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IoT Based Agricultural System and Legal Frameworks: A Study with reference to Indian Socio-economic Conditions

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ABSTRACT

Influenced by the sustainability-concentration the agro-policy and regulatory frameworks, besides, preserving depletion of natural resources vis-a-vis reinforce productivity, have turned its hand to democratized approach of knowledge-intensive convergence of technological data-outcomes (commonly known as Internet o Things) to configure the agrarian distress in a comprehensive manner with the objectives of attainment of societal, economic and health priorities of the country. The underpinning of IoT based agricultural system is the integrated and coordinated approaches to foster the "leapfrog" opportunities to consider and address: a) the desired-efficiency in agro-productivity to mitigate the market-demands; b) efficient allocation of resources; c) climate change-induced risks and market intelligence; d) sustaining capacity-growth for both i) domestic food security and rural development, and ii) as benefactor to the valued supply chain of international trade on agro-productivity. Putting such modernized version of agriculture into being within the frame of reference of the traditional smallholders' 'subsistence - agriculture' in India would transfigure the agro-sector into 'commercial agriculture', with the surge of performance expectancy, diversification of agro-productivity portfolios, competitiveness and strengthening of economic-base of the farmers however, to accomplish such awes and wonders quintessentially urge the expanded capacity-building at the Infrastructural and Institutional levels to facilitate the opportunities to myriad small and marginal landholders of the country - which is capital-intensive. And to capture such benefits of value-additions with the view to set up a market-oriented agri-food market in India a comprehensive agro-policy and regulatory frameworks is indispensable. Present legislations that the Government has come about contemplated to achieve the desired outcomes, have experienced huge protest. The present endeavour is focused upon ascertainment of the projected 'facilitator-driven model' and its contributory roles harmonizing the economic-interests of all stakeholders in the light of enhanced agro-productivity on adaptive agricultural system with IoT in Indian agro-sector.

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Keywords*: Smart Agriculture, Internet of Things, Socio-Economic Condition, Legislative Framework.*

I. INTRODUCTION

IoT - the data-driven dynamics with digital space technological innovations, redesigned with wireless forecasting-sensors have enumerated the new possibilities to espouse the intertwined and complex aspects of SDG, Food Security and Ecological Resilience, primarily, in the spectrum of potential and effective sustainability issues in the socio-economic policy frameworks. Attributes of IoT patently would facilitate the food *availability, stability* by addressing the key factors to boost food productions, like, soil preparation, crop surveillance, crop status, irrigation, insect and pest detection through automated and unmanned Ariel vehicles, etc. but furtherance of the *access*, and *utilization* of such copious proceeds of agriculture require institutional approach to provide fair, efficient, structured and effective *distribution-channels* to care and support for the increasing human concentration[3] and settlement in the light of the existing mandate of *'ensuring that no is left behind'* in 2030 SDG[4]. The technological advancements to mitigate the global demand thus, necessitates the policy underpinnings of the State to restructure the existing distribution mechanism in most fair, equitable and inclusive manner. The Conference on Sustainable Development 2012 (Rio +20) endorsed '100% increase in smallholder productivity and income'[5] as sustaining tower of strength in 'Food Security and Nutrition and Sustainable Agriculture' programme. To provide leverage in smallholders' income through various subsidy-handouts by the Governments has marginally paid off due to intervention of political spectrum in the local institutions through which the allocations of such benefits are being made. IoT - being the game changer in providing increased industry solutions has endowed with undercover to enable optimizing new strains of nutritious and tasty crops in a wider range of environments commensurable to the market demand pattern - which, in turn, would coax the augmentation of global trade and capital movements. However, the global challenges in ensuring food security through Smart Agriculture in India, are primarily, *inter alia*, the infrastructural vulnerability in absorbing the

[3] As per United Nations Reports on *World Population Prospects 2019* the medium-variant projection predicted that the global population could grow to around 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100. [Accessed on May 15, 2024]: Available at (https://population.un.org/wpp/Publications/).[https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf]

[4] Sustainable Development Goals (SDGs) (https://sustainabledevelopment.un.org/) [Accessed on May 14, 2024] Available at https://sustainabledevelopment.un.org/index.php?page=view&type=30022&nr=106&menu=3170

[5] Sustainable Development Goals (SDGs) (sdgs.un.org) [Accessed on May 2, 2024]Available at https://sdgs.un.org/topics/food-security-and-nutrition-and-sustainable-agriculture

 [ISSN 2581-5369]

weather-related shocks, under-developed markets, laxity in governance.

