An Agro-Food Planning System: Democratic, Decentralized, Holistic, and Voluntary Participatory

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Article

An Agro-Food Planning System: Democratic, Decentralized, Holistic, and Voluntary Participatory

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Abstract: In both capitalist and socialist economies, agricultural planning has been un-derstood as the allocation of planting areas to certain products, and the exist-ence of farmers, who are the main productive actors, as humans, their pro-duction potential and their ability to act rationally have been neglected. In ad-dition, in both economic structures, the desired results have only been achieved partially by determining prices. These experiences also reveal two important results: Agriculture is not fully planned, but it cannot be continued without planning either. Secondly, in a structure where production is social, it is nec-essary for agricultural products to have an exchange value, but price is a mul-tifunctional phenomenon and how it is determined is important. The current equivalent of the claim that prices are determined through the market mecha-nism is to advocate that prices are determined by capitalist companies that have monopoly power in the markets. The increasingly severe problems and in-creasing fragility of agricultural-food markets, which are already largely under the control of these institutions, already prove that this structure is not a solu-tion. On the other hand, it is no longer possible to provide food security by planning primary agricultural products alone, agri-food production and dis-tribution have acquired different structural characteristics, and it has become necessary to address food security within the framework of agri-food systems. Therefore, effective agricultural planning actually requires the planning of the agricultural food system as a whole. The e-nam system, which is being popu-larized in India and has achieved a certain success, points out that it is possible to organize and manage agricultural food markets after primary production. Moreover, it also shows that technological opportunities offer more effective planning opportunities. In this study, first of all, based on historical and current experiences, the inadequacies of the market mechanism, the fact that agricul-tural production is carried out by using living things to produce living things and depending on uncontrollable factors have been taken into consideration. Then, it has been concluded that a democratic, mix of centralized and decen-tralized planning, aiming to determine both production quantities and prices by utilizing the capacity and conditions of farmers and technological opportunities will meet today's needs. And in accordance with this result, a basic planning proposal has been presented.

Keywords: Agricultural planning; agro-food system planning; democratic planning; food security

1. Introduction

A review of agricultural planning may start with three considerations. Firstly, while malnutrition, hunger, and famine prevail in the world, the destruction of food resources continues. Fluctuations in food production and prices, uncertainties, population and food demand growth, climate change, water scarcity and competition for the control of lands are just a few of the problems experienced in the agriculture-food system. As the passage of time worsens the problems day by day, permanent solutions have not yet been found so new approaches are needed. In recent years, in this context, the idea of planning agriculture has begun to be expressed more frequently in many countries in different parts of the world. In fact, when agricultural policies followed throughout history including in capitalist economies are considered, it is clear that agriculture cannot be maintained without planning and an agricultural policy. On the other hand, when it is considered that agriculture produces other living things and is dependent on natural conditions, it is also accepted that it is intrinsically unplannable. In other words, planning agriculture is necessary but has limits..

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Secondly, the planning of agriculture needs to be addressed alongside the regulating role of prices, which are put forward as opposites. A policy towards agriculture is followed in all capitalist economies because it is ludicrous to expect food security to be ensured through the market mechanism (Van Der Ploeg, 2020, p. 963). Given that the price mechanism cannot be a solution to problems in the production and distribution of agricultural-food products, but also that price policies are used as a planning tool in both capitalist and socialist economies, it becomes necessary to address price formation and agricultural-food markets in the context of agricultural planning. Wherever production is socialized, the exchange of different goods and services requires a determination of their exchange rates—in other words, of a price—. But this does not necessarily result in a price that is determined by the intensity of supply and demand, and, therefore, a market mechanism. In fact, today, the prices of most agricultural products worldwide are directed, managed, and determined by intervention.

Thirdly, today, both the sustainability of agriculture and the provision of food security require that the issue be addressed not only in terms of primary agricultural production but also in a broad framework extending from agricultural inputs to the recycling and disposal of food waste. The need to address the issue in this way is met by the "agro-food systems" approach. This includes diverse production, distribution, consumption and recycling processes, the result of these on society and the environment and other institutional arrangements, alongside the cultural, educational, and economic dimensions of food consumers. From this point of view, when it comes to agricultural planning, what is revealed is the need for planning not only primary production but also the entire agricultural food system and, moreover, the need to re-evaluate traditional agricultural planning and its tools. The Indian experience is noteworthy in this respect, especially regarding the processes after primary production, including intermediation and price formation processes.

The three elements listed here provide a huge amount of information related to agricultural planning, both at the theoretical level and that of historical experience. These include agricultural planning approaches in centrally planned and capitalist economies, the meaning and functional limits of price, the function of the market mechanism, support the theoretical foundations for a new agricultural planning approach. In addition, perhaps as a fourth element, technological developments impact the three listed and offer opportunities for implementation

In this study, planning experiences, planning problems, agro-food system, small commodity producers, and planning issues are first analyzed, and then the concept and function of price are analyzed. Finally, it is suggested that an alternative planning approach may be possible within the framework of the agro-food system with the opportunities provided by technology. Each of the topics discussed here—planning, price, agro-food systems, and techniques used in planning and markets—has its own huge literature, and it is not possible to discuss all these topics in detail within the framework of a single article. Therefore, just their distinctive features are introduced.

In the following section, agricultural planning experiences and approaches are discussed, and some different principles of a new approach are presented. Then, the concept of price and the price policies followed in agriculture are considered, and a price approach that can be used in new agricultural planning is proposed. Finally, the new agricultural planning approach is concretely presented in the light of technological developments and experiences regarding the planning of the agricultural food system as a whole.

2. Planning

In today's conditions, agricultural planning can be defined as the use of agricultural resources to meet the needs of industry, primarily for food. This is primarily directed and controlled by global markets; 23 percent of food calories are currently traded internationally, and about 85 percent of countries rely on food imports to meet domestic demand (D'Odorico et al., 2018) However, the reliance on global markets is proving to be extremely problematic. The system does not show resilience even in the face of the smallest shocks, and concerns about the uncertainty of food crises are increasing. For this reason, countries try to protect by striving for food sovereignty, national or regional arrangements to ensure food supply. Meanwhile, 'food empires', which have survived and

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evolved from the old colonial food system thus by doing so they have control power agriculture, food chains and the food industry, in an indirect, yet very powerful, way. (Van Der Ploeg, 2020). Within this structure of the global agriculture–food system, increasing agricultural production and meeting the predicted demand becomes an ever more urgent problem to be solved:

The challenge is to try to find how this can be done by adopting measures that are socially acceptable and environmentally sustainable, and/or to find ways to moderate the increased demand on agricultural production (Tisdell, 2015, pp. 30-31).

3. Lessons from Capitalist and Socialist Planning and Policy Experiences

Agriculture and food have been subject to government policies across the world throughout much of history, with the redistributive effects on agro-food policies used by policy makers for various social and political purposes. Therefore, agricultural policies and institutions are also political institutions and policies (Swinnen, 2018, p. 3). While, in the capitalist economic system, legislative measures have been designed to establish effective marketing practices for agricultural produce, agricultural policies have also aimed to stabilize food prices and supplies in various ways, from supporting farmers and subsidizing targeted farming products to taxing consumers (Swinnen, 2018, p. 32). While in the capitalist economic system, in order to establish effective marketing practices in the marketing of agricultural produce, legislative measures have been designed, on the other side agricultural policies had a broader and varied aims to stabilize food prices and supplies, from supporting to farmers and subsidizing to taxing consumers i.e. by governments (Francisco et al., 1979 p. 8). State intervention in agricultural product prices and agricultural planning, often both, have historically been the most frequently used policy tools. In this section, these two policies will be evaluated by looking at the experiences of the United States, China, India and the USSR.

4. The US Agricultural Planning Experiences

In the U.S., import tariffs were the dominant protective policy tools until the Great Depression. A key moment was the establishment of formal producer price supports, which led to a " proliferation of import barriers as well as export subsidies".(Sanderson, 2016). Export subsidies and price supports would be preferred by producer groups in the following years. However, a pre-WWII, very interesting and in many ways meaningful planning experiment would come to fruition.

