AGRI-FOOD SYSTEMS AND PUBLIC POLICY FOR FOOD AND AGRICULTURE

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Since 2020, Prof Jayati Ghosh and I have participated in a food systems economics commission which has done much to whet our curiosity about 21st century food systems worldwide, about market systems within food systems and about the roles of policy in the development of food systems and how that development is conceptualised.

Between 1979 to 1984, India's food system was the object of an UNRISD project (Chattopadhyay and Spitz, 1987)[2], since when data and evidence, magnitudes and complexities have done nothing but expand. From 1980 to the present, after the consummation of the first green revolution, food production – equated with that of food-grains - has doubled. So also has that of pulses, livestock, fruit, vegetable and spices, while that of oilseeds has trebled.[3] Meanwhile, skipping over post-harvest distribution, India's food system's notoriously dysfunctional outcomes have endured and some have deteriorated. Despite the initiation of the World Bank's Integrated Nutrition Project in 1980 and a stream of national and state-level projects since then, India staggers along, ever nearer the foot of the Global Hunger Index and ranking alongside Sub-Saharan African countries in the

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[1] Developed from the transcript of the joint lecture with Prof Mekhala Krishnamurthy given at the XV International Conference on Public Policy and Management, August 25th 2020. https://www.iimb.ac.in/sites/default/files/inline-files/CPP_XV_Conference.pdf and with permission to revise and republish from *Economic and Political Weekly*, 2021. With thanks to Prof M. R. Sriram for triggering this lecture, to Prof Mekhala Krishnamurthy for her response (in *Economic and Political Weekly* Dec 18th vol lVI no 51 pp 64-70) and to Dr Saher Hasnain for her comments on the EPW version.

[2] Boudhayan Chattopadhyay and Pierre Spitz (eds) *1987, Food Systems and Society in Eastern India: Selected Readings*, UNRISD, Geneva

[3] https://www.indiabudget.gov.in/budget_archive/es1980-81/2%20Agricultural%20Production.pdf

World Food Security Index.[4] Half of India's under-fours are malnourished as are a quarter of their mothers. 60 % of her women are anaemic. But the socially malevolent food system is not just a matter of patriarchal oppression. The food system's labour force remains an epicenter of poverty that is increasingly mapped onto the social deprivations and discriminatory practices of caste.[5] Nor is its malevolence confined to society. With fertilizer consumption expanding 5 times since 1980, India's soils are being increasingly mineralized. Some 80% of cultivable land suffers physical and chemical degradation from many agricultural practices, prime among which is the application of the agro-chemicals necessary for the achievements in agricultural production.[6]

Given such egregious and persistent contradictions and given no evidence of adequately forceful drivers of social and environmental transformations in response to them, my tribute to Jayati's engagement revisits food systems in general and India's in particular. The essay has four parts, developing four questions.

First, I discuss definitions. Ideas and theories are often conceived making – and masking - assumptions that need to be made explicit, because lack of clarity – though it may act as a comfort blanket - impedes fruitful interpretations and understanding. I ask what is food. Food means many things to many people. Second I ask what are systems. To answer the system question, the pioneering work of Rolando Garcia seems to have stood the test of time. Third I turn to agricultural markets, my own research field for a half century, which act as the hinge between

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[4] 101/116 countries https://www.globalhungerindex.org/india.html; 71/113 for WFSI https://impact.economist.com/sustainability/project/food-security-index/

[5] Ira N. Gang,Kunal Sen,Myeong-Su Yun , 2008, Poverty in rural India: caste and tribe, *Review of Income and Wealth*, Vol 54, No 1 pp. 50-70 https://doi.org/10.1111/j.1475-4991.2007.00259.x

[6] Anjan Bhattacharyya & Birendra Nath Ghosh & Prasanta Kumar Mishra & Biswapati Mandal & Cherukumalli Srinivasa Rao & Dibyendu Sarkar & Krishnendu Das & Kokkuvayil Sankaranarayanan Anil & Manickam Lali, 2015. "Soil Degradation in India: Challenges and Potential Solutions," *Sustainability*, MDPI, vol. 7(4), pages 1-43, March.

production and consumption. How are markets and distribution seen in food systems terms? Fourth, I ask the same question of policy.

I try to clarify and develop these questions by looking at global research on food systems: as a precursor to - and context for - future Indian research. I make links from the planetary scale, at which the food systems commission to which Jayati and I contribute has to operate, to some of the constitutive context for India.

What is food?

This may seem a strange question when we all depend intimately on food. Yet food is actually a fuzzy concept, one subject to multiple meanings. For some scientists (and at the outset here), food is simply a set of crops we eat - so food is categorised in various ways - either by individual crops or crop groups such as grains and legumes, vegetables and fruit. And very often, this kind of classification of food privileges vegetarian ideas of what food is. It neglects fish and animal meat and products. It neglects insects, which some people in some parts of the world enjoy eating. The definitions of food, feed and waste are often quite arbitrary. What tends to be forgotten is that food is impossible to produce or consume without water. Others –including some anthropologists - think of food as the elements of a diet. With this understanding of food, some of the world's multitude of food cultures are found not necessarily to distinguish between food and medicine. Nutritional scientists think of food in terms of nutrients: macronutrients, which are calories and proteins, plus micronutrients, which are vitamins and minerals. If you accept the nutritionist's conception of food you have an enormous universe of detail which you are bound to try to describe and from which you have to select if you are going to try to build nutrition into models of possible food systems.

