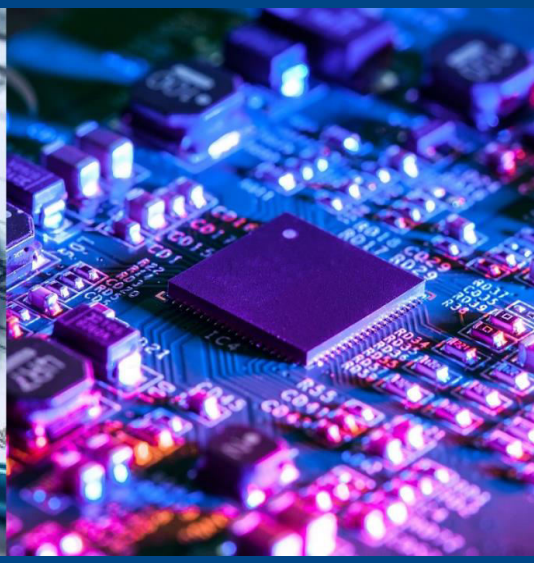
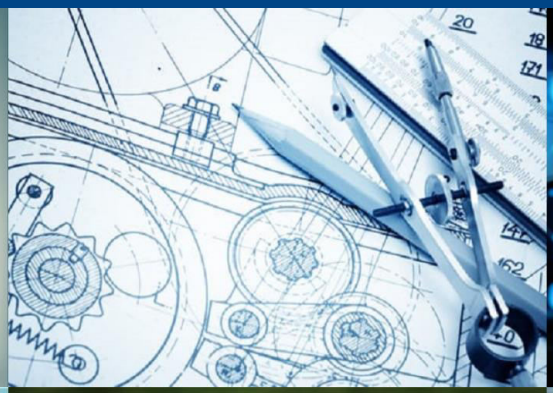
ISSN: 2582-7219

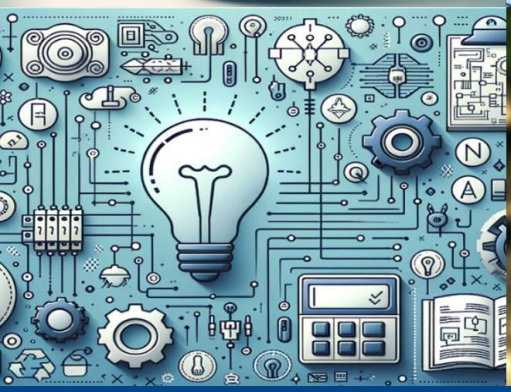




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206 **Volume 8, Issue 3, March 2025**

© 2025 IJMRSET | Volume 8, Issue 3, March 2025| DOI: 10.15680/IJMRSET.2025.0803318

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

A Study on the Problem of Agriculture Sector and their Impact on Farmers

Dr.Madhu Sudan Pradhan

Associate Professor, Department of EAFM, Govt. Lohia College, Churu, Rajasthan, India

ABSTRACT: Farmers suicide has emerged as a serious problem today in India, each year thousands of farmers commit suicide due to lower income and heavy debt, they don't have access to market, new technologies and irritation facilities, their land is being taken away by private sectors, Contract farming, small holding of lands

KEYWORDS: problem, farmers, agriculture, private, suicide

I. INTRODUCTION

Farmers all over the world are plagued by several issues. These problems indirectly and directly affect the farmer's life. Furthermore, farming practices and other aspects of agriculture can take up resources and time. The problems faced by farmers are typically unnoticed in the food industry. This article aims to highlight the major problems faced by farmers. They are:
Lack of infrastructure
Lack of access to credit
Lack of insurance
Uncertain water rights and supply3
Lack of remunerative income Inadequate transport
Farmers in developing countries have a hard time transporting their produce to markets due to lack of roads, vehicles and money. They often have to carry their produce from the farm to local markets on foot or by bicycle, which can be challenging and time-consuming. This means that they often have to sell their produce at very low prices because they cannot transport it to places where there is better demand for food.[1,2,3]

Lack of capital
Farmers need capital to get their businesses off the ground and grow them into successful operations. However, they often have little access to credit or financing because lenders don't understand their unique needs. The lack of financial resources affects not only productivity but also affects the quality of agricultural produce. Farmers in some developing countries do not have access to adequate funds to invest in better technologies, machinery and equipment which results in poor-quality agricultural produce.