II. DESIRED-EFFICIENCY IN AGRO-PRODUCTIVITY & MARKET DEMANDS

Such transformative transition from labour-intensive approach to technology-driven approach in Agriculture, once stretched out to the vast array of indoor to large outdoor farms would certainly ensure the efficient use of the limited availability of resources like synthesizing water with micro nutrients, etc. and would address both the food-based and health-based poverty traps to mitigate the demand of global community. The issues like, *warmer earth* due to global warming, *decline in soil moisture and soil preparation, insects and pests detection, sustainable use of water resources, crop surveillance and status,* etc. - the unpredictable hazards and vulnerabilities to the loss of agro-productivity could be addressed over a shorter period of time. However, such efficient technological initiatives to bring long-term changes for food-security and sustainability could be made effectively meaningful when utmost importance to the socio-economic concerns at implementation-stage for wide-spread acceptability and adoption would be addressed by the State in the policy framework related to Agricultural. The impact of IoT in Agriculture Sector would emerge greater market opportunities - like, research and development by the Agri-Biotech entities for Genetic Technologies, sustainable farming-technologies, etc., and the legal protection of such technical innovations, in turn, would unearth the new locations of investment for the revenue potentials of those IPRs.

i) *Robust & Trustworthy Connectivity*:- Modern data-based agriculture system requires robust data management capacity-building - both institutional as well as infrastructural - which involves long-term huge investment. IoT inherently being knowledge-intensive converged version of data-driven technological outcomes, and to reap the benefits of such technological solutions to the growth of agro-productivity warrants the secured infrastructure of services like connectivity and energy rather within the frameworks of Cyber-Policy relating to data-trust frameworks. Presence of any vulnerable conditions in the Policy and its implementation may subject such smart technological solutions to unauthorized access and immense damage causing thereby *Ransomware, Endpoint attacks, Phishing, Third-party attacks, Supply chain attacks, Machine Learning-driven attack (Artificial Intelligence), Crypto-jacking, Cyber Physical Attacks, State-Sponsored attacks, IoT attacks, threats to smart devices,*etc. IoT, indispensably, being the combination of techniques, skills and processes - and its integration in such Smart farming would flourish market opportunities, primarily in the investment, and service-sectors and interconnected businesses thus to avoid severe disruptions to the extent of financial devastation, physical injuries or death. Hence, for the purpose of data integrity, data utilization

 [ISSN 2581-5369]

strategy, data-trust, cloud computing and to prevent the loss of data vigilant Network Security Protocols, Cyber-Security measures and techniques are to be given utmost importance to counter exploitable vulnerabilities like, data-privacy, data-piracy, data-loss, data-poisoning, etc. and the like undesired intervention in achieving the desired-efficiency of IoT applications in agro-productivity.

ii) Integration of IoT in the contexts of increasing fragmented smallholdings, lower resource settings, e.g., indoor farming as well as large outdoor farming, geophysical feature-variances, etc. entails befitting and acceptable modalities - resulting in thereof the scope and extent of enhanced market opportunities relating to like, electro-mechanical product-variants, skill-specificity and awareness programmes on technical know-hows, etc. Adoption of new technologies in agriculture to secure the cost and time efficiency of IoT means acceptability of an embedded system that would consist of information-based sustainable decision making process in farm-production and that too on appraisal of market demand-pattern. Therefore, genetic modifications for the innovation of health-based nutritious crops - access to biodiversity for incremental innovation and benefit sharing to reward farmers for on-farm conservation and management of such biodiversity, standard of data-communications system - whether long-range or short range, technology transfers (in case of joint-initiatives between countries), etc. would again certainly urge the paramountcy of the secured ecosystem in dealing with the data sharing, data utilization, data-trust, data-management and protection - both at domestic and global levels. Such capacity-building for strategized data-management requires long-term huge investments because it involves development of human capacities for data analysis also. And again the natural endowments of some plant species which are grown as to be more and more nutritious foods in spite of climate change and the indigenous communities through their traditional knowledge are aware of hence, in view of the International Treaty[6] preservation of the genetic diversity of crops, Breeder's rights are also to be entailed in the Agro-Productivity Policy. Revenue potential of the research innovations like, developing the traits to increase nutritious value of the food to fight diseases, adaptability to new climates along with higher yielding, integration of agricultural produces with energy sectors, e.g., biofuel, etc. by the aforesaid Agri-Biotech entities would lead to i) loss of crop-diversity as genetic modifications actuated by major market-demand would lead genetic uniformity; and ii) the integration of other sectors with agriculture sector, e.g., biofuel etc. would again frustrate the aim of food security, for, it would cause food-price spikes. India, during its colonial regime has already experienced the inclement authoritative policy-implementation to optimize the cash-crop productions and