In 1938, the United States Department of Agriculture (USDA) initiated an agricultural planning system that included local institutions, farmers, and government officials as stakeholders. These actors combined to plan public policy throughout rural America. The main idea was that "participatory planning as the best way to democratize the agricultural policy process and to counter growing domination by a powerful conservative coalition" (Gilbert, 1996, p.233). With the economic agenda partly directed toward shaping the public agricultural policy, this participatory planning spread very rapidly. Approximately 40,000 (32,000 men, 8,000 women) farmers were members in 1941, and 2,200 counties (about two-thirds nationwide) had established planning committees by 1942 (Gilbert, 1996, p.240-241). However, the "undemocratic forces" of war and powerful special-interest groups intervened to curtail the effort. Thus, the agricultural planning program was destroyed by mid-1942 by parties who saw it as an organizational and ideological threat to their own control over agricultural policy. Although this planning program and its democratic vision were thwarted, the idea and its implementation can still inspire and instruct today (Gilbert, 1996, p. 250).

In the 1960s, the US applied a payment system which guaranteed producer prices. However, determining the market price like this led to the accumulation of unmanageable surpluses, and export subsidies were reintroduced in the 1980s. Meanwhile, the then European Community improved a strong price support approach by means of import levies and export restitutions in the context of the Common Agricultural Policy (CAP). EU countries continued to produce large surpluses. The US and EU agricultural surpluses were traded on the world food market and with destructive effects on the agriculture of less developed countries. Aiming to eliminate to surpluses, there were attempts in the US and EU to change the support system. Because of producer resistance to significant cuts in support prices, the US came to rely increasingly on supply controls. These are theoretically voluntary, but

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compliance with acreage limitations is a precondition for securing deficiency payments and other benefits (Sanderson, 2016, p. 5). Both the US and EU later adopted a direct payments system as an alternative to market intervention, but these, too, were faced by politically difficulties (Blandford, et.al., 2011).

By the turn of the century, "production and marketing contracts govern 36 percent of the value of U.S. agricultural production," which was "up from 12 percent in 1969" (MacDonald et al., p. i) fruits and tree nuts and 15 percent of the vegetables produced in the US, are regulated by committees (Cave & Solant, 1997, p. 255). These developments indicate that answers to production and demand increases and diversification, the need for food security, and many other questions can be found with a planned approach.

6. The Chinese and Other Socialist Experiences

As is well known, both the People's Republic of China and the Union of Soviet Socialist Republics adopted collectivization in farming and tried to maintain agriculture through central planning. Although the collective agriculture approach mostly failed, there were a number of successful reforms; with results like the Hungarian agricultural success of the 1970s and the growth of Chinese agriculture after 1977.

The USSR established the Sovkhozy and Kolkhozy collectives. Rather than being cooperatives or semi-autonomous self-governing units, they worked under conditions of constrained decision-making, and in the 1970's, they combined their operations , which served to further centralize decision making system. In the Soviet system, prices were fixed and did not reflect real costs, concealing subsidies that cannot even be well estimated. Usually, there was a price 'gap' between input and output prices. The prices of industrial products for agricultural inputs were often overpriced, while agricultural products were sold at below market prices. According to Nickolsky, the main reason for the ineffectiveness of agrarian collectives can be explained by this price system that overvalued input prices while devaluing agrarian products (Szelenyi, 1998, p. 2).

Socialist economies suffered because of a lack of information in the planning process where decisions were made and a lack of incentives at the point of production (Kornai, 1959,) This led to the establishment of irrationally large farms where workers did not have sufficient autonomy to make decisions and felt little incentive at the family level to work hard and carefully.

In Chinese rural areas during the 1960s and 1970s, households were forced to work in collective farms and to sell their products to the state at very low prices. Severe poverty and hunger were widespread. Around 30–40 percent of rural households had an income of under a- dollar a day. Chinese administration used the low prices to impose a heavy tax on agricultural output at artificially from 1950s to the 1970s (Lardy, 1983; Sicular, 1988; Swinnen, 2018).

Reforms in agricultural planning and pricing in China since 1978 have generally reduced direct interventions in the economy. The importance of the direct planning of production and procurement has diminished, and the government has increasingly relied on prices, incentives, and markets to guide the rural sector. Specific measures have included reductions in the state planning of agricultural production, commerce, and pricing; the decentralization of decision-making authority to local governments and producers; greater leniency towards and encouragement of free market exchange; and increased reliance on market prices (Sicular, 1988, pp. 671 and 676). Following the first price reforms at the end of the 1970 in a number of separate actions, between 1978 and 1983, planners in China increased farm prices by around 50 percent (ibid). State-run procurement stations only purchased grain from farmers if they had fulfilled their mandatory marketing delivery quota, which was purchased at a lower price (McMillan & Jing, 1987)

Reforms followed which returned land from collective farms to households, named the Household Responsibility System (HRS). By the end of 1983, more than 90 percent of farming families were covered under this system (McMillan et.al.,1987, p. 4). The HRS enhanced incentives in agriculture, stimulating productivity, and allowed households to keep part of their production, for which they received a higher price (Swinnen, 2018, p. 127). In addition, the accessibility to inputs increased during this period (Lin, 1992, p. 34). and, because of institutional arrangements, farm

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producers become much more responsive to changes in relative prices and enhanced marketing opportunities. In the three decades from the late 1970s, Chinese agriculture grew at an average rate of 4.6 percent annually (Swinnen, 2018, p. 128). Between 1978 and 1984 output in the Chinese agricultural sector increased by over 50 percent (McMillan et.al, 1987).

These impressive output gains followed the adoption of a system stressing individual responsibility in place of a system of communal decision-making and rewards. The individual peasant, became the basic unit for decision-making in agriculture. On the other hand, land ownership remaining within the collective (Lardy, 1983). The rapid growth in agricultural production was followed by reduced increases from the mid- 1980s. Scarcities and surpluses occurred, and prices became unstable, as did state policies as the government first raised procurement prices, then lowered them and raised them again. The mandatory procurement quotas were similarly reinstated (Sicular, 1988, p. 676).

6.1. Reasons behind the High Performance of Chinese Agriculture

There are different interpretations of the source of the success of the policies China followed in agriculture after 1978. McMillian, Jing and Whalley (McMillan et.al, 1987, pp. 17-18) argue that it was "one-quarter due to the increase in productivity due to higher prices, and three-quarters to changes in the incentive scheme.". Muldavin, (1998, p. 2) argues that "changes in property relations after 1977 in China had not much to do with the growth of agrarian production"—rather, it was "the increase in agrarian output prices, which consequently reduced the gap between prices of industrial goods and food-stuffs, [and helped boost food production and productivity in the agrarian sector." According to Sicular (1988, p. 703) "adjustments in prices and incentives frequently have either no effect, only temporary effect, or too strong an effect." Sicular also notes that such measures may have undesirable effects, and that a mixed system is sustainable and can have desirable efficiency and distributional effects. Markets, however, limit the range of sustainable plans, and in the presence of markets, state planning may no longer directly influence production and consumption behavior.

According to Lin (Lin, 1992, p.39), China's rapid agricultural growth was dependent not only on the restoration of household farming and the increase in market freedom, but also on rises in the acreage devoted to cash crops and the expansions in animal husbandry, fishery, and subsidiary production. Adjustments in crop patterns in response to soil, temperature, rainfall, and other region-specific characteristics are a major source of productivity growth in agriculture generally. Changes in the multiple cropping index are indicators or how intensively land and labor inputs are utilized. Also, in China's case, any change in farming institution would alter the compensation scheme and affect the level of effort supplied by each farmer; findings indicate that the dominant source of output growth during 1978—84 was the change from the production-team system to HRS. Ultimately, family farming has advantages because it makes more productive use of inputs (Lin, 1992, pp. 41, 47–48).

6.2. Problems with the Chinese Agriculture Reforms

In China, as is the case with many centrally directed experiments, there was "under- and over-production in the resulting quantity adjustments (Lardy, 1983, p. 9). Incentives generally tend to conflict with planned targets for reasons such as budget constraints and the need to harmonize the plan with the market. If farmer decisions conflict with planning targets, interventions occur.

The higher level and wider scope of above-quota price bonuses together with high market prices for some products encouraged evasion, and the government's ability to enforce quotas had been weakened by de-collectivization." "In some cases large differentials between state and market prices have influenced state contract procurement. (Sicular, 1988, pp. 691–695).