The central questions about food, which are exercising the minds

of people who study the planet and which are relevant to India, are three-fold. First, that current global food production and consumption has unhealthy outcomes for humans. We live in the midst of pandemics of over-nutrition as well as under or mal-nutrition. Second, at the same time, our global food system is environmentally destructive: it is completely and critically unsustainable. The world food system is thought to contribute in the region of 30% of global greenhouse gases, and this would be an even bigger fraction if we factored in the enormous amount of carbon and other heating gases that are emitted when land use is changed from forests to agricultural and pastoral production. The food system is also nailed as a major driver of the sixth mass extinction that is gathering space. Third, a significant proportion of food output is thought to be wasted and/or lost: we are talking 30 or even 40%.[7] FAO currently calls out 14% of food as wasted worldwide between harvest and retail alone. In wealthy countries, more food is wasted in consumption while in developing countries more is thought to be lost in production.[8]

The food question concerns these three sub-questions. We already know certain answers: the foods that are most damaging, both to human beings and their health, and to nature and the health of ecosystems. First, red meat produced by the mass-production of ruminants. Second, refined and highly processed food involving starch and palm-oil: the sort of food that you grab in hurry in a supermarket. Third, the intensive means by which milk and eggs are produced and consumed, which cause harm to both human beings and nature. Enough is known to identify those parts of the food system that need to be changed in directions less unhealthy for society and nature. What is

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[7] https://www.consilium.europa.eu/en/policies/food-losses-waste/ . Data and methods have been carefully evaluated in Jenny Gustavsson, Christel Cederberg, Ulf Sonesson and Andreas Emanuelsson 2013, 'The methodology of the FAO study: "Global Food Losses and Food Waste - extent, causes and prevention"- FAO, 2011', SIK report No. 857. There is now a literature measuring waste and loss in excess of 700 papers.

[8] https://www.fao.org/climate-change/our-work/areasofwork-old/food-loss-and-waste/en/#:~:text=In%20order%20to%20combat%20the,Nations%20Environment%20Programme%20(UNEP);

stopping this change? Why is it not a food policy priority?

In the 21st century the food question is not just a question of the socio-economic system or the policies that have together produced this unhealthy outcome. It is also a question of nature. And giving nature due weight involves integrating into our concepts of food system, not just 'the environment' but the nine planetary sub-systems through which the environment is constituted. They are the carbon cycle, land use changes, water, the nitrogen and phosphorus cycles, biodiversity, chemicals production, ocean acidification, ozone and aerosols.[9] While 'nature-positivity' is difficult for social scientists to understand, it currently makes sense to ecologists and bio-geo-physicists to study the planet through those nine sub-systems.

To make trans-disciplinary models of food systems, physical and life scientists and social scientists then have to figure out how we understand one another when we are talking about these sub-systems' conceptual categories, the relations between them and their measurement. For instance, if we measure consumption in terms of nutrients, as nutritionists do, which has appeal as a common ground amid all the conceptual diversity of food, should the production and the distribution system also be measured in the equivalent sorts of units, which will be energy and material elements including biomass?

The 21st century has brought new urgency to the food question and new problems in our understanding of the food system - hence the need for clarity about what a system is.

What is a system?

In1980 I was inspired by the ideas of the food systems theorist Rolando Garcia. His training was in meteorology but he was also interested in how we know what we know: in epistemology. His

[9] Johan Rockstrom et al 2009 ' A safe operating space for humanity', *Nature,* vol 461 pp 473-5

contribution was to bridge the gap between the engineering and mechanical mind-set, which prevails in systems modelling, and the plural theoretical worlds, the varied kinds of evidence, and the reflexive nature, of the social sciences. His ideas influenced the trans-disciplinary field project on food systems and society referred to at the start here. It was pioneered in Mexico, in West Bengal and in Orissa and coordinated in Geneva through the United Nations Research Institute for Social Development (UNRISD).[10]

Garcia pointed out that systems are not something existing out there. They are conceptual devices to enable us to make sense of complicated things whose inter-related parts we think depend on each other, and whose sum exceeds the sum of their parts. In studying systems, we are not trying to understand entities in isolation. We are trying to understand things in relation to each other.

He then argued that although we are prone to conceiving systems in terms of their elements[11], this is an incomplete approach. Rather, we can best identify elements (and the 'stocks' of which they are composed) only once we have conceived the relationships, the links, the dynamics, the interconnections, the processes that we think contribute to the purpose or the goal of the system in which we are interested. Calling them flows and fluxes, he admitted that they have many names. His point was that the structure of a system consists of these relationships and the varied ways in which they feed back upon one another. Examining food systems in the late 70s and the early 80s, he identified many activities that we would now talk about as policies, as flows and fluxes entering and exiting the food system. Fluxes into the system include things like 'credit policies', 'technology', 'demand for specific products', 'food imports' and 'workers'; fluxes out of the system include 'agricultural products',

[10] Rolando Garcia 1994 *Food Systems and Society : A Conceptual and Methodological Challenge*, Geneva, UNRISD
[11] Donella Meadows (1993) 2008 *Thinking in Systems*, London, Earthscan

‘processed products’, ‘water’, ‘workers’ (again), and ‘profits’. We can work back from these suggestions to the theoretical ideas informing them.

If we look at Garcia’s elements and relationships from a 21st century vantage point, however, we find there’s no energy there, no materials, no bio-diversity or planetary sub-systems. There is not even a hint of capital, although Garcia identifies labour and workers as flows or production relationships in his food system. There is no waste or losses. There are no gender relations. There are no policies as a category, despite many policy-like activities. In fitting policy and public administration into food systems, Garcia reveals that they occupy quite fluid positions conceptually.

Garcia also argued that there is no single scale to a food system. In the systems concept, scales will vary according to our own needs for purpose, precision, intelligibility and interpretation. Systems can, and usually must, also be conceived of as made up of sub-systems: these may overlap, they may be contained within a system or may exceed certain of its boundaries, they will almost always be in a hierarchy, and they will also be dynamic and unstable.