[6] Art 15 of the International Treaty on Plant Genetic Resources for Food and Agriculture, 1991

 [ISSN 2581-5369]

the severe impact in India. Therefore, the potential security threat to farm-data control and ownership, maximization of production efficiency, food and sustainability to such technological solutions warrants wise tailoring of both qualitative and quantitative yield optimization in agro-sector.

iii) IoT being the convergence of technological seamless data outcomes and especially it's application in agricultural sector prioritizing the integrated data farm service providers, through the use of networks and various software applications and functionalities of the devices for communications and for practical decision making process hence net neutrality becomes another important aspect to be taken into consideration for, any discrimination, restriction or interference based on user, content, website, platform or application by the Internet Service Providers would severely affect the operationalization of the devices as well as the decision making process. India neither is having any specific laws relating to net neutrality or interoperability amongst the service providers nor any comprehensive policy on data protection.

Therefore

iv) Admonishing to integrate modern sustainable farming technologies like IoT in agriculture for sustaining optimization of productivity to meet the food-needs of expanding populations could not be a seamless journey in India for, the perennial issues relating to Agricultural sector have hardly been addressed. On achievement of independence structural reforms to settle the land-tenurial system in favour of the farmers by removing the intermediaries, etc.[7] have been effected however, over the passage of time decline in the landholding size has emerged to be one significant issue in the context of localization and heterogeneity of IoT devices for the acceptability of the farmers to adopt such advanced technological system depends of their willingness. As per available data 140 million hectare area of Indian territory is used for agricultural purpose[8] and over the years fragmentation of such land has been from 36 million hectares in 1971 to 93 million in 2011[9]. The percentage share of agricultural sector in national income was 57.7 during 1950-51.[10] Agricultural exports accounted for 44.3 per cent of India's

[7] Abolition of Zamindari System, Abolition of Estates, Reformation in the Tenuery Rights, Fixation of Celling on Landholding and Fixation of Landholdings and Redistribution of Surplus Lands among Landless or Marginal Farmers through Land Reforms Legislations effected for agrarian reforms in Independent India.

[8] *Table 13.1: Agricultural Land by use in India, Agricultural Statistics at a Glance 2015*,(Feb 18, 2021 at 12:00 P.M) http://eands.dacnet.nic.in/PDF/Agricultural_Statistics_At_Glance-2015.pdf.

[9] *Agriculture Census 2010-11*,(Feb 21, 2021 at 12:00 P.M) http://agcensus.nic.in/document/agcensus2010/completereport.pdf.

[10] Jomon Mathew, An Overview of the AgriculturalSector in India , "The impact of new economic policy on Indian agriculture: Astudy of selected cash crops " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 2006 https://shodhganga.inflibnet.ac.in/bitstream/10603/61922/11/11_chapter%203.pdf

total merchandise exports during 1960-61.[11] Even after so many reformative measures through legislation Agriculture and allied sector contributing just 15% to GDP [12] and showed a low growth of 2.9% in 2018-19 as per Central Statistical Office Report. While our country aims to become a 5 trillion dollar economy[13] and agriculture supports livelihood of more than 50% population therefore, sustainability and enhanced agro-productivity becomes the need of the hour.