Problems developed with the relative share of growth between grain and non-grain crops and imbalances of supply and demand, unstable market prices, and unsustainable price subsidies. These all contributed to the reduced growth in farm production in China from the mid-1980s (Sicular, 1988, p.702-703).

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7. Review

In both collective economies and capitalist economies, the determinations of production quantity target and price level are considered the two most basic tools of agricultural planning. Of course, there is a strong relationship between these two tools; whichever is selected as the primary tool, the other must be set and controlled accordingly. Theoretically, in an environment isolated from all other factors, each tool can give same result as the other. Neo-classic economics prefers indirect control by prices, while the technical planning approach prefers the direct control of quantities. Because it is understood to provide information savings (i.e. require less informational inputs), price is theoretically seen as the superior planning tool. In fact, the same information is needed for each option, and both are simple and easily understandable (Weitzman, 1974), and in practice, the quantitative restriction policies followed in China had similar effects in the U.S., Canada, and the then EEC (Sicular, 1988, p. 2).

However, both price and quota applications are limited tools; high prices lead to overproduction, while low prices lead to under-production. Moreover, since quotas always impose restrictions on a production area, a black market for quotas emerges. As production quantities and prices must be managed for planning to achieve its goals, a successful plan should be able to use these two factors effectively and harmoniously. As will be explained in detail below, planning based on price guidance is not possible in an economic and agricultural food system in which monopolistic structures are dominant.

The American experience in 1938 and the Chinese experience after 1978 show that the participation of farmers and other stakeholders in the planning process increases the success of planning. As the Chinese experience shows, if producers can show initiative in the use of their labor and other agricultural resources, the result is an efficient use of resources and increased productivity, which ultimately increases both agricultural production and farmer income.

It is possible to derive a third result from the first two findings. If small commodity producers, who constitute more than 90 percent of agricultural producers in the world, are voluntarily included in a planning system and can take the initiative to make decisions on production resources, they can make a significant contribution to the successful results of planning. However, based on planning experiences, it should be noted that , to date, agricultural planning has not sufficiently taken into account the most important resource of production, namely, people. When it comes to agricultural planning, both in the literature and in practice, the first thing that comes to mind is r the questions of what will be grown, how much, and on which lands. Across the world, it is predominantly the farmer who faces and is thus the source of the solution to fundamental farming questions, including those of agricultural planning related to, for example, resource use efficiency, productivity, and production flexibility.

Farmer initiative, which was limited by central planning in socialist societies, could achieve extraordinary success if its capacity is freed up and it is directed towards production, as seen in the Chinese experience as well as in countries like Turkmenistan where there are still peasant far—even though today's farmers are rapidly aging and decreasing in number, a factor that will need to be taken into account when considering the petty commodity producer and peasant agriculture as a planning opportunity (and a goal). Therefore, below, peasant (smallholder, family) agriculture is discussed separately.

Of course, farmer participation alone is not enough for successful agricultural planning; there are many factors that will affect its success, especially prices. In order to develop a wide perspective on this, it is necessary to consider the problems faced as broadly as possible. A plan targeting food security today should take into account many factors in addition to primary agricultural products, such as transportation, storage, processing and sales channels. In other words, planning in agriculture cannot be successful without planning in the agro-food system. Table 1 presents the problems challenges faced by a planning system within the framework of the agro-food system. Essentially this is a listing under five headings that categorize types of factors to be considered.

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Table 1. Challenges Faced by Agro-Food Systems.

In Production Process	Price Related	In Social-Political Context	Related to Economic System	International
Dependency on Nature	Agricultural price volatility spillover effects	Bribery and corruption	Capital abundance	Production of exporter and Importer countries.
Disease	Supply and demand dynamics	Strength of institutions	Exports/Imports	Comparative advantage
Seasonality	Demand-supply imbalances	Availability of collaboration and communication	Access to markets	International market price situation
Availability of cultivable land	Speculation	Strategic stockpiles and reserves	Demand and supply situation	Global economic conditions
Availability of labor and workforce resilience	Financial market interdependencies	Risk management	Effect on Industrial Cost Structure	
Technology	Market perceptions and expectations	Tariffs	Effect on general price level	
Cost of production	changes in stock levels	Domestic subsidies	Effect on cost of living	
Number and kind of suppliers	Transaction costs	Foreign trade policies	Strength of local and regional food systems	
Sustainable agricultural practices	Trends in market prices		Investment in technology and digitalization	
Perishability and Seasonality	Changes in input prices		infrastructure and logistics	
Inter-crop price parity	Input/output price parity		market structure	
			Biofuel production	
			macroeconomic factors	

8. The Agro-Food System

Along with farmers and farming families and those directly employed on the land—the agricultural labor force— the agro-food system involves a wide range of related sectors, industries, companies, and individuals; analyzed vertically starting from the farm, these include traders, logistics services, retailers, restaurants, consumers, and recycle services. As indicated (Table 1), fo od systems need to be resilient to many types of shocks at different scales that can affect food production and availability, such as extreme weather, pest outbreaks, market crises, failing institutions, and political conflict (e.g., Misselhorn et al., 2012; Schipanski et al., 2016). Systems of production thus need to be robust and able to recover after these shocks or adapt to them in order to deliver food in sufficient amounts with nutritionally adequate quality and affordable prices (D'Odorico et al., 2018, p. 498). The resilience of the system as a whole further depends on factors such as the globalization of food trade, the amount of food traded, the number of trade links between countries, and the characteristics of the trade network. Food and Agriculture Organization (FAO) data suggest that over the past few decades the system has become "increasingly vulnerable to instability as a result of demographic growth, dietary changes, and the increasing interconnectedness of the trade network" (D'Odorico et al., 2018, p. 500).

Historically, the center of decision-making of the systems was farmers and state; nowadays, it has shifted to industry-processors and retailers. Industrial and retail corporations have grown and expanded horizontally and vertically to benefit from economies of scale and technical and financial efficiencies. This has resulted in their becoming the determining factor for prices; in other words, they

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have gained market power. They can control competition and not only pull down the prices local and regional producers and traders can demand, thus directing national and international prices, but also have a strong influence on food accessibility. There are a relatively small number of such traders and processors in the supply chain against a large number of farmers: "Farmers have very low bargaining power against both input suppliers and buyers" (Kazak et al., 2021, p. 1). At the same time, the globalization of food chain and rising interdependency on mutual trade has reduced the resilience and increased the vulnerability of the agro-food system as markets have a greater susceptibility to failure for economic and political reasons (D'Odorico et al., 2018, p. 498).

Governments are involved in surveillance, such as of food safety regulations and competitiveness, as well as making trade agreements, providing information, and developing sustainability comprises. The system integrates agricultural policies, producer conduct, market structures and environmental aspects, and appropriate policy-making is important to ensure food security in all countries. Given the increasingly complex structure of the agro-food system, policy-making requires the cooperation and participation of as many stakeholders as possible.

In the literature that deals with the planning of agro-food supply chains, the topics addressed include crop and livestock production models, location analysis, and strategic production-distribution models. Large companies use such studies and individual farmers are increasingly having to contend with these complex models. The list below, drawn from Borodin summarizes various reviews related to agro-supply chain management, highlighting the importance of planning, sustainability, and operations research tools.(Borodin et al., 2016, p. 2.). Nd individual farmers are increasingly having to contend with these complex models.

Ahumada and Villalobos (2009) assessed production and distribution planning models for agro-food supply chains;

Woodward et al. (2008) discussed simulation-based approaches for farming systems innovations;

Lucas and Chhajed (2004) reviewed the operation of research-based techniques for location problems;

Beske et al. (2014) focused on sustainable supply chain management practices in the food industry;

Akkerman et al. (2010) considered quantitative operations management approaches for food distribution;

Higgins et al. (2010) emphasized the complexity in agriculture value chains and the role of operations research;

Thornley and France (2007) reviewed mathematical models for agricultural decision-making;

Hovelaque et al. (2009) highlighted the complexity and constraints in managing agricultural supply chains.