Garcia’s food system was construed through three sub-systems – a physical one, an agro-productive one and a socio-economic sub-system. The physical sub-system was constituted through soil, water, climate, biodiversity; the agro-productive one through costs and returns, technology, physical inputs, production relations, post-harvest technology and spatial transformations, consumption and waste; and (betraying Garcia’s disciplinary formation as a meteorologist) the economic-social sub-system was very loosely specified as ‘social and political structures’. This is an early pointer to the finding that when people trained in one field, such as economics, try to model the planetary food system, vagueness in relation to other fields of knowledge is admitted

alongside the precision of the concepts which their own training leads them to employ.

Garcia goes on to examine feedback relationships between sub-systems, and finds that they are not symmetrical and have varied content. The forces that the physical system imposes upon the agro-productive system are different from the forces acting in the opposite direction. He talks about such system attributes as quality, stability and resilience. The last two attributes work themselves out over time - and time and delays are rarely explicitly acknowledged in depictions of systems. Resilience is something that has stood the test of time and the evolution of the food system over time. Garcia's key attributes are not things set in tablets of stone but constantly evolving.[12] They are complex.

The study of complexity has advanced since 1980 but, for Rolando Garcia then, it was an attribute of the methodology and it was a function of our own capacities to understand. It required clear and widely comprehensible language, some kind of lingua franca, some kind of intelligibility between fields and disciplines and concepts. This is not a trivial problem. At the same time, models have to be selective, a selection defined by the purpose of the analyst – the function or process that she/he wants to understand. Systems are concepts inside our heads and so we also need to be honest and critical in defending the two kinds of purpose: the purpose for which we are translating the purpose of food production, distribution, consumption into a systematic model of a system.

Most real-world systems are open but, when we conceive them, they have to have boundaries. These boundaries are conceptual and they result from hypotheses we have about how we might close a system conceptually. There are no isolated systems in nature, however. Physicists have a particular definition of closed

[12] Attributes are also contested. Others, such as the systems theorist Donella Meadows, have identified attributes as resilience, self-organisation and sub-system hierarchies (2008, pp 75-85)

systems[13] but all our open conceptual systems and sub-systems have to have closure in order for us to analyse them. In the case of economics, even the economy is a closed system in terms of its concepts, its language and its definitions. So disciplinary boundaries have to be clarified too. System boundaries condition knowledge about the system, scales at which it is discovered and conclusions made about the system. We must attempt to specify why we 'bound' the system in the way we do, recognising that others will bound the system differently for different reasons and that things outside the system are not necessarily independent of it. There may be many flows, especially in the food system, which cross system or sub-system boundaries. Money, food products, material inputs and energy for instance are not independent of what we suggest as being within the food system. There are other boundary conditions that cannot be expressed as material flows. Researchers in public policy, may be interested in the idea that information is both a non-material flow and a constraint on system functioning. Decisions are taken outside the system which produce or include decisions and changes in flows within the system. Again we have to be clear about the non-material boundaries and define them as best we can.

Lastly, reflexive relations also define the boundaries of the system – how agents within the system define the boundaries of the system in which they are acting. We need to try to incorporate this reflexivity as well. This is not easy.

In systems theory the environment refers to everything, which is outside a system, but not necessarily independent of it. Rolando Garcia talks about a 'continuum of relevance' in which we make judgements about elements, stocks and flows, which are outside and affecting the system to a greater or lesser degree. And these days, economic modellers are focused on shocks (recognised as 'hidden costs' by some), which occur outside a system but affect the elements and the flows within it. The question how such risky

[13] Systems which do not exchange matter with their surroundings

or downright uncertain forces are identified and described is unresolved - let alone how their impact is valued and measured.

The concept of system that Garcia described, which I think stands the test of time, attempts to minimise vagueness and yet is full of indeterminacy, full of concepts and ideas which might change in the process of research. He proposed starting with the concept of a system, which is justified through hypothesising its goals and relations, which could then be modified as things become evident from research. In his conception, evidence or data is something that has to be sought. It is not confined to quantitative information. It is concepts, it is relations, it is definitions, which matter crucially as we go out and hunt for our system - as others hunt for theirs.

What are Agricultural Markets?

We now turn to the substance and role of agricultural commodity markets within food systems. In the food system, agricultural markets are the indispensable link between production and consumption. They are often forgotten. They consist of a series of economic activities in a sub-circuit of capital called distribution or circulation. Those activities are buying, selling, brokering, transporting, storing and processing, and lending money and borrowing money throughout the sub-system that starts where production ends and ends where consumption starts.

The firms populating India agricultural markets are commonly depicted in two extreme ways. The first is as competitive and efficient. When I started studying them in the late 1960s, that is exactly the simple (perhaps ideologically driven) conclusion that the early generation of price behaviour studies used to generate – although they actually revealed considerable detailed complexity if you read the fine print.[14] Second, they were and are

[14] Barbara Harriss 1979, 'There's Method in my Madness, or is it Vice Versa? Measuring Agricultural Market Performance' in *Food Research Institute Studies, Stanford,* vol. XVI, no. 2, pp. 40-56

characterised as oligopolistic - and socially protected as oligopolies - with masses of petty trading firms surrounding them.[15] Of late, as Jayati Ghosh has analysed, a new scale of corporate capital has entered to disrupt this structure.[16]

Policy for India's agricultural markets has rested for decades on two completely incompatible assumptions about them, which are related to these two characterisations but which resulted from political processes not directly related to the polarised research conclusions.[17] First, agricultural markets are efficient enough only to need the regulation of the first transaction between the farmer and the trader. This transaction between farm and firm would be mediated through a democratic committee of different economic interests which would manage a Regulated Market. Mekhala will explain the fate of Regulated Markets and their 2020 reforms. The second policy assumption is that they are not efficient, they are inefficient, they fail, or they don't exist at all, and because of these circumstances, the state has to step in and replace them. Hence, India has the Food Corporation of India, the states' Civil Supplies Corporations and Warehouse Corporations, the Public Distribution System, the Essential Commodities Act, the Agricultural Prices and Costs Commission, the Minimum Support Price, movement restrictions, and all the current debates. In practice, in India, there is no 'either-or'. Instead, the two policy principles are implemented and co-exist in layers, like