However, in the context of increasing fragmented small landholding wholesome endeavour to ensure the effective infrastructural provisions of power supply and connectivity for installation of the IoT-based sustainable farming technologies insists transformation of land system, in default, it would become risky in view of cost-management, i.e., loss of revenue as well as to incur costs for the protection of sustainability of farming technological services. Provisions of Cooperative Farming in Land-Reforms Legislations could not affiliate much significant developments - the indicative of lack of formation of social capital while Institutional initiatives of awareness programmes on technical messages for the small and marginal farmer relating to use of agriculture machinery and irrigation for efficient use of natural resource to escalate agricultural productivity has little contribution due to subsisting financial-base of the small and marginal farmers for seasonal farming even - the indicative of business capital. India is endowed with vast natural capital with its geophysical variances however The desired-object of the State as has been contemplated in the recent legislations relating to *farmer producer organization*[14] are but the indicatives of trade architect where the complementary and supplementary operative forces of i) Business capital; ii) Infrastructure; iii) Human Capital; iv) Intellectual Capital; v) Natural Capital; and vi) Social Capital are prioritized. The interrelations amongst those factors and actors require strategic and harmonious governance regulations to make an acceptable balance which has been dealt in the last part of this discussion. IoT chiefly belongs to Intellectual Capital that would work together in combination with others. Constant fiscal stimulus by the State has already experienced large budgetary deficit even in developed economies hence, the economic policy-reforms since 1991 Indian Government has gradually been devising flexibility in regulatory norms like tariff-tax reduction, cost-reduction in social development etc., to facilitate the investment of private capital to such developmental goals.

[11] Id.
[12] Gurneel Kaur, Budget 2020, Agriculture Key in Revival of Economy https://www.grainmart.in/news/budget-2020-agriculture-key-in-revival-of-economy/
[13] *Supra Note* . 10
[14] THE FARMERS(EMPOWERMENT AND PROTECTION) AGREEMENT ON PRICES ASSURANCE AND FARM SERVICE ACT, 2000; THE FARMERS' PRODUCE TRADE AND COMMERCE (PROMOTION AND FACILITATION) ACT, 2000.

 [ISSN 2581-5369]

Such transition to liberal approach with open-market economy has been set in motion to reduce the inequalities of income and wealth as well as creation of employment opportunities. Present endeavours of the Central Government by making the i) provisions for *futures contract*, ii) legislative protection of remunerative price frameworks[15], iii) responsibility of the Sponsor or Farm Service Providers to comply the legal requirements for providing farm services[16], etc. in the recent agriculture related legislations may incentivize some present generation farmers to volunteer in accept and adopt the knowledge-based IoT -Farming system for high-value crops as, present generation farmers, to certain extent, are oriented with the minimal technical knowledge relating to the functionalities of the advanced technological devices and thus bridging them to some minimal operational-training programmes relating to know-hows of the IoT farming technologies may have the cascading effect in the society.

Again, demographic-difference relating to willingness subsists, primarily, due to poor capital-base of the small and marginal farmers. The introduction of IoT urges initial investment support for them to incur the substantial installation cost and subsequent operative costs for availing of the necessary farm services. Additionally, labour-intensive traditional farming method in the context of soaring prices of chemical fertilizers, price volatility, rigidity of MSP facility in selective crops led agriculture to be the disrupted livelihoods, resulting in alternative occupational preference that caused not only increased urbanization rather deficiency of working forces in villages has increased labour costs. Therefore, agricultural productivity has been afflicted with many more intervening factors and for achieving the increased productivity on application of IoT in comparison to cost of production in that particular landholding, would reduce the profit margin in comparison to the production of the neighbouring landholding where cultivation was made through traditional method. Surplus of agro-productivity on achieving self-sustainability would actuate the participation in the global product supply-networks and in that event the TBT and SPS provisions of GATT relating to misleading technical specifications, susceptible malfunctioning in Quality and Standards measurements, hygienic conditions, lower nutrient-contents, grading etc. would come into effect relating to such agro-productivity. Hence, besides GAAT other global multilateral trade agreements like TRIPS, ASCM, SPS, TRIMS would also have their significant involvement in the Agricultural policy framework.