9. Advantages of Peasant Farming in the Context of Agricultural Planning

Peasant or smallholder agriculture, which was historically expected to decline and disappear with the development of capitalism, has decreased numerically in the wealthy countries of the First World (the West), but this is not the case worldwide. Today, it still constitutes more than 90 percent of farmers These figures alone explain why peasant agriculture is vital from an agricultural planning perspective. Peasant (family) farmers do farming with low costs and in which the co-production of human and nature is central (Ploeg et al., 2019b). It has resilience against price fluctuation and natural disease because of its low usage of external inputs and finance, mixed cropping methods, and skilled labor (Ploeg, 2010). Peasant farmers often do multifunctional activities and cooperate with other farmers. They have flexibility regarding different agricultural systems, climate conditions, and tactical adjustments to capitalize on good conditions and minimize losses under poor conditions. In other words, peasant farming is inherently sustainable. Its productivity, however, is moot.

One of the most important topics in the debates about small commodity producer farming concerns its relative levels of productivity. It is argued that large-scale farming is efficient (not productive) up to a certain scale. In the other hand productivity is depend on technical, natural

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condition not related to scale. . In fact, peasant farming is more productive than large-scale farming in many cases, and when its multifunctional and synergistic structure is taken into account, it can achieve higher productivity especially per person (Akkari et al., 2019, p. 134). Therefore, a complete transformation to big-scale farm might not be necessary: Small-scale farms can helped to be more productive by providing them with sufficient inputs and supports, in which case, they do indeed often achieve greater yields than large-scale farms (Samberg et al., 2016). Moreover, if smallholder farmers are provided with financial, technological, information and market access support, they can constitute a source of food security, poverty alleviation, and food system resilience (D'Odorico et al., 2018, p. 503).

When considered on a product-by-product basis at the regional or national scale, the involvement of independent small producers in an agricultural planning project may at first glance seem quite problematic. First, when production is directed through a high price determination, there is a high probability of an increase in production, but it is almost impossible to predict the amount and how each individual small producer will react to it. Second, directing production either through price or a quota system cannot ensure the efficient use of resources at the micro level: Because the primary aim is quantity-driven—to reach the desired production amount—efficiency—the optimum usage of land and other resources— at the micro level is not adopted as a priority, and it is very difficult to achieve this with a macro plan. Neither macro-level data can accurately reflect the micro-level, nor can micro-level data accurately reflect the macro-level (Ploeg, 2020, p. 960). Small commodity producers can only ensure the efficient use of the resources they have, and their working dynamics are much more complex than they might appear: Peasant farmers make decisions that involve taking many competing factors into account as a farm and a household, such as labor--versus-consumption, benefit-versus-burden, human-versus--nature, production-versus-reproduction, internal -versus-external resources, and scale-versus-intensity (Ploeg, 2013).

A planning approach that aims to benefit from micro-level efficiency can be achieved through the voluntary participation of independent producers in the planning process. The historical experiences recounted (above) show that participation in planning increases its effectiveness, while the involvement of multiple actors in agricultural development planning has led to the development of strategic plans that take into account the multiple functions of farmland. The participation of farmers and other actors in agricultural planning is not only about determining specific plan objectives, but also about "taking into account the multiple functions of farmland, including food production, conservation of water resources, heritage landscapes, and attracting visitors to farms" (Akkari et al., 2019, p. 132).

10. Price, Market, and the Agro-Food System

Since humans form societies in which production is socialized, it is inevitable that products will be exchanged, so there will be a rate of exchange and thus, as a concrete expression of this, a price for the products. In economic theory (ideal practice), t he price of agricultural products, like other goods, has many functions. First, it determines the distribution of income among farmers and those who produce agricultural inputs, those who process agricultural products, and those who consume agricultural products. If, for example, the price of agricultural products increases faster than the prices of the products and services produced by all these groups, the distribution of income changes in favor of agriculture. Second, it covers the costs, income, and profits incurred by the farmer. If the price of an agricultural product falls below the production cost, consequences can run from the farmer discontinuing that production and turning to another product to losing money (capital), going into debt, being unable to pay off the debt, and finally stopping production altogether. Naturally, when product prices are high, the farmer produces more of that product.

Third, the financial expression of price —as an amount of money, in other words, monetary prices— causes the value of the product to be affected by changes in the value of money (currency) . If this decreases while the price of the product remains unchanged, the real value of the product also decreases, and vice versa. In common parlance, if agricultural product price increases fall behind the rate of inflation, the real value of the product will decrease (as shown by different price indices).

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Fourth, in the long run, where other conditions remain the same, a decrease in the real price of a product reflects a decrease in production costs and/or an increase in productivity. Therefore, when comparing agricultural and non-agricultural prices in the long run, it is necessary to take productivity developments into account. Fifth, the price of a good also reflects whether that good is in abundance or scarcity (per classical supply-and-demand economics. Thus, as a sixth function of price—one that is extremely important for our subject— it reflects the bargaining power of the parties. There are many factors that determine bargaining power, but the most decisive is the ability to use it to control supply or demand .

While prices have so many functions and are formed depending on many variables, identifying the "right" or the "fair" price has occupied economists throughout history. There is no definitive way to settle the issue, and governments have long sought to determine and direct agricultural-food prices. Therefore, price is also a political phenomenon and subject to power relations. In this case, explanations about how price should be formed also carry political and ideological content. According to the views that defend capitalism as an ideal system, prices should be formed in the market. A market economy is an economic system controlled, regulated, and directed by markets alone in which the production and distribution of goods and services are left to this self-regulating mechanism. Such a 'pure' market system is an ideal or abstraction—a fiction rather than reality; markets are always embedded in and regulated by social and political institutions. State intervention in agricultural product markets is not the exception but the rule.

On the other hand, oligopolistic and monopolistic companies are dominant in the marketplace nowadays and thus enjoy pricing power (market power). Depending on their size, information access, and competitors, they can raise the price without losing significant market share. Thus, as Jan and Harriss-White explain,

"Against the neo-classical conceptualization of markets as autonomous entities, these researchers find that commodity flows and prices, the volume and seasonality of supplies and the location and number of intermediaries is not entirely independent of other parts of the economy, especially the agrarian structure" (Jan & Harris-White, 2012, p. 43).

Therefore, results expected from an ideal pricing system—including efficiency allocation, welfare, competition, and cost considerations, buyer and seller satisfaction, are actually formed according to corporate power as mitigated by state policy. In other words, price is not only formed according to bargaining power in a competitive environment but according to economic power and political preference:

"Since prices, whether local or international, reflect power positions and the struggle over the distribution of resources and incomes, there can be no 'right' prices independent of implicit or explicit aims regarding such distribution" (Ghosh, 1992, p.25).

Finally, one more feature of price in a capitalist economy is that it provides information about the past but not the future. This is important since production decisions are made according to future estimates and calculations, and demand decisions mostly occur in the future. For this reason, price as a mechanism lacks the capacity to coordinate production decisions with consumption decisions and thus to perform all other positive functions expected of it (as listed).

11. Agricultural Products and Prices

Production of an agricultural product is typically an annual process; the output of any year involves a response to price in the previous year, and so on. In other words, output is reactive to lagged prices. If producers believe that a high price in one year will also continue in the next year they will decide to increase production, leading to supply increases, and inducing a downward pressure on prices and consequent decisions to change product. Without intervention, cyclical and volatile dynamics then come into play.

Another characteristic of agriculture is seasonality. Generally, farmers sell their agricultural produce immediately after the harvest to deal with debt payments and other needs and also because many agricultural products spoil quickly. Therefore, supply increases rapidly upon harvest, and prices fall. In this case, the claim that total agricultural output can be raised most effectively by

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ensuring 'remunerative prices' in a free market without government intervention is flimsy because the prices that fall as a result of increased production often cannot even cover the costs of production. Thus, agricultural products are generally believed to have price-inelastic demand and supply functions (Schnepf, 2006, pp. 21–22). When demand is inelastic and supplies rise, the price drops.

Product prices have to cover costs if production is to be sustained, but if the price falls to below cost, government intervention is necessary. A longer-term reason for price reduction is productivity growth. In this case, productivity gains do not offset the price decline losses, and intervention is still required. In short, output and price fluctuations usually require some kind of stabilization intervention. However, price support schemes alone tend not to secure increased agricultural production. Thus, ensuring 'remunerative' production for farmers implies fairly systematic state intervention. In most developing countries, the bargaining power of any socio-economic group in the rural agricultural market depends on factors like its initial asset distribution, power and influence, and relations with the state. Importantly, government and markets are socially and historically structured, reflecting class combinations, power relations and the bargaining strengths of different groups (Ghosh, 1992, pp. 22, 24–25).