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[15] Barbara Harriss-White 1990, 'Another Awkward Class: Agricultural merchants and Agricultural Change in India', in (eds) H. Bernstein, B. Crow and M. Mackintosh *The Food Question* Earthscan pp 91-103

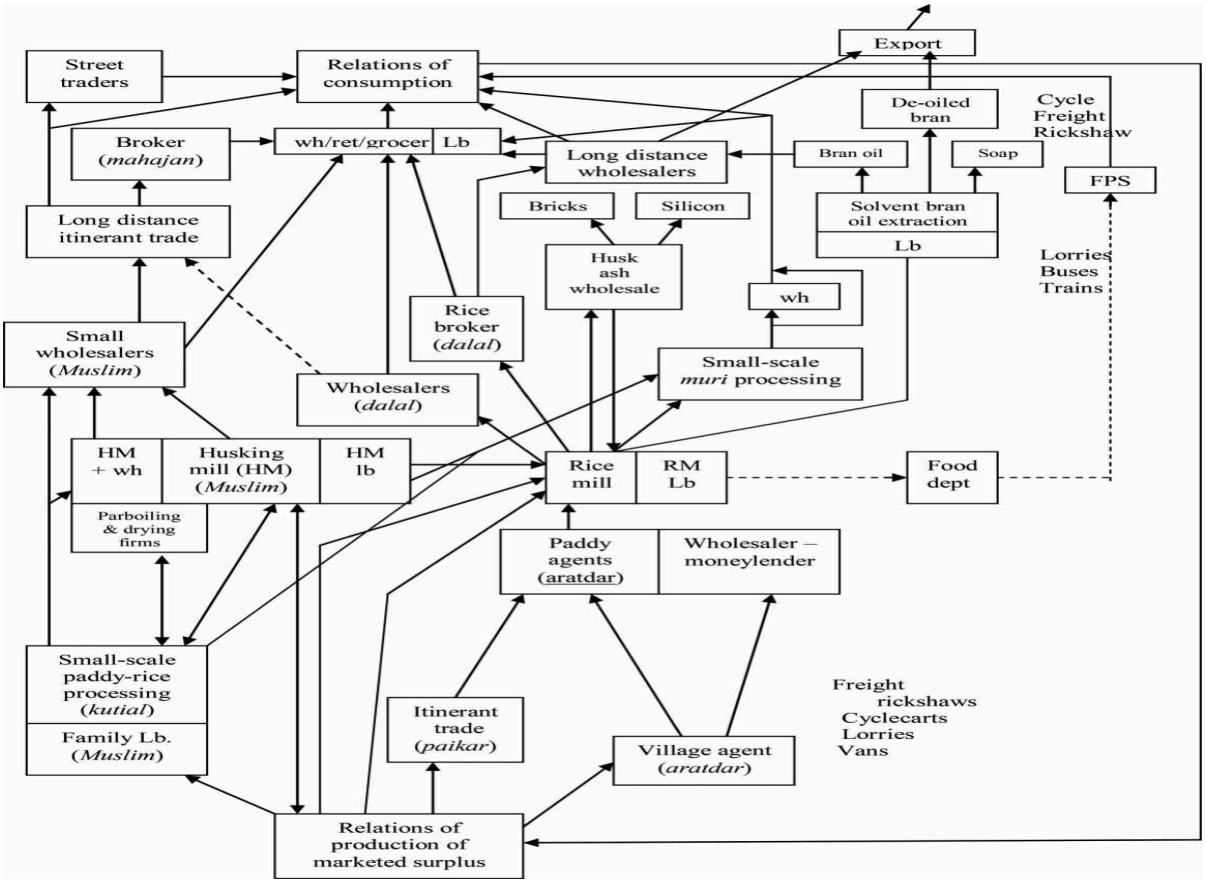
[16] Jayati Ghosh 2003, 'Corporate agriculture: The implications for Indian farmers' https://www.macroscan.org/fet/dec03/pdf/Corp_Agri.pdf see also Ritika Shrimali 2021, *Contract Farming, Capital and State: Corporatisation of Indian Agriculture,* Palgrave; Hartosh Singh Bal, 2021 'How the Adani Group is poised to control the agricultural market following the farm laws' *Caravan* https://caravanmagazine.in/excerpt/how-the-adani-group-is-poised-to-control-the-agricultural-market-following-the-farm-laws

[17] Barbara Harriss-White 1996, 'Order...Order... Agrocommercial Microstructures and the State - the Experience of Regulation' pp 275-314 in (eds) S. Subrahmanyam and B. Stein *Institutions and economic change in South Asia: historical and contemporary perspectives,* Oxford Univ Press, New Delhi

geological sediments, along with their divergent political-economic interests.

Here is an example of an agricultural commodity market system based on fieldwork in West Bengal in 1980-1 as a small part of the UNRISD project on Food Systems and Society to which Garcia made his seminal contribution.

Figure 1: Post harvest market system for paddy-rice, West Bengal, 1980s to early 21st century.