Agricultural marketing
Agricultural marketing refers to the process of bringing a product from the farmer to the consumer. It includes activities such as finding buyers for the products, negotiating prices, transporting goods and getting feedback on quality. Because there are many people involved in this process, it can be quite challenging. Farmers have to find buyers who will pay them a fair price for their goods while also ensuring that they don't sell too cheap or too expensively.
In many cases, they are forced to sell their products at a low price or even give them away because they cannot find buyers. This situation creates an incentive for small farmers not to produce more than what they need for their own consumption.

Soil erosion4
Soil erosion is a natural process that happens when wind or water moves soil particles from one place to another. When this happens on a large scale, it causes serious problems for farmers.
Soil erosion is caused by many factors including over-tillage of the soil, which erodes soil quality and retains less water. When it floods, it removes the top layers of soil very quickly. Soil erosion can be prevented by controlling the

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

amount of water used for irrigation, using mulch and cover crops to protect soil from wind and water erosion, and preventing overgrazing by livestock.

Irrigation problems

Irrigation is known to help improve agricultural production, and while irrigation methods have improved to help increase the income of farmers, there are still numerous irrigation-related hurdles that make it harder for farmers to get income commensurate to their expenditure. The main problems that farmers have around irrigation are:

Lack of mechanisation Climate change

Surface water overexploitation Increased demand for water Old irrigation infrastructure Inadequate drainage Inadequate lighting

Whether it's because of droughts, floods, or just low rainfall, irrigation can be difficult to maintain.

Farmers have often been forced to fall back on groundwater resources when surface water sources dry up during droughts. In other cases, they've had no choice but to rely on groundwater even when adequate surface water is available. This can cause problems as groundwater levels drop and farmers 5

are unable to pump enough water to keep their crops alive through the dry season.

Lack of high quality seeds

The quality of seed used in farming is essential in attaining a higher crop yield. It is also important in getting sustained growth in agricultural production. Distribution of high-quality seed is as important as seed production. High-quality seeds are typically out of reach for most farmers, especially marginal and small farmers due to their prohibitively high prices.

Lack of infrastructure in the agriculture sector[4,5,6]

One of the biggest issues that farmers face is lack of infrastructure. This includes poor roads, transportation facilities and so on. Farmers have to depend on others for transport services which increase their costs significantly. Without proper transportation facilities, it becomes difficult for farmers to sell their produce at reasonable prices within their respective localities or even outside their villages or townships.

Farmers are unable to get good quality seeds and pesticides at reasonable prices. They also have to spend money on fertilizers and other inputs like irrigation systems etc., which is quite high as compared to other countries like China or USA where they have all the facilities available at their doorstep.

Biocides, fertilisers, and manures

Biocides are used in the form of pesticides to kill insects and other pests that destroy crops. However, they can also have harmful effects on humans and animals who eat food that has been treated with them. This may result in health problems such as cancer or infertility. Biocides are also linked to water pollution because they can be washed into rivers or lakes by rainwater after application onto crops.

Fertilisers and manures are important in providing the soil with the right nutrients. Just as the human body requires nutrients to function optimally, well-nourished soil can provide high crop yields. Research estimates that6 around 70% of plant growth in agricultural production can be linked to increased fertiliser application. Therefore, increased fertiliser use can be seen as a measure of agricultural prosperity. There are various practical difficulties in providing adequate fertilisers and manures in certain parts of the world. In some regions, animal waste is used as manure to replenish the soil, but this is often limited by the high costs and demand for fuel in rural areas; chemical fertilisers are also expensive, making them out of reach to the local farmers.