The Agro-Food System, Markets, and State Interventions

Many countries have tried to control the prices of certain commodities but ended up abandoning their attempts. Price controls have set prices temporarily but not been sustained in the long run. The fundamental difficulty with price control is that it is almost impossible to set a price that will match supply and demand, so price controls result in product shortages or excess. Because price control gives the wrong signal , it also distorts to resource allocation.

Agricultural production, prices, and trade were regulated from the 1940s to the 1970s at the levels of national policy and the world economy. These regulations managed the supply of various products and stabilized prices. Since these policies were gradually removed from beginning of the 1970s, the agro-food regime has become increasingly susceptible to sharp price changes. Moreover, the long-term trend in farm products showed a decline over the period from 1955 to 2000 that was particularly notable from 1986 to 2005, where prices fell by an average of 1.4 percent per year. Then, as agricultural product prices rose, in 2008, worldwide food crises occurred. More recently, during the COVID-19 pandemic, food crises and vulnerabilities in the agro-food system affected the world. However, it is necessary to note that these trends have not always been consistent across all agricultural products.

Theoretically the market can be analyzed in three ways: with a view of power (e.g. K. Marx, P. Bourdieu), institutions (e.g. M. Weber and K. Polanyi), or networks (e.g. E. Durkheim, M. Granovetter, M. Callon). These understandings are not always independent. For example Bourdieu, combined notions of power and institution in the concept of the market as a ‘field’ where power struggles occur under an institutional structure favorable to a particular group. In Neoclassical Economics, the "market" is treated as an autonomous and flexible mechanism of voluntary exchange based on choice, by which prices are formed as a result of supply and demand, and through which scarce resources are valued and allocated. Efficiency is achieved under perfect competition and perfect information where actors towards to equilibrium levels. Actually, of course, perfect competition nor more exists than ideal markets, and where is no any means that coordinate to supply and demand decisions While a host of coordination mechanisms are applied in agricultural marketing channels, there is no theoretical framework for marketing co-ordination. (Jan & Harris-White, 2012, p. 43).

Agricultural production has its unique characteristics—such as the biological nature of the production, limited assets, and time lags—which preclude rapid adjustments in output and prices, and the functioning of agricultural markets is driven by biophysical and socioeconomic factors, as well as different policies. In a capitalist economy, the main information is price, which is determined in the market as result of buyer and seller decisions. In centrally planned economies, prices are designed to provide much of the same information as in free markets. The planning office sends information to the managers in the forms of a set of price signals, and the managers return

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information to the central planners in terms of their output; if the planned output is greater than needed, a new set of accounting prices is communicated to the managers. This process continues until a particular set of production levels is realized. In a mixed system, plans and markets interact in several ways. Allowing markets to emerge alongside state planning both enhances and limits the power of planning. Markets enhance planning's distributional function and improve allocation efficiency, but they limit the state's ability to direct production and consumption by means of planned quotas and prices (Sicular, 1988, p.705).

Although often cited as prime examples of competitiveness, agricultural markets are not well represented by the classical Walrasian model. Price formation according to supply and demand is observed in some local markets, but agricultural food markets actually do not and cannot operate on a competitive basis, largely due to their unique characteristics. On the supply side, not only is production determined by the amount of area under cultivation, but also unexpected shocks such as weather or crop diseases distort prices, and governments imposing market regulations cause significant deviations from the conventional supply-demand structure (Lucke, 1992, p. 235). Moreover, farmers have different production functions and, quotas, available acreages, and relevant risks (Lucke, 1992, p.15).

Nowadays, as noted, prices are influenced by corporate market power (MacDonald et al.). The major actors in the spot and forward freight markets are the large shipping companies, old commodity houses, like Cargill, Bunge, Archer Daniels Midland, and Louis Dreyfus, and banks, such as Rabobank and Morgan Stanley, which have been involved in the trading of commodities for a long time. Agricultural and food marketing based on consumer orientation cannot be well coordinated (or only at a high cost) through market prices; additional coordination mechanisms need to be applied. Price volatility affects all actors in the food supply chain; implying increased risks to farmers, who may react by reducing output supply and investments in production. For consumers, on the other side of food supply chains, price increases pose food security risks (Lucke, 1992, p. 239).

An effective pricing system should ensure that accurate information is transferred both about the costs and price changes in the production process (to the user of the final product) and about the price changes in the final product (to the producer of the primary product). When the final price of the product changes, this is transmitted to farmers' sales prices through costs and pricing strategies, which are also related to market power. For example, corporate retailers like supermarket chains may use their market power to keep consumer prices constant or reflect only farmer sales price changes, in which case, the costs of price change transmissions are higher in competitive markets (in both directions). Increases in price transmission costs can also increases price transmission volatility (Assefa et al., 2017, p. 94).

Contract farming, price formation through auction-based tenders in spot markets, and futures markets can all produce information and conditions that reduce price uncertainties, although, of course, these methods and markets also have their own flaws. For example, the stronger party determines the terms in contracts, there is speculation in futures markets, and price formation is based on market power in both markets. In the US, contract production and marketing accounted for 36 percent of the value of agricultural production, up from 12 percent in 1969 (MacDonald et al.) Contracts are preferred especially for livestock and certain grains, and are mostly carried out by relatively large agricultural operations. Contract farming reduces the producer's income risk due to price and production changes, and guarantees market access In agricultural auction markets, power is applied through human interactions, such as among auctioneers and between sellers and buyers, and between humans and market devices. Power differences result in information asymmetry among auctioneers and buyers in trading (Kim, 2017, p. 526).

In recent years, some systems have been developed based on market intelligence, information flows, and early warning systems. For example, the Agricultural Market Information System (AMIS) was set up by the FAO, in 2012, complementing the Global Information and Early Warning System on Food and Agriculture (GIEWS); USAID launched the Famine Early Warning Systems Network (FEWS NET), while the World Bank established Food Price Watch (in 2010), followed by the Food Price Crisis Observatory. Yet, the key questions still remain in the policy debate: How much can the

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market be relied upon to provide food security, and when and how much should the government intervene on behalf of this objective? (Garrido et al., 2016, p. 2). In other words, how can we move toward a food regime that offers more food security to people around the world? (Winders, 2011, pp. 2–93). In the context of the agro-food system, food security should be a major definer of the role of the market; the market ought to be a tool used to help achieve society's goals. As explained, however, even if the market works properly, it fails here because there are significant public purposes that cannot be achieved by prices and markets alone (Ackerman & Gallagher, 2000, p. 1). Assessing and improving agro-food system resilience to improve food security requires the development of appropriate measures and indicators, as well as stakeholder involvement and a participatory and collaborative process.

Summarizing, in a socio-economic structure in which production is socialized, the exchange of goods is necessary, implying transactions that, at present, are facilitated by price. However, the market mechanism is an insufficient tool for determining prices, and today, in almost all markets, it is more realistic to talk about a price formation based on market power rather than the ideal model of competition where the relationship between supply and demand determines prices. The basic tool for ensuring food security, apart from price, is quantity regulation, but it is not possible to ensure food security and price stability with quantity regulation alone. Rather, the agriculture-food system as a whole must be considered, the whole process from production inputs to waste disposal

In fact, agro-food system analyses have been developed from this need—but can an agro-food system be planned as a whole? When the myriad complex, interacting, and unpredictable factors affecting both production and post-production processes are taken into consideration, effective planning in the traditional sense does not seem possible. In these conditions, it seems more reasonable to manage the agro-food system dynamically and continuously by using price, quantity, and technological opportunities as the most powerful tools at hand. Thus, after discussing the technological developments used in directing the agro-food system as a whole—and briefly considering the Indian experience—an alternative planning and management approach will be proposed within the framework of the experiences and theoretical foundations outlined. A listing of the major factors affecting prices that need to be considered for market analysis in the context pf food security is given in Table 2.