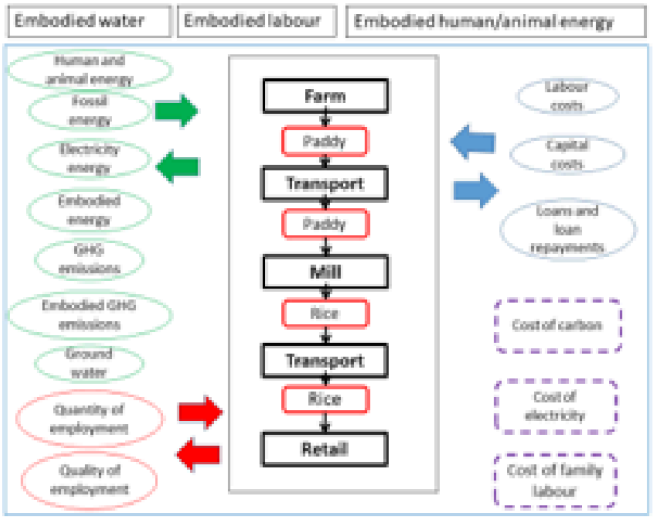
Source: Harriss-White B. 2008, *Rural Commercial Capital: agricultural markets in West Bengal* , OUP, New Delhi

It is partial and incomplete and yet it is already complicated. In this agricultural market system, elements are firms, classified by scale (very roughly according to stocks of capital), by activity and by whether they were private-owned or state-owned. The flows

are commodities: paddy and rice, their by-products together with money. The dynamic of the system, which I would now identify as capital and labour, is missing. Energy, materials, biomass relations, all are missing. Information is missing. Policy is missing.

Much more is revealed as missing when we start trying to depict a system using methods drawn both from social sciences and environmental sciences.

Figure 2 : Stylised Supply Chain for Paddy Rice, South India, 2013-14



Source: Barbara Harriss-White, Alfred Gathorne-Hardy and Gilbert Rodrigo, 2019, 'Towards Lower-Carbon Indian Agricultural Development: an Experiment in Multi Criteria Mapping', *Review of Development and Change*. 24(1) 5–30

In Figure 2, the 'stork's nest' in the West Bengal system of agricultural markets has been simplified and stylised so that Life Cycle Analysis (LCA) from environmental science – through which

the energy, water and GHG pollution from each stage of a food production-distribution-consumption system can be computed - can be made compatible with Supply Chain Analysis (SCA) from business studies - through which costs, returns, energy and labour can be calculated.

A big challenge for the 21st century is to find some way to complexify food systems in a way, which the physical and life sciences speak in an equal way to the social science and together bring us insights about its purpose and dynamics that we didn't know we didn't have.

What is Policy?

Last, what is policy? Here we have a case of experience grating against concepts. Defined as a course of action either proposed or practiced by a government or an organization, in development economics policies are conventionally a set of implications to be drawn from a modelling exercise or regression analysis. But policy isn't an implication, nor is it well represented by a linear kind of organogram with arrows from design or formulation to implementation and onwards towards monitoring and evaluation – sometimes feeding back to design. And although policy cannot exist without labels, it is not confined to a label but has implications for budgets, law, human resources and materials. An objectivized, closed-system approach to food policy labels worldwide has discovered that there are 16,000 food policies, 3800 food policy frameworks and 120 food policy types.[18] Although an unprecedentedly large data set, this policy 'wholesale godown' has been arbitrarily sourced from ministries, laws and acts using key words.[19] Policies affecting the system but not in the set of keywords are discarded. The data-set of labels

[18] Sarah Lowder, Caterina Ruggeri Laderchi, Nicola Cerutti and Kelly Parsons 2022, 'Food system policies: a global snapshot from the food system policy database' FSEC Work in Progress

[19] Policies regulating food corporates are omitted since their law, the Companies Act, is not a key word for the food system.

has been arbitrarily cut-off at the year 2000 ignoring all policies enacted before then (which in India structure the entire food system). The 16,000 policies are neoliberal food polices. Bundled together through content analysis, divorced from experiences and institutions of implementation, policy-labels are wrenched from the context and outcomes that such policy analysis is intended to improve.

Meanwhile, policy has been theorised inside six social science disciplines, each seething with internal debates about paradigms and about the strengths and weaknesses of concepts and theories.[20] An important lesson about policy, one consistent with systems thinking, is that there is no one superior way to analyse a policy. There's also no a-theoretical way to analyse policy, even when policy is being written about without explicit reference to theory of any kind. Comparative analyses of policies combined with an inclusive but critical attitude to theoretical pluralism are valuable. This is especially the case when we search for explanations for policy paradoxes: outcomes which differ radically from their apparent original intentions – a common and widespread reality.

Further, as long ago as in 1974, at IDS Sussex, Bernard Schaffer declared 'policy is what it does'. This shook me like an earthquake: after two years in the field researching the distribution of paddy and rice in South India and Sri Lanka I had experience that policy was far more than an implication and that policy paradoxes were not to be reduced to 'corruption'.[21] Schaffer argued that 'what policy does' involves politics, so the key question was how to research the politics of policy. And what he argued in a nutshell (though in his rather mystifying language) is that policy is a simultaneous process of three (I would say four)

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[20] See https://www.youtube.com/watch?v=qrcQm61B2I0

[21] See Bina Fernandez 2016, *Transformative Policy for Poor Women: A New Feminist Framework,* Routledge, for an authoritative analysis of the technologies of bureaucratic politics in India.

kinds of bureaucratic politics seething away all the time.[22] It's not a 'thing', it's not an implication, a lever or a 'choice bundle', it's a set of bureaucratic processes with their own politics, and that resonates with Garcia's argument that systems have to be identified through processes.

The first process in bureaucratic politics is the agenda: policy formulation, intentions, plans, proposals, manifestoes etc. Most academic work is about this dimension of policy. Agenda making – the social construction of 'issues' that bubble to the top of a list of priorities – is the product of a range of power relations, which determine what reaches the top and how the policy question is framed. Discourse analysis has its place here. So does the study of media and electoral political prospects. Agenda forming is itself nested in a context, a political, historical context, which is almost always outside the study of a given policy. In systems terms, this context is the 'environment' of policy agenda making.