Loss of agricultural land

One of the major farmers problems has to be the loss of agricultural land, as when more land is lost, it becomes increasingly difficult to produce the right volume of food required to feed the entire population.[7,8,9]

Lack of modern farming equipment

One of the major problems faced by farmers is the lack of adequate farm equipment which can hamper their ability to adapt to the requirements of modern farming practices. When farmers are trained using the equipment, their lives can significantly develop. Implementation of said equipment is important.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Possible Solutions For Farming Challenges

Despite the myriad of problems that farmers face, there are a number of ways that farmers can avoid or at least minimise their impact. While technology is an obvious one, there are also solutions which are already available to the farmer. Some are:

Farmer organisations

Farmers' associations play a pivotal role in ensuring farmers are represented at all times. They can also ensure proper participation in creating and implementing agricultural transformation procedures. These associations should be designed to represent the interest of each of their members while ensuring they offer food security. The role of the farmer's organisation is extremely important as it ensures farmers are all singing from the same7
hymn sheet. For this reason, farmer's associations are a great concept to have.

Increase in investment

While research has repeatedly shown that the world population is growing at an alarming rate and is soon to outpace the world's current agricultural output in a few decades, there still appears to be a lack of solid investment in agriculture. This is especially true when you compare other sectors and industries of the economy.
Insufficient attention is given to investing in agriculture — improving farming operations and the lives of those in rural areas. This is an issue that needs to be rectified. Adequate and targeted agricultural investment can result in high yield and other improvements such as increased agriculture infrastructure.

Improved storage facilities and infrastructure

Considering that the majority of top agricultural-producing nations are dealing with many other issues highlighted in this article, it makes perfect sense that they also struggle with the lack of efficient storage facilities.
The purpose of agriculture in today's world is to increase food security around the globe. This aim cannot be achieved if farmers have to deal with inefficient storage facilities. It can be said that agricultural produce storage is just as pertinent as farming.

When trying to solve this issue, it is imperative to understand that it must be viewed as a business issue, rather than a farming one. For this reason, there needs to be the creation of amble storage such as cold storage facilities and on-farm storage units. These products can raise the availability of products.

II. DISCUSSION

Introduction of modern farming technology

Some top agricultural-producing nations, such as Nigeria, Guinea, and India are overwhelmed with a dearth of mechanisation in their farming operations. The use of conventional and crude tools instead of machines in the farming process required to feed the world's growing population isn't something that should be allowed to fly.
There are a plethora of benefits associated with introducing mechanised farming. Nevertheless, various measures will need to be put in place for this to happen. Some measures will require forward-thinking government policies, such as subsidising machine purchases and promoting the re- education of farms on the benefits of improving their agricultural processes with the times. Doing this can result in a increased agricultural produce yield.

Increased availability of fertile land[10,11,12]

When it comes to farming, one problem farmers face is land shortage. While millions of hectares are used for agricultural purposes every year, millions more hectares are lost to erosion, salinisation, desertification, and urbanisation. All land on earth represents just 29% of the earth's surface, which stands at 57,308,738 square miles. Just 24,642,757 square miles of all land is habitable while the rest are made up of desert and mountains.

When land lost to urbanisation, desertification, erosion, and human habitation are accounted for, the remainder appear to not be sufficient to cater to the world's agricultural demand. This is especially important as the world's population continues to grow. Furthermore, when land is set aside for non-agricultural purposes, it is rarely restored for farming purposes. This is because government policies are formulated to stop the frequent use of lands for non-agricultural purposes.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Farmers' education is vital
This is another solution because it will help farmers understand how to farm properly and use new techniques that will improve their lives. This is vital 9
because they need to know how to manage their land properly, so they receive maximum yields from each crop planted on their land. Having access to information about modern farming techniques also helps them make better decisions about what types of seeds should be purchased for planting in their fields each season.

The requirement for Crop Insurance
Farming is a risky business because there are many things which can go wrong during cultivation or harvesting season. Farmers should always consider purchasing crop insurance as it will help them recover from any losses caused by natural disasters or pests like insects, animals, etc. It is important for farmers to have proper knowledge about crop insurance, so they can take advantage of this benefit provided by various companies at affordable rates.