III. EFFICIENT ALLOCATION OF RESOURCES

[15] Preamble to THE FARMERS (EMPOWERMENT AND PROTECTION) AGREEMENT ON PRICES ASSURANCE AND FARM SERVICES ACT, 2000

[16] Sec 3 of THE FARMERS (EMPOWERMENT AND PROTECTION) AGREEMENT ON PRICES ASSURANCE AND FARM SERVICE ACT, 2000

 [ISSN 2581-5369]

In the free-market economy framework for the achievement of sustainable development programmes the following objectives: *viz;* i) conscientious and comprehensive time-bound achievement of policy goals; ii) sustainable management of resources; iii) strategic-designing of inter-sectoral synergies; iv) sustainable structures with sustainable system of operationalization within the framework of Agriculture Policy. Reformatory programmes by the Government from structural to institutional and infrastructural developments, subsidized support-schemes have been engineered and implemented from time to time. Agricultural crisis was felt during the '*command-control*' model of governance and the percentage share of agricultural sector in national income was 57.7 during 1950-51.[17] Agricultural exports accounted for 44.3 per cent of India's total merchandise exports during 1960-61.[18] Legislative reforms like abolition of intermediaries, enforcement of policies, agriculture and allied sector contributed just 15% to the GDP is a matter of concern.[19] This sector showed a low growth of 2.9% in 2018-19 as per Central Statistical Office report. While our country aims to become a 5 trillion dollar economy.[20] "As agriculture supports livelihood of more than 50% population, it is essential to make this sector self sustaining through strategized policy framework and structured regulatory norms. The States like Punjab and Haryana that pioneered the Green Revolution and also topped the list in average farm household incomes in India the annual incomes of marginal and small farm households were Rs 72,000 and Rs 1.78 lakh, respectively. Their income is much lower than their debt burden of Rs 1.82 lakh and Rs 2.70 lakh, respectively, for 2016-17. Survival with better living conditions led the small/marginal farmers to conclude to be the wage workers in the sectors other than agriculture would economically be viable option for their livelihoods as they cannot hinge upon the agro-farming"[21] The traditional knowledge of cultivation along with that poor economic holding with poor agriculture session makes a farmer indebted. Farmer indebtedness due to non compatible crops or low profit margin or domination of market by moneylenders was the usual problem during pre-independence era . The debt burden passes to the next generation along with the landed property. To prevent the exploitative money lending practice "National Bank for Agriculture and Rural Development" and The Agriculture Refinance and Development Corporation" was established. "Reserve Bank

[17] Jomon Mathew, An Overview of the AgriculturalSector in India , "The impact of new economic policy on Indian agriculture: Astudy of selected cash crops " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 2006 https://shodhganga.inflibnet.ac.in/bitstream/10603/61922/11/11_chapter%203.pdf
[18] Id.
[19] Gurneel kaur ,Budget 2020, Agriculture Key in Revival of Economy https://www.grainmart.in/news/budget-2020-agriculture-key-in-revival-of-economy/
[20] Jhon Mathew, An Overview of the AgriculturalSector in India , "The impact of new economic policy on Indian agriculture: Astudy of selected cash crops " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 2006 https://shodhganga.inflibnet.ac.in/bitstream/10603/61922/11/11_chapter%203.pdf
[21]https://thewire.in/agriculture/in-indias-breadbasket-mounting-debts-are-driving-farmers-to-daily-wage-labour

of India became the constant guardian of institutional credit mechanism.

Crop insurance can be the remedy to the inevitable crisis faced by farmers. This mechanism has been in the country since 1972, yet it has been beset with several problems such as lack of transparency, high premium, delay in conducting crop cutting experiments and non-payment/delayed payment of claims to farmers. The farming community at large does not seem to be satisfied with the partial expansion of scope and content of crop insurance scheme in the form of NAIS over Comprehensive Crop Insurance Scheme (CCIS).“NITI Aayog has proposed that 75% of the premium paid by farmers under the Pradhan Mantri Fasal Bima Yojana (PMFBY) will be returned to them if they don’t file claims for crop damages for four-six consecutive agricultural seasons.”[22] However, the new changes has been brought which shows where mandatory crop insurance for loanee rule was not effective now and restriction on Normal Premium Subsidy sharing from the side of Union[23] along with that flexibility approach is given to state to extent the premium subsidy according to there situation. Such changes clearly shows the manifesto of upliftment of Farmers income is now diluted by the shifting of acceptability.