The second kind of 'politics of policy' congeals around procedure. By that, Schaffer meant laws, regulations and office practices. These are costly, though they have hardly ever been analysed as such. One starting hypothesis is that procedure warps statements of intention uttered at the agenda stage. A second is that control over procedure is also a resource, which is subject to all kinds of attempts by interested parties to capture it.

Third, and Schaffer didn't really write about this very much, are resources. We need to know about the politics of the allocation of financial resources needed for implementing policy- and about resources of human skills and experience: the kind of personnel needed in a regulated *mand*i, for instance, to enable it to work. We also need to understand the politics of technology as a resource, and perhaps now energy, because we now know that these are necessary conditions for policy in practice.

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[22] Bernard Schaffer 1984, 'Towards responsibility: public policy in concept and practice', ch 9, pp142-190 in (eds) E. Clay and B. Schaffer *Room for Manoeuvre: an Exploration of Public Policy in Agriculture and Rural Development,* London, Heinemann

Fourth, in the processes of policy politics comes the politics of access. Schaffer stylised this as the rules according to which people in civil society queue (or jump, duck or exit queues) to gain access to the state. Queueing systems have politics, just as they have economic costs.

To accept the reality of four kinds of policy politics along with their costs is to accept complexity in real-world conditions in which there is plenty of pressure to simplify things. But if we deny the existence of this complicated set of bureaucratic political processes, they do not go away. So to the question how to incorporate all this into a depiction of a food system, the answer is not apparent.

The Global Food System

With these clarifications, we can examine how some of these ideas are being represented at the level of the planet. Between 2020-22, I encountered 20 representations/models of the global food system that have often been collectively developed by expert teams and have been peer-reviewed.[23] I see them as internationally authoritative, published representations of our food system. I have laid out eight of them in Figure 3.

The eight examples are complicated and every single one is substantially different from the others, not simply through their mode of visual representation but through their combinations of elements, their linkages, and their handling of the system's environment. To compare the 20 individually exceeds my

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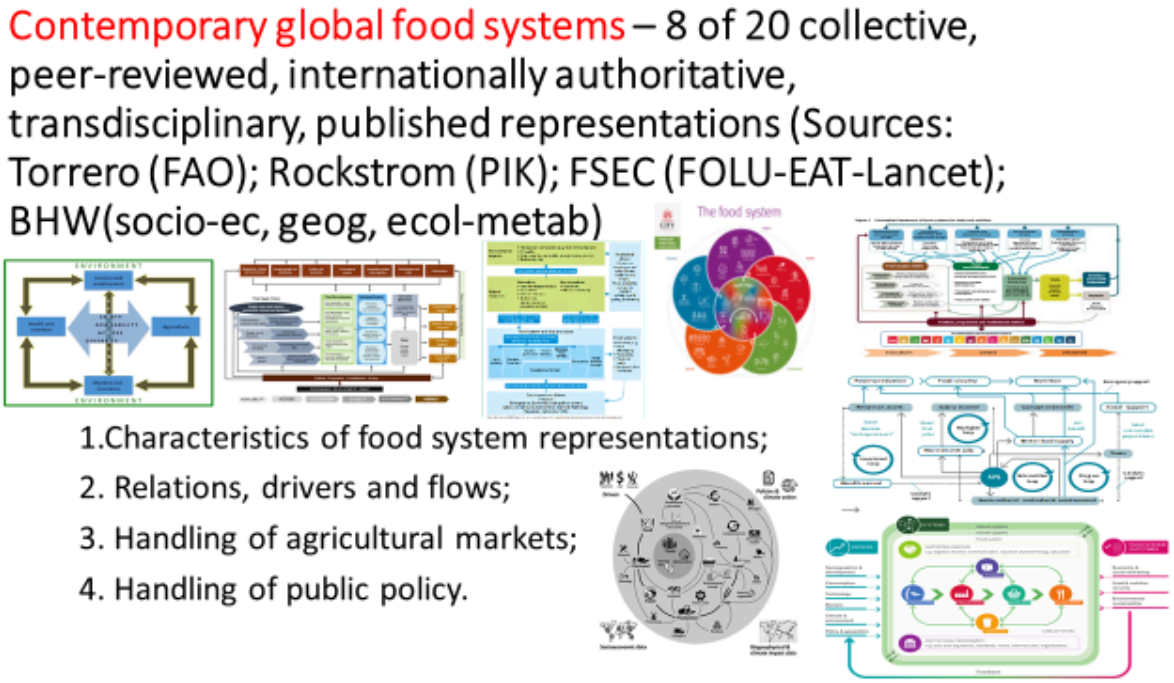
[23] By the time you read this FAO will have collected over 150. And Marshall, Fanzo et al 2021, Building a Global Food Systems Typology: A New Tool for Reducing Complexity in Food Systems Analysis *Frontiers in Sustainable Food Systems 5,1, pp820-8* used a keyword search on Scopus, Web of Science and PubMed to discover 317 different publications describing food systems.

cognitive capacities but they can be analysed briefly in four dimensions.

First, the way the food system is represented. Second, how its drivers and relations – which Rolando Garcia argued were crucial to a food system - are represented. Third, how these approaches to food systems handle agricultural markets. And last, how public policy is handled in these models of the planetary food system.

Figure 3: Depictions of Food Systems Models



The answers prove unavoidably complicated and they need to be considered as provisional.