Table 2. The Factors Related to Production, Price and Food Security**.**

Lack of globally safe assets	Stockpiling policies	Inelastic supply in the short term	Packaging cost	Speculation
Random demand shocks	Product innovation	Product differentiation	Storage and warehousing	Input bottlenecks
Residual demand	Constant upgrading	Economic diversification	stock balances from before reference period	Increasing in efficiency
External volatility, shocks	climatic conditions	Seasonal and cyclical fluctuations	New scientific and technological solutions	Labor shortages and shutdowns
Market information	Transport cost, disruptions	Grading and standardization	Flexibility of supply chain actors responded	Financing cost and availability
Export-import trade and tariffs and subsidies	Processing and value addition	Risk bearing	Labour wages rates	Input prices
Import / export parity prices	Domestic production	Livestock prices (& terms-of-trade with cereals)	Price variations among markets	Consumer price indices
Net food balance	Taxes/levies on food commodities	Monetary exchange rates	Quota systems	Market connectivity and accessibility
Market system/ structure and infrastructure	Policies & Regulations	Market concentration	Imports /exports bans on specific foods	Consumer and or producer subsidies
Market integration / fragmentation	Quality control systems	Price controls	Lost and waste	Food aid imports
Food export duties and subsidies	Food/feed use	Quarantines	Domestic usage including industry usage	

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12. Technological Possibilities for Managing the Agriculture-Food System

The Agricultural Marketing Information System

The agricultural marketing information system (MIS) is a tool employed to collect, analyze, and disseminate data about the situation and dynamics of agricultural market prices. It has been us for almost a century in developed economies, while in most developing countries, a first generation MIS was developed in the 1980s and a second generation in the 2000s (Galtier et al., 2014, 2014) such as Nepal and the United Republic of Tanzania (Magesa et al., 2014). MIS is employed in the formulation of public policies, enabling market transparency and the provision of commercial information. It is used by farmers, farmer organizations, traders, market wholesalers, food processors, policy analysts and policymakers, researchers, educational and research institutions, extension officers, private companies, donors, and, sometimes, consumers (Umar et al., 2020).

There are, of course, possible negative impacts of MIS. For example, expectations based on information gained might concentrate on some points and thus cause to bubbles or panic; powerful actors may collude through price fixing agreements; and readily accessible, cheap information provided by MIS might discourage market players from seeking new types of information or using alternative sources . Negative effects such as these, however, can generally be expected be rather marginal (e.g. occurring only in very exceptional circumstances).

The main driver of MIS development was the emergence of information technology (IT) (see the listing in Table 3), which also solved information problems that hinder market access for many small-scale farmers, increased information about extension services, and provided new perspectives for improving agricultural supply chain management (Deichmann et al., 2016). Overall, IT and MIS provide farmers and other stakeholders with better decision-making, planning, and community participation.

Table 3. Key Technological Tools in the Food Industry.

Smart contracts	Internet of Things (IoT)	Embedded systems	Dematel Fuzzy logic algorithms
Artificial Intelligence (AI)	Radio Frequency Identification Device (RFID)	Big data	Block chain
Cyber-physical systems (CPS)	Agricultural robots	Decision support systems	Data mining
Digital twin technology	Machine learning	Sensors	Simulation modeling
Geographic Information Systems (GIS)	Smart robotics	Value stream mapping	Digital support systems
Automation technologies	Traceability systems	Digitalization	Technological instruments
Smart sensors	Smart packaging	Provenance tracking	QR codes

Source: Abideen et al. (2021).

In general, new IT-based technologies can apply organizational innovation in accordance with evolving consumer demand. It is seen as vital that agricultural engineering education and training centers use IT to integrate approaches and programs focused on innovation and farm management (Agricultural Markets Task Force Brussels, 2016, p. 9). In the context of agro-food system, it can support many operational and research improvements, such as in planning, sustainability, production and distribution planning models, farming systems, location problems, supply chain management practices in the food industry, operations management, mathematical models for agricultural decision-making complexity, and constraints in managing agricultural supply chains (Borodin et al., 2016). in the context of agro-food system and IT. ICT advantages for agriculture: IT advantages for agricultural development can be summarized as follows:

- More effective and open agricultural markets
- Farmers connected to urban, local, and international markets

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- Enhanced governance and services for the underprivileged in rural areas
- Farmers encouraged to innovate in agriculture
- Enhanced management of natural resources and land
- Encouragement to boost the rural economy
- Enhanced productivity, sustainability, and effectiveness
- Disease and pest control described
- Current market data provided
- Bolstered representation of and capabilities for farmers
- Reduced social isolation
- Expanded business horizons
- Weather data provided
- Increased quality of life
- Better and more affordable financial access.

These opportunities are especially important to manage and overcome to uncertainties and risk in the agro-food system, which are summarized in Table 4.

Table 4. Types of Uncertainties and Risks in Agriculture.

Uncertainties connected to pricing	Risks unique to agriculture
Price-related uncertainty	Market and price risks
Regulatory uncertainty	Technology and innovation risks
Environmental uncertainty	Financial risks
Weather-related uncertainty	Production or yield risk
Input-related uncertainty	Other institutional risks
Technological uncertainty	Weather and climate risks
Types of risk in agricultur	Biological risks
	Policy and regulatory risks
	Human and social risks
	Institutional risk

International information on agricultural commodity markets can be sourced from the following institutions: the FAO, World Food Program of the UN, UN Commission on Trade and Development (UNCTAD), International Fund for Agricultural Development, World Trade Organization (WTO), World Bank, International Monetary Fund (IMF), OECD, US Department of Agriculture (USDA), Business publications (e.g. Fertilizer Week), CRU publications.

13. Supply Chain Efficiency: The Marketing System

An effective agro-food system needs to develop primary production to wholesale, industry, and retail sale linkages. It should cover primary agricultural marketing, physical and IT infrastructure, knowledge production and dissemination, export-import channels, and human resources. Crucially, the success of the system depends on the inclusion of farmers (Kumari et al., 2020, p. 71).

Electronic devices and methods used in agro-food markets can ease the marketing process and help farmers secure a good price for their produce. E-balance and e-tendering processes can reduce operation time. Electronic devices and communication technologies are appropriate tools to improve efficiency and transparency in marketing agricultural produce (Joshi & Reddy, 2015, p. 155). These systems help in the collection, regulation, analysis, evaluation, interpretation, and distribution of accurate and real-time information to support decision makers In this regard, MIS tools, too, can be used by public institutions, professional organizations, farmer organizations or NGOs to secure food quality, safety, and traceability and for the coordination of transactions. Table 5 presents a market analysis listing indicating areas in which supply chain efficiency can be increased through the marketing system.

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Table 5. Market Analysis.

Supply	Is there a food gap	Appropriate form of food assistance
Infrastructure for intervention	The best time to intervene	Amount of food aid should be
Appropriate quantities of commodities to be purchased	Nominal and relative domestic prices	what supply arrangements are required
International food markets	International prices	Optimal food purchases
Markets to buy		

Source: Mukeere (2009).

13.1. Auction (Tender) Systems

Another system that is increasingly used alongside MIS systems and of which the applications in India are an effective example is the auction (tender) system. This application and the Indian experience are briefly discussed below.

Another IT-based system that is increasingly used alongside MIS is the auction (tender) system, of which the application in India is an effective example. In a computerized electronic auctions system, both large and small buyers and sellers can submit their offers. The system matches these offers and exchange transactions are enabled. With participation made relatively easy (including distance participation, which is especially important in remoter locations and for farmers who need to physically present on the land), there are more (and a greater range of) buyers and sellers, so pricing efficiency and competition increase (Hamm and Purcell, 1985). Moreover, since wholesale produce auctions can be useful for alternative marketing, it can provide considerable benefits to smallholders and is "highly recommended for rural communities" (Hanson, et.al., 2002, p. 22).The Indian experience is quite inspiring in this regard.

In the Indian computerized tender system, buyers and traders have to first obtain the unified market license, pay a fee to register with the ReMS, and show some security in the bank. The buyer can with bid and make revisions online. After closure of an auction period, the bids are displayed. Then, to complete a transaction, the producer/seller is required to give their acceptance to the bid. If seller rejects the bid, a second round of bidding takes place on the same day and in the same way.

13.2. The Indian Experience

Agricultural markets in India are characterized by poor competitiveness, fragmentation, inefficiency, the excessive presence of middlemen, and widespread price manipulation (Chand, 2016, p. 159.). More than 60 percent of prices paid by consumer goes io the mediators (arhatiyas), which negatively effects both rural and urban households.