Apart from all the issues which a farmer faces becomes more complex when it get accompanied with the climate change. Where the governmental scheme focuses about the “food security” , the climatic diversification in India hardly got attention .The complex climatic condition is one of the major reason for low productivity for sustainable and systematic agro productivity Government has implemented schemes like *“National Mission on Sustainable Agriculture (NMSA),National Initiative on Climate Resilient Agriculture, National Agro Forestry Policy***;** and the *Soil Health Card Scheme”.* However The policy is not given any emphasis on Rainfed farming and micro irrigation techniques with small/marginal farmers. The promotion of genetically modified crops by conserving genetic resources is not given importance in the policy. Where other Asian countries are following such kind of climate smart agro techniques there is no proper policy for climate smart agriculture in India.

And again if the present facilitating central legislations on farmers and farming produces be viewed from global trade perspectives WTO Agreements[24] contribute significant role to

[22]https://www.financialexpress.com/opinion/farmer-distress-why-niti-aayogs-cashback-proposal-for-fasal-bima-yojana-is-a-bad-idea/1353963/

[23] The Centre decided to restrict its premium subsidy in its flagship crop insurance schemes to 30% for unirrigated areas and 25% for irrigated areas (from the existing unlimited), and to make enrolment of farmers in the Pradhan Mantri Fasal Bima Yojana (PMFBY) and Restructured Weather Based Crop Insurance Scheme (RWBCIS) voluntary from the 2020 Kharif season. https://indianexpress.com/article/explained/explained-how-crop-insurance-changes-6278800/

[24] Agreements on Agriculture, SPS and TBT measures

 [ISSN 2581-5369]

SDG2[25] in particular, the strategic trade policy initiatives in 2030 Agenda with the precise objective of agriculture reform relating to global trade of agricultural produces. And production-distorting agricultural subsidy entitlements are but augmenting greater agricultural productivity and income-generating capacity to ensure higher living standard. Developing country members, however, are enlarged with the opportunities to continue to benefit *'claim exemption from reduction commitment'*[26] until the end of 2023, provided they are policy-specific and publicly-funded government programmes. Elimination of subsidies, causing distortions in agricultural markets would ensure fairer competitive markets which would again be beneficial to both the consumers as well as to those producers having negative market price support regionally[27]. Recently the urge by the CAIRNS Group[28] in January 2020 at Davos[29] before the upcoming of the 12th WTO Ministerial Conference in June 2020, to address the *'disparities in domestic and export supports that distort global agri-food markets*', influenced for the reduction of budgetary allocation by Indian Government in two major schemes – PM AASHA[30] and MIS-PSS - which may be considered as evidentiary reformative steps by Indian government to exhibit at world forum of WTO about the alignment of the domestic agricultural policies with global order. The Department of Expenditure of the Ministry of Finance, India and the Indian Ministry of Agriculture are at loggerhead relating to the use of MSP[31]. The Standing Committee on Agriculture concluded continuous drastic under-utilization of funds allotted under various schemes between 2012-2017[32] like, out of around Rs 5,400 crore allocated in 2016-17, Rs 3,892 crore were released. Further, out of this released amount, only around Rs 3,400 crore was utilized. This is a further shortfall of 24.5%. Therefore, being a member country under-

[25] *Annex Resolution 2. A/RES/66/288 U.N. General Assembly. Sep 11, 2012* ,(Feb 19, 2024 at 12:12 P.M)https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E

[26] *10th WTO Ministerial Conference Nairobi 2015 relating to 'Export Competition', commitment was reaffirmed to exercise restraint with regard to any recourse to all forms of export subsidies and all export measures with equivalent effect.(Ministerial Decision of 19 December 2015 :WT/MIN(15)/45 — WT/L/980)* (Feb, 25, 2021 at 10:04 A.M)https://www.wto.org/english/thewto_e/minist_e/mc10_e/l980_e.htm

[27] *OECD/ICRIER (2018), Agricultural Policies in India, OECD Food and Agricultural Reviews, OECD Publishing, Paris.*(Feb. 24, 2020 at 12:54 P.M) https://doi.org/10.1787/9789264302334-en

[28] An interest group of 20 Agricultural Exporting Countries, namely, Argentina, Australia, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Guatemala, Indonesia, Malaysia, New Zealand, Pakistan, Paraguay, Peru, the Philippines, South Africa, Thailand, Uruguay, and Vietnam.