Global Food Systems Models

In the set of 20 planetary food systems' models, there is no consensus about what a food system is, and minimal consensus about what its sub-systems should be. Several identify the same sub-systems as Rolando Garcia, an environmental one although labelled variously (as an ecosystem, ecology, nature, natural

capital etc.), an agro-production system (variously called a food system (in itself) or agriculture), plus a sub-system to do with society. It might be called ‘people’, ‘culture’ or even ‘food environment’. Various other concepts may be added on to these three sub-systems (e.g. innovation, technology, infrastructure). Two are multi-scalar and zoom from global elements such as climate change through supply chains to characteristics of food and then of the diets of individual consumers. But most perplexing to me, about which I feel critical rather than simply reporting it, is that very often, the sub-systems are *disciplines*. There will be environmental, economic, sociological, political plus sometimes demographic or health sub-systems without apparent awareness of theoretical ferment within disciplines, of their scope, their different understandings of purposes, relationships and system drivers, their languages and protocols. In other cases, the sub-systems are food commodity groups or diet groups such as the meat/ vegetable/cereal system and so on and so forth. The picture is not merely of complexity but of confusion.

Only one of these 20 models states that the system is irreducibly complex. This model conceives sub-systems in terms of resources and assets, labour, commodities, organisations and territorial spaces.

The classification of the elements of the system may be hard to justify. In one case, productivity, which is an outcome, is classified on a par with farmer behaviour, which is a flow, and on a par with the environment, which is either a framing or a sub-system. In another, without feedback relations, an activity is also an outcome. These category confusions make it tantamount to impossible to make sense of the concepts through which experts and their organisations have modelled the planetary food system.

The planetary food system is conceived as a closed system with boundaries, which are very rarely problematized. David Goodman and Mike Watts, sociologist and geographer, observe that the way

the agro-food system fits into global political economy is itself a big problem.[24] But you would not draw that conclusion from the 20 models. There is no indication in any of the 20 that the boundaries are political or multiple or 'zones' or the result of different projects or that they might be modifiable through research.

Relationships and Flows

We appreciate more why this is so as we turn to drivers, relationships, processes. In most of these models, the drivers are not relations, they are available, measurable, quantifiable data that can (or are meant to) be inserted into models. They are not theorised processes in the light of which evidence is assembled so as to make the model work, to modify it or to splice quantitative together with qualitative evidence before inputting it.

Entities labelled as drivers can be entirely outside the system with little indication how they drive it – 'climate change', 'globalization', 'income growth', 'leadership', 'socio-cultural context'. Arranged in sets of drivers, they betray unacknowledged theory. Drivers are also often depicted as disciplines (e.g. politics, economics, demographics, environment). So disciplines can be sub-systems, they can also be drivers, and sometimes sub-systems in one model are drivers in another and just occasionally, the same discipline is a sub-system and a driver inside a given model.

The relationships between the sub-systems, which we know are very unlikely to be commensurable, or symmetrical, or subject to identical delays, or measurable along one single numeraire, are either evaded completely, with the use of arrows, occasionally with feedback arrows, or lines connecting elements (or stocks) without specifying the content or direction of the implied flows.

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[24] David Goodman & Michael Watts (1994) Reconfiguring the rural or fording the divide?: Capitalist restructuring and the global agro-food system*, The Journal of Peasant Studies,* 22:1, 1-49, DOI: 10.1080/03066159408438565

We must assume the content and scale, the speed, lag and timing of flows of .. food, material, energy, work or dollars. The latter is a numeraire which will become more and more important as time goes on, where flows and relationships are 'harmonised' by imputing dollar values. In substituting dollars for the material relations implied, other values are ignored and crucial relationships negated.

While no model can be 'complete', the 20 models miss out gender-relations and food behaviour inside the family which, *pace* over-, mal- and under-nutrition as parts of the food question and as food system outcomes, and if the purpose of modelling the food system is to improve such outcomes, ought to figure in global models. Even more striking, not one of the flow relationships expresses the contradictory economic interests – we might say the driving forces - of capital and labour. That the system's dynamics are not really interesting to the modellers except for the modelling of resilience, is likely to be due to the intellectual history of resilience in SDG 15.[25] And questions of information, of money, of energy and its dissipation, of waste which is central to the food question, all these processes, relations and sub-systems are missing from these models, or at best occasionally alluded to at levels of abstraction which don't actually address the difficulties of trying to relate them to other sub-systems.

Agricultural/Food Markets in Systems

For the most part, the depiction of agricultural markets in food systems is a lucky dip, a shambles, absolutely untheorised. References to aspects of agricultural markets are splattered all over the sub-systems. Only two models have a systematic representation of elements of an agricultural marketing system. These are physical activities, organized in supply chain terms and lacking flows between them. Elsewhere, agencies,

[25] Judith E. Krauss (2022) Unpacking SDG 15, its targets and indicators: tracing ideas of conservation, *Globalizations*, DOI: 10.1080/14747731.2022.2035480

organisations, sectors and activities are conflated. So a category called ‘traders’ sits alongside one called ‘food industry’ or one called ‘wholesaler’ alongside ‘delivery’, or composite categories like (marketing and storage), (distribution and retail), shuffled from one model to another as (distribution and storage), (marketing and retail) or ‘distribution’ as different from ‘marketing and retail’ or ‘marketing’ as advertising while buying and selling is altogether absent. Sometimes, concepts like ‘food supplies’ stand in for markets. Marketing processes are reduced to ‘sourcing’. Some models ignore markets completely. Clearly, what a market system consists of needs better understanding before it is modelled. There are substantial literatures in social sciences, which are being ignored while physical science imagines social science to suit its purposes.

If food market systems are reduced to global supply chains, as in Figure 2 when I was explaining agricultural markets as systems, what we neglect are food market systems, which are complex. In simplifying planetary food markets to global supply chains we also miss out about 70% of food which is not actually entering global supply chains in the way that supply chains are modelled. This actively expels the idea that local food markets are in fact major manifestations of commercial capitalism with local institutional specificities.[26]

If this state of knowledge is provocative, it calls for projects of comparative research on actually existing food markets and research to improve Indian food system concepts and their systematic representation.