The National Agriculture Market (NAM) is a pan-India electronic trading portal. Launched in 2016, the NAM portal networks the existing Agriculture Produce Marketing Committee (APMC) and Regulated Marketing Committee (RMC) market yards, sub-market yards, private markets, and other unregulated markets. This unifies all the agricultural markets nationwide by creating a central online platform for agricultural commodity price discovery. There are about 585 APMC markets, which were linked e-NAM in 14 states in India by 2018. The system aims to include 1,000 regulated wholesale markets in 18 states and three union territories. Smallholder farmers can benefit if they find ways to aggregate produce, thus bypassing the middlemen and even the local market in the process (Roy, 2022). Across the pan-Indian region, e-Nam aims to integrate markets, facilitate trade in agricultural commodities, streamline marketing and transaction procedures, and support farmers/sellers with, among other things, more buyers/ markets, the removal of information asymmetry between farmer and trader, better and real-time prices according to actual agro-commodity demand and supply, transparency in the auction process, and online payment facilities. Additionally, it aims to establish assaying systems for quality assurance and to promote stable prices and the availability of quality produce to consumers. Strategically, e-Nam can guide cropping patterns and incentives production. If the system covers more products, it works more efficiently. It can also enable implementation of a floor/reserve price for auctions at regulated markets. India,

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additionally, has developed an elaborate system of estimation of crop sown areas, yields and production of different crops, along with demand and price forecasting, and a focus on monitoring demand and supply situations to arrive at associated price forecasts.

In e-NAM agricultural product auctions, the buyer side is not restricted to traders within the market since industrial companies and other buyers can also participate. Thus, cartelization and the power to suppress the prices received by farmers has been eliminated. Price formation is competitive, transparent, and efficient. Farmers are selling online, enabling higher prices. Along with higher net returns to farmers—and greater financial literacy and reduced dependency on public procurement—studies on e-auctioning and e-tendering, including e-NAM, show increased marketing efficiency, competitiveness, transparency, market integration, market-driven diversification, and trade expansion and reductions in transaction time and costs and the number and power of market intermediaries and trader monopolies, fewer market imperfections, less wastage and lower final consumer price (Umar et al., 2020).

Considering the recent technologically based developments in particular, it seems inevitable that an alternative planning approach will be developed within the framework of historical and current experiences and theoretical approaches presented here, not only for agriculture but also for the agro-food system as a whole. A discussion of the basic elements of a planning approach that can contribute to the solution of the increasing global agro-food problems and a proposal for such a system are made in the following section.

14. A New Approach: Volunteer, Incentives and Directed Argo-Food Planning

The central idea of this study is that arrangements to quantify agricultural production, regulate and actively manage agro-food markets can reduce the gap between food supply and demand and therefore eliminate price volatility and provide efficiency throughout the agro-food system. These arrangements can be made, it is proposed, using a decentralized and voluntary planning model. The following sub-sections consider this planning process step by step.

15. Predicting Food Demand

As Adam Smith stated, the "stomach of a human is certain size" (Smith, 1776, pp.180-181])—although demand at the individual level is not exactly fixed, it is also generally true that people can only consume a certain amount. If we consider total demand as set by the quantity of consumption of a product at a macro level, we observe a stable (straight-line) increase,; as opposed to the Malthusian argument in which food demand (as compared to food production) rises exponentially (shown as a curved line). Of course, population and income increases, imports and exports, natural disasters and suchlike can affect consumption levels, but if assumed unexpected factors are treated as a constant and measurable factors like population rises predicted, approximate consumption amounts for the following period (e.g., year) can be calculated. Should, for example, extraordinary exports occur (foreign demand) affecting the total (domestic and international) demand, a deviation will result. This can be accepted as risk point or factor and compensated with appropriate measures or new policies.

The variables of the food demand calculation include different consumers with different product demands and the different demand elasticity of different income group's along with, institutional consumption, contract farming, and industry demands. A second important pillar of the food demand forecast is seasonality; many products are required in different amounts at different times of the year. A third component is product storage capacities and conditions. Fourth is substitution products: if there is an alternative product, demand will be more sensitive to price changes. Fifth is alternative usage of the product; where a product has alternative uses, price can be affected, negatively or positively (e.g., a sauce industry can buy an excess of supply of tomato that it can use without depressing prices, but if there is supply deficit, the industry demand can raise the price).

From the perspective of agricultural planning, the theoretical assumptions related to demand that form the basis of the model can be summarized as follows:

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1. Agricultural/food product demands are relatively stable and can thus be predicted within workable parameters;
2. If product demands are stable and supplies arranged according to them, prices will not fluctuate extremely.

16. Supply Planning: Voluntary and Individual

A fundamental aspect of agriculture is that it produces living entities using other living entities. Agricultural products also require specific actions, such as cultivation, storage, purchase/sale, transportation, consumption, and recycling, at each stage, from planting and fertilization to final consumption or disposal. The supply side of agricultural production has many factors to be taken into consideration, including product kind, seed and rise time, harvesting period, producer type, contract farming, agro-food-chains type, commercial, processor, and retailer actors, product waste and loss, storage facilities, transaction costs, alternative products, climate-base issues, and pest and weed control. All these factors have effects on production quantity and quality. When the demand for a product is stable, its supply can be arranged according to demand taking the above factors into consideration. For supply planning, it is necessary take reduced supply into account and calculate predicted risks by a margin that will compensate for their likely effects.

Secondly, after production, even if production is sufficient to meet demand, it is necessary to manage the product so that it can be accessed at the appropriate place and time. The total supply of a product emerges from independent producer and then processor and distributor decisions regarding release. While so many farmers are small-scale producers and there are also large numbers of middleman and industrial actors, there is no mechanism that coordinates the plans of the primary (raw material) and secondary (food) producers and traders. Although the supply of agricultural products is sensitive to price changes, supply arrangements take time. In general, farmers are rational actors; they increase production as product prices rise. However, this attitude alone does not cover everything related to agricultural production. A number of policy variables and other factors affecting the level of agricultural production can increase or decrease the effect of price. It is also necessary to consider these other incentive factors, which are sometimes more important than price (Mamingi, 1997, p. 32).

Given the diversity within and across differently scaled agricultural systems, from the global through national to the local, there is no silver bullet that can be applied in all contexts. Adaptation measures need to be context-specific. A range of planning tools and foresight approaches are available to support planning and implementation. These should be applied in conjunction with stakeholder engagement efforts and efforts to link with indigenous knowledge.

The relationship between farm scale and land productivity has been well studied (e.g., Chayanov, 1986 [1926]; Sen, 1962; Carter, 1984; Eswaran and Kotwal, 1986; Barrett, 1996). The data favors the promotion of small-scale farming for equity and efficiency gains and land redistribution towards smaller farms for economic growth. While some studies confirm that productivity increases as scale increases, others have shown the opposite. Overall, empirical analysis has confirmed that smaller farms have greater land productivity than bigger farms up to a variable threshold with a median value of 11 ha, although cautious interpretation is needed for the upper tail of the farm size distribution due to the low representativeness of larger-scale farms (Chiarella et al., 2023). The evidence in favor of scaling up comes mostly from data on capital-intensive agriculture in developed countries (Lund and Hill, 1979). In a scale-neutral environment and under relatively certain conditions, large- and small-scale farming can operate together.

Supply controls greatly complicate analysis of the effects of the entire complex of government interventions on production, consumption, trade, and costs to consumers and taxpayers (Sanderson, 2016). For this reason, it is necessary to use other tools, on the one hand by product planning and the other by balancing where problems occur.

In capitalist economies, both the plans made by large firms, mostly through contracted production, and the various interventions made by states show that the agricultural-food system will not work on its own,. Hence the need to develop a planning system that takes into account

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sociopolitical, economic; and environmental priorities. Notwithstanding all these interventions, fluctuations in food prices, food shortages, and overproduction in capitalist economies have not been prevented.

Both the capitalist and central planning approaches to agriculture have failed to consider the conditions of the farming household. These include the production-consumption balance, allocation of resources to different activities, and harmony and complementarity between different activities. As a result, the models applied have not allowed and encouraged farmers to use their resources effectively. Concrete experiences indicate that production and productivity increase wherever the farmer can use their initiative as an independent agent. Therefore, a planning approach should assume that farmers can make the most effective decisions about their own conditions, production, and suchlike.