[29] **50th** Annual Meeting **of the World Economic Forum, Davos, Switzerland, January 21 -24, 2020.**

[30] Pradhan Mantri Annadata Aay Sanrakshan Yojna (PM-AASHA - budgetary allocation for the year 2020-21 in PM-AASHA scheme has been made Rs. 500 Crores reducing it from Rs. 1500 Crores in 2019-2020) and Market Intervention Scheme and Price Support Scheme (MIS-PSS - wherein budgetary allocation for the year 2020-21 has been made Rs. 2000 Crores compared to Rs. 3000 Crores in 2019-2020)

[31] *Mishra, Dheeraj., Agriculture Ministry Knows Increasing MSP Isn't Directly Linked to Market Distortion, Feb. 24, 2021* (Feb. 24, 2021 at 3:15 P.M) https://thewire.in/agriculture/farmers-msp-increase-market-distortion

[32] *Report No. 42, Standing Committee on Agriculture: 'action taken by the Government on the observations/Recommendations contained in the Thirty Fifth Report (Sixteenth Lok Sabha) of the Standing Committee on Agriculture (2016-17) on 'Demands for Grants (2017-18)', Lok Sabha, August 10, 2017,*(Feb 18, 2021 at 2:31 P.M) http://164.100.47.193/lsscommittee/Agriculture/16_Agriculture_42.pdf.

utilization may one step to attain the global commitment of trade liberalization however, the commitment to the citizens in pursuant to policy appears to be frustrated.

The inverse relation between declining numbers of Farmers and the bulk-need for the growing global populations in view of Sustainable Development Goals (hereinafter called SDG) has brought immense pressure not into upon the food security efforts within the perimeter of limited natural resources rather also the maximum sustainable yield of Ecological resilience so that its terrestrial dimensions could become contributory in shielding the crops and increasing agro-productivity. The accelerated pace of urbanization and increasing number of populations with the perceived threat to accelerate the growth of agro-productivity unto the attainment of self-reliant whether the Sachs' top-down economic model[33] of infusing of fiscal leverage emphasizing thereof to incentivize the long-term sustainable framing agenda for productivity of agriculture should be considered or Easterly's bottom-up model economy by strengthening more transparency and accountability with the spirit of effective enforcement mechanism or the blended one is the crucial issue. The challenges like climate-change, increased-productivity, use of IoT for efficient use of natural capital etc., require structured and comprehensive policy frameworks both at Institutional and Infrastructural levels to ensure the sustainable developmental goals. Fiscal Budgetary allocations of resources are but the priorities the structural interdependence of the Developmental Policies of the country. To continue the developmental programmes with the Public Capital is no more a viable option while *'alliance capitalism'*[34] with the creation, management and disposition of physical and human assets of country might be considered to be the agenda of sustainable development. Thus an efficient and effective legal framework would more contributory for achieving the desired-goals.

IV. IoT FARMING VIS-A-VIS CLIMATE CHANGE-INDUCED RISKS AND MARKET INTELLIGENCE

Market Intelligence is an experimental evaluation to capture the market dynamics relating to informed commodities production and market decision. Information that disseminate primarily from a) Policy design, b) climate shock forecasting, c) Product variances, etc. are having direct bearing with the price behaviour of the commodities in the market. Hence any discrepancy or inaccuracy would have the rippling effect upon the price precision predictability, in turn, would affect the production supply chain, and such price-signal would have spillover effect upon other markets and investment decisions as well. Integration of IoT in Agricultural sector would