Policy in Food Systems

How do the 20 models deal with policy? While the social purpose of most food systems modelling is to see how to change its parameters, by providing a rational basis for policy, and while a

[26] Stefan Kuhl 2019, *Work: Marxist and Systems Theoretical Approaches*, London, Routledge

model ought to be able to indicate the directional impacts of pulling a policy lever, there is very little shared understanding of what policy actually involves. Or where policy for a better global food system could be made.

The conception of policy in these 20 food system models, if it exists at all, is usually confined to Bernard Schaffer's first process of bureaucratic politics: agenda – policy formulation and decision-making. Occasionally it's seen as part of the environment outside the food system and labelled as such. Sometimes, it's a 'frame', or context, and labelled as a 'system setting'. Sometimes, it's a sub-system in its own right and labelled 'choice bundles'. Sometimes, it's an element and sometimes, it's a flow. Very often it's ignored, it doesn't exist or it is aggregated on a par with other categories - so you get (policy + institutions), (policy law, political parties and governments). Or it is reduced to 'governance', or 'politics and leadership' or 'political programmes and institutional actions' or it is a list of specifics, construed through examples. Few give policy any kind of attributes except, in one or two models, as 'lobbying' (which might be understood by some as an inconvenient and illegitimate interference with an ideal process). One of the models however does recognise 'trade-offs between policies' as being an attribute of policy, which is an important insight.

But overall there is no sign of engagement with implementation or policy practice as a field of public administration. In that sense, there seems to have been no change since the 1970s. How can we conclude other than that notions of policy are chaotic, that they are depoliticised in Schaffer's sense, or that they are re-politicised as a technical matter with power residing in the technician and scope confined to the agenda. Yet again, a great deal of work needs to be done.

Summing up : the Purpose of Food Systems

What are we to make of these 20 models? Is the obscurity we

uncover actually for a purpose? One kind of interpretation is that of Goodman and Watts, when they talk about a panoply of tools and invoke the value of - and the necessity for - theoretical plurality.[27] Another has been advanced by Ariella Helfgott and Gerald Midgley, comparative analysts of 13 systems boundaries for UK food: "there is not one single food system (or even a single system comprised of interacting sub-systems), but rather multiple ways of looking, with a systems-thinking lens, at what is going on with food"…and that the range of boundaries that are unacknowledged in our present study represent "multiple nested and overlapping wholes, visible to different stakeholders" testifying charitably to "the richness of detail and the value conflicts this inevitably reveals".[28]

But is that really what we are seeing here? A third interpretation would be critical of an empiricism, which is led by available data, unaware of the kind of preconceptions that lie behind the terms that are being invoked. On a bad day, we might call it pre-conceptual anecdotalism. And if there is no recognisable theory, and if empirical categories are driven by the availability of data – and it has to be a certain kind of comparable data for, say, a minimum threshold of 150 of the world's 196 countries – what is the explicit role of a factor like 'experience' which the systems theorist Donella Meadows saw as so valuable in evaluating models? Has experience – presumably that of experts – replaced theory and evidence? If so, why? These are questions I cannot answer but they need asking.

Much of consequence for the 21st century's food question is missed out of the 20 attempts to model it, all published in the 21st century. For environmental scientists, society can be simplified to the point of meaninglessness as 'people' or 'culture'.

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[27] David Goodman and Michael Watts, 1994, 'Reconfiguring the rural or fording the divide? Capitalist restructuring and the global ago-food system', *The Journal of Peasant Studies* 22 (1) 1-29

[28] Ariella Helfgott and Gerald Midgeley 2020, *Exploring Boundaries in Food Systems Research Implications for Projects on UK Food Security,* Swindon: RCUK Global Food Security Programme

And conversely, the same is true for the environment when social scientists invoke it as 'resources' and improvements to it as 'nature positivity'. There's a great trans-disciplinary project ahead, to accept sub-systems at different scales while making their analytical units consistent – which may – or may not - involve material elements and nutrients.

Now, Rolando Garcia, whose contribution I summarised at the start, acknowledged that systems are mental constructs and they are built for purposes. So when 20 models of the food system differ, should we be at all surprised? Perhaps not. But these models have all been built for more or less the same purpose. I am forced to conclude that rather than being rich in detail and values, this extreme lack of consensus about the planetary food system and the privileging of idiosyncrasy reveal a problem. It is not eased by invoking 20th century disciplines with all the contentions we know that exist within them. When disciplines are deployed to mask over discursive chasms and complexity, and when disciplines still remain irreconcilable domains of knowledge, when politics or economics or sociology are invoked as sub-systems – or drivers - of a food system, assuming no difficulty in interpreting what the discipline stands for, the problem we have is exacerbated.

An alternative provisional conclusion is that these food systems' models manifest a stupendous disregard for theory of any kind. This is the problem. So the food system exists: it exists in our heads. It functions in reality with outcomes we deplore. Conceptually it is broken.

Are food systems' modellers merely bringing the limits of their own experience to the food system? Or are we living through a crisis of naming where innovative labels are praised for their originality but where, at the same time, collective projects are more easily advanced if labels are fuzzy concepts and can mean whatever you like them to mean? Why are physical and life scientists treating the social sciences as though they did not exist

and vice versa?

For a country like India, this messy planetary situation presents an enormous opportunity for food systems analysts to critique and avoid some of the elephant traps I have tried to indicate while, like the proverbial blind men, you set about feeling the elephant of the food system. There is a need for a rigorous analysis of the socially and ecologically beneficial and damaging outcomes of the Indian food system for specifically Indian objectives – and of the politics of Indian policies – nationally, at the state-level and locally.