Depending on the supply-demand imbalance, similar but longer fluctuations than those occur in the production of animal and animal products. This is because it takes more time to adapt the amount of animal production to demand. On the other hand, there is an advantage to following animal production more closely due to the already existing tagging system. The monitoring and planning of fishing and beekeeping and other activities may be easier due to the fewer numbers of producers.

Guiding production so that it both attains efficiency in resource use and meets the level of demand cannot just take the form of calculating production quantities and areas and realizing the plans developed from this information. The majority of farmers are engaged in both crop production and animal husbandry, so the compliance of these farmers with the desired production planning cannot be achieved on the basis of only one or the other; both activities should be considered together due to their complementary characteristics.

Price

As in all other sectors, agricultural product prices are directed by states but determined by actors with market power, and the market mechanism alone only gives information about the past, so production planning conducted according to market signals will likely fail and any balancing of production quantity and demand will be coincidental.

In both centrally controlled and capitalist economies, price represents a problem to be determined according to the priorities of production and society. As mentioned (above), price has many functions, so setting any price can have undesirable as well as desirable consequences. For example, high prices favor the farmer but are against the interests of the consumer. For this reason, it is also important to consider which functions will be effective in addition to price, in line with the preferences that determine the price. This choice is also a political choice so price is a political phenomenon.

Ensuring the continuity of agriculture, that farmers have a good level of welfare, and especially that poor consumers have access to food can be the primary criteria for price determination. Setting the product price involves problem of determining a value that will provide the producer with an income above costs and continuity of production, prevent excessive income flow between sectors, and provide consumer welfare and access to food for the poor, reflect developments in productivity. and eliminate the negativities of world prices. In fact, governments that manage prices can achieve this.

17. Marketing and Processing Activities

Even if the planning of agriculture by determining the cultivation areas and production amounts is done correctly, it remains a fact today that inadequate conditions for trade and the storage and transportation of agricultural products after primary production along with the lack of information on production, markets, and prices cannot prevent the monopolistic behavior of actors with market power. Under current contemporary conditions, therefore, prices will thus continue to fluctuate, and overproduction and shortages will still be inevitable. However, technological developments and experiences in applying them to agro-food markets show that it is becoming increasingly possible to

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manage and direct the agriculture-food chain as a whole. Utilizing already existing technological opportunities and further developing advanced systems in agricultural production and marketing, for the processing and delivery of products to the final point of use, and for the disposal of wastes has many, multifaceted potential benefits.

Since agricultural production and product prices are subject to many different effects, uncertainties, and risks, stabilizing them is not possible by making a one-time plan. Rather, it is necessary to constantly follow developments, producing and analyzing information, predicting and managing the risks that will arise, and creating mechanisms against unexpected occurrences. All changes conditions assumed as constant and other predictable areas can included into the mode to be developed as manageable risk factors.

18. Volunteer Planning

According to the above, volunteer planning in agricultural production is possible; an example proposal of this planning model is outlined below on a step-by-step basis:

1. A data processing and information center (DPIC) is established. The DPIC team consist consisst of members with specializations in statistics, econometrics, economics, agronomy, sociology, and IT. It collects data about the past and present supply and demand of specified products. This team analyzes the data, estimates demand, and considers other aspects of the agro-food system, including risk factors, and then disseminates the results to all stakeholders.
2. The DPIC develops cellphone/computer applications for use by farmers giving information on seeding time, planed seeding quantities, and estimated harvesting times and amounts. It also develops tools and methods for farmers to use the applications
3. The DPIC prepares explanation material (documents, manuals, films, etc.) on the planning system for farmers and the public. Then, the state, agricultural ministry, and agricultural occupation organizations communicate information about the planning system to farmers and the public.
4. The state, agricultural ministry, and/or DPIC prepare a detailed application procedure and present it to farmers. This should include the advantages of participating in the system, just as purchasing guarantees (without which, price determination is not meaningful). When purchasing guarantees are being declared, it is also necessary to establishing related infrastructure, such as storage facilities, cooling systems, and personal and financial allocations to facilitate product purchases.
5. The DPIC communicates with farmers before the seeding time to learn when they will seed, the size of their planned seeding areas, the species of product they will seed, and when they will harvest (and similarly in animal husbandry and other domains).
6. After processing all the information collected from farmers , the DPIC calculates the total estimated supply and supply-demand balance. According to this calculation, one of three situations will be considered.
    - **a)** A balance between supply and demand: In this case, the DPIC sends a message to farmers to realize their plans.
    - **b)** Excess supply: The DPIC sends a message to farmers asking them to reduce their seeding (or similar) plans (by a certain percentage) and to then send information about the new plan. If the new plans secure the supply-demand balance, the realize- your- plan message is sent; if there is still excess supply, the DPIC or Ministry of Agriculture, make a plan to use excess production after harvest (e.g., by identifying new markets or another product use area), and then realizes this plan (i.e., after the harvest).
    - **c)** Excess demand: The DPIC sends a message to farmers to increase their planned seeding planning (by a certain percentage) and then send information on the revision. In cases of excess demand, provisions are made (e.g., using contract farming, state-farm seeding, importation) to compensate for the supply deficit.

If, there is more than one season for one product, the same process applies. It is anticipated that farmers will both voluntarily join the system when they are given a price and purchase guarantee that guarantees the cost of reproduction plus an income and also be willing to change their production levels in line with the demands of the planning center. Additional advantages, such as

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agricultural insurance, can be offered to farmers in order to increase their motivation to participate and protect against risk.

After the harvesting process, there will be a need for updated information and open tender organization. The organization and operation of markets using the open tender method will aim to ensure effective price formation and the delivery of products to users. Agricultural products will be bought and sold on a national scale, and monopolistic tendencies and speculation will be prevented. This organization can be established by the state with participation of farmers, distributors/traders, industry representatives, and professional organizations, but it must be clearly under state control.

The DPIC will continue to observe climatic and drought conditions, diseases, extra ordinary conditions in both supply and demand at the national and global levels, changes in the market and market structure, and any new substitute products. If some extraordinary development occurs that breaks the supply-demand balance, the DPIC will seek alternative solutions. As necessary, it will develop new alternatives as opportunities arise or make reductions (to seeding or stock planning, import-export channels, etc.).

If everything goes according to plan but supply excesses still emerge, the state will purchase these products at a declared price for producers participating before the seeding period. The state can sell these products abroad, distribute to the poor at home or elsewhere, process them (make another product), or store for times of scarcity.

The DPIC will follow the producer, wholesale, stock-exchange and futures, and retail markets and continuously monitor the prices of products. If a problem is observed, it will intervene in the market, mainly by means of buying or selling products. If stakeholders and speculators know the DPIC will intervene in the case of extraordinary conditions, they will tend to act properly as little advantage is to be gained from actin g otherwise.

Planning can be initiated with a limited number of products that have had high price volatility in the recent past. Then, new products can be covered under the planning process, which can be extended across all products in a country and also at regional (e.g. EU) and global levels. Within this system, it may be possible to further direct agriculture in many areas, from product patterns to climate change, from energy and water use to packaging, both through purchasing guarantees and reasonable prices, and by the employment of additional tools

19. Conclusion

This article may be considered as a response to the following situation assessment to the following:

Most countries have very little experience in setting rules for local and regional self-regulation (and related schemes for redistribution) and assuring democratic mechanisms for setting the right balances at different levels of aggregation. Here again, critical research and debate is needed. What can social movements realistically and concretely demand from the state? It is more urgent than ever that social movements develop the capacity to demand the needed responses from the state. (Ploeg, 2020, p. 968).

The approach outlined has reviewed the historical background and contemporary situation with regard to the control and coordination of agricultural production, and an example model has been proposal that embodies the basic approach outlined; many other, more structured models can be developed. The basic principles applied involve i) a participatory system with the final production decision being made by the farmer, ii) prices and purchasing guarantees prioritizing sustainable production and the welfare of the farmer, and iii) the continuous monitoring and management of the agro-food system as a whole. The particular proposal developed envisages the establishment of a national DPIC as a structure through which this may be achieved, along with its basic mode of operation.

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