[33] Sachs, J.D., The Age of Sustainable Development, (2015), Columbia University Press.
[34] Dunning, John., The Advent of Alliance Capitalism, J. Dunning & K Hamdani (eds.), The New Globalism and Developing Countries, (1997) Routledge

facilitate to disseminate data with precision for practical decision making process relating to the climate shock predictions and crop conditions from pre-harvesting stage to the reaping at the field levels for having its high-end technologies, thus would minimize the risks and vulnerable conditions to the process of optimization of the agro-productivity. Price trends in the market is determined upon the price expectations of the farmers and the short-term forecast by the traders to farmers in an appropriate time for effective transactions of the production. And again the price forecasting is based upon the seasonal, cyclical and irregular nature of the productivity. Precision in predictions of climatic-conditions and certainty of productivity would strengthen price forecast accuracy provided there is no such instability or unforeseen variance or priorities in the Policy for the sustainable farm productivity. The Farmers'(Empowerment And Protection) Agreement On Prices Assurances And Farm Services Act, 2000 in its preamble has envisaged to promote Futures Contract and precision in price forecasting is having significant weightage in supply chain management and trade as well. Such extension of efficient services of securing reliable data to the farmers and traders and traders by dint of the advanced technologies would strengthen even the market-surveillance to locate and control the price-distrotions in the market and to achieve the aim of Farmers' Produce Trade And Commerce (Promotion And Facilitation) Act 2020. Therefore this data-driven IoT by harmonizing the safest data-recording and effective reporting mechanism from pre-harvesting to reaping, would enlarge the scope to determine the choice of crops, area allocation, timing of harvest, choice of market, timing of sale, etc., and help in improvising the allocation of the resources in the sustainable agro-productivity policy frameworks.

V. SUSTAINING CAPACITY-BUILDING

The feasibility aspect that has been strategized in the legislative policies of Agrarian Laws is but a paradigm shift from subsidy-induced developmental measures to market-oriented measures viewed at the spiral benefits of likely to accrue through large-investments viz; productivity, food-security, financial independence of small and marginal farmers, alleviation of malnutrition, seamless supply chain, etc. The implementation of the agro-productivity priorities to integrate IoT as game-changer requires a massive-scale balancing of legal rules predominantly between Public Laws and Business Laws as the paradigm shift to market-oriented approach of agriculture sector. The areas that require much attention to achieve the success of IoT Applications in the agricultural sector in India essentially seeks for the interrelations and acceptable balance amongst the Data-Security Laws, Laws related to IPRs, Environmental Laws, Infrastructural Laws for expanding the scope of IoT applications, Commercial Laws relating to transactions, role of market-structures and operations, Foreign

 [ISSN 2581-5369]

trade policies, Consumer Laws, etc. to promote the trade objectives. Blending of *consumer sovereign* in the evolving corporate ecosystem consumer preferences has affected the demand pattern in the market eulogizing health-based preference to quality in place of quantity. Hence, the Product Liability, Product safety for public interests, the punitive damages, etc. with the initiatives of tracking technology in the agriculture to trace out the health-safety information in IoT based agriculture would be the crucial areas in case of export of agri-produces.

Recent initiatives of the State towards Agriculture assimilate diverse social systems like sovereign's autonomy in time of exigencies or emergencies for public welfare[35] vis-a-vis controlling mechanism on price certainty, hoarding, exemption of the PDS and TPDS and again to facilitate the farmers as well as to promote trade - which are predominantly focused upon the transactional laws of the country. The underlying economic object in such initiatives are to set the economic order for achieving the benefits of scale economies. To harmonize by engineering the regulatory norms comprised of both economic and non-economic goals to promote sustainable development denotes the competition and at time confliction between two social systems - the distributive aspects of Public Laws and the self-referntial social practices in business transactions for, the legal quality of the self-referential rules followed through social practices is but an empirical matter. The Public Laws has a vertical structure of governance while the transactional laws has a horizontal structure. Introducing of private capital is inherently directed to earn profit or to compete for profits from the markets and such private investments are primarily focused to economic policy goals ,i.e., subject to Contract Laws and other economic regulatory norms rather than non-economic social policy goals. Market transactions are purely stimulated by consensus and fair bargain on symmetric information. Free-riding of liberalized market policy and restructuring of regulatory norms how far would mitigate the standards of public welfare and address the inequalities of income and wealth distribution, how far would be complementary to achieve the desire efficacy of the sustainable developmental regulatory control is …. Application of IoT in agricultural sector has enlarged the opportunities of increasing-productivity, distribution, research and development, electronic communications and so forth however, social-engineering of limited intervention of government to ensure long-term public policy goals and reconciling with private freedom with re-distributive effect of equality under public law becomes the underpinnings of the Legislative policy.

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[35] Sec. 3 (1A) Essential Commodities (Amendment) Act, 2020

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