. Without returning to costly public mechanisms for permanent price stability, it will be necessary to aim to reduce the most significant fluctuations in prices.

However, pricing policy cannot give signals that are strong enough to direct behaviour. Public investment can perhaps play a more determining role. Indeed, in countries with rapid population growth, the localisation of infrastructure investments, in other words the physical planning policy, will no doubt have a strong influence on the localisation of populations. The level of pressure put on natural resources by rural populations will therefore be influenced, together with the speed of evolution in the relationship between urban and rural dwellers which controls the evolution in agricultural productivity requirements. It is probable that in a large number of cases, policies such as this can only be financed by international aid. The State also has to learn to work with territorial authorities in order to make investments geographically coherent

The State should therefore increasingly become a development strategist as well as an element for regulating the conditions for fixing prices and incomes. One may consider this to be an ambitious role since many States are almost bankrupt, some are in the hands of warlords, and others are led by corrupt elitist politicians. The decentralisation of public authority and the liberalisation of markets are therefore necessary to guarantee a certain resilience in growth and development mechanisms, so that fluctuations in the real capacity of States to govern their countries do not compromise the essence of the movement.

Livelihoods for the poorest in the community: priority to local ecological, economic and social resilience.

Reducing rural poverty is first and foremost ensuring that rural populations can obtain locally the means of existence which at least allow them to benefit from adequate food security. The means of existence are the whole range of resources and products to which they have access and the activities which they can carry out. With regard to resources, this could mean timber, firewood, plants, fruit and wild animals. With regard to activities, it could mean opportunities for employment or local income obtained through the processing of agricultural products, the sale of craft items, employment in farm work, etc. (Conway, 1990).

These local livelihoods must be permanent, i.e. be based on viable production ecosystems (satisfactory management of common property), on institutions which give the poor people access to resources and power over them (rights), and on economic channels with a certain regularity. In other words, these activities should allow for a certain local resilience in local ecological, economical and social systems so as to ensure that poverty is not aggravated by economic and social disturbance.

Such local resilience should encourage resilience in the same systems at more general geographical levels; this is a new application of the principle of subsidiarity. This concept should make it possible to minimise the risks of generalised imbalance in ecology and societies during the period of rapid population growth.

Conclusion: Political will

There is no reason for the Doubly Green Revolution to be able to impose itself on societies even where it is necessary. Yet this is revolution inevitable. How can agriculture stay isolated from the laws of ecology? And how can such complex changes be permanently controlled by governmental decision-making centres? Ecology and the decentralisation of decisions will make societies evolve towards new methods of organisation. However, in this evolution, the State will retain a decisive role which will dictate the speed and fluidity of the transformation processes. But above all, the fairness of this process and, finally, its social viability will depend on the State. Therefore, nothing will be possible without the political determination of the political leaders.

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