Budgeting
When any business is being run, it is important to ensure it is run with a firm budget. This is especially important when running a farm, as the costs can quickly spin out of control over an extended period of time. It also helps that the effect investing in agriculture has is effective and fast. Nevertheless,
an extremely suited catalyst required to achieve this growth is finance. The inability of small-scale farmers to get the loans required to finance their
farming activities can result in a cap on their production and efficiency. Proper restructuring of finance options and systems and lower interest rates linked to loans can help agriculture and small-scale farmers have a brighter future. Farmers might also want to enlist the services of a trained accountant. This trained accountant can handle the farming budget to ensure it doesn't spiral out of control.

In all, these are just some of the problems faced by farmers. All of the issues, as well as their solutions are connected. For one, more investment in agriculture can increase infrastructure spending, the purchase of manures, and fertiliser, using modern farming equipment to propel agricultural yields and processes into the 21st century.10

III. RESULTS

While agriculture's share in India's economy has progressively declined to less than 15% due to the high growth rates of the industrial and services sectors, the sector's importance in India's economic and social fabric goes well beyond this indicator. First, nearly three-quarters of India's families depend on rural incomes. Second, the majority of India's poor (some 770 million people or about 70 percent) are found in rural areas. And third, India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. To do so, a productive, competitive, diversified and sustainable agricultural sector will need to emerge at an accelerated pace.[13,14,15]

India is a global agricultural powerhouse. It is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea. The country has some 195 m ha under cultivation of which some 63 percent are rainfed (roughly 125m ha) while 37 percent are irrigated (70m ha). In addition, forests cover some 65m ha of India's land.

Challenges
Three agriculture sector challenges will be important to India's overall development and the improved welfare of its rural poor:
1. Raising agricultural productivity per unit of land: Raising productivity per unit of land will need to be the main engine of agricultural growth as virtually all cultivable land is farmed. Water resources are also limited and water for irrigation must contend with increasing industrial and urban needs. All measures to increase productivity will need exploiting, amongst them: increasing yields, diversification to higher value crops, and developing value chains to reduce marketing costs.11

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

2. Reducing rural poverty through a socially inclusive strategy that comprises both agriculture as well as non-farm employment: Rural development must also benefit the poor, landless, women, scheduled castes and tribes. Moreover, there are strong regional disparities: the majority of India's poor are in rain-fed areas or in the Eastern Indo-Gangetic plains. Reaching such groups has not been easy. While progress has been made - the rural population classified as poor fell from nearly 40% in the early 1990s to below 30% by the mid-2000s (about a 1% fall per year) – there is a clear need for a faster reduction. Hence, poverty alleviation is a central pillar of the rural development efforts of the Government and the World Bank.
3. Ensuring that agricultural growth responds to food security needs: The sharp rise in food-grain production during India's Green Revolution of the 1970s enabled the country to achieve self-sufficiency in food-grains and stave off the threat of famine. Agricultural intensification in the 1970s to 1980s saw an increased demand for rural labor that raised rural wages and, together with declining food prices, reduced rural poverty. However agricultural growth in the 1990s and 2000s slowed down, averaging about
3.5% per annum, and cereal yields have increased by only 1.4% per annum in the 2000s. The slow-down in agricultural growth has become a major cause for concern. India's rice yields are one-third of China's and about half of those in Vietnam and Indonesia. The same is true for most other agricultural commodities.
Policy makers will thus need to initiate and/or conclude policy actions and public programs to shift the sector away from the existing policy and institutional regime that appears to be no longer viable and build a solid foundation for a much more productive, internationally competitive, and diversified agricultural sector.

Priority Areas for Support[16,17,18]
1. Enhancing agricultural productivity, competitiveness, and rural growth Promoting new technologies and reforming agricultural research and
extension: Major reform and strengthening of India's agricultural research and extension systems is one of the most important needs for agricultural12 growth. These services have declined over time due to chronic underfunding of infrastructure and operations, no replacement of aging researchers or broad access to state-of-the-art technologies. Research now has little to provide beyond the time-worn packages of the past. Public extension services are struggling and offer little new knowledge to farmers. There is too little connection between research and extension, or between these services and the private sector.
Improving Water Resources and Irrigation/Drainage Management: Agriculture is India's largest user of water. However, increasing competition for water between industry, domestic use and agriculture has highlighted the need to plan and manage water on a river basin and multi-sectoral basis. As urban and other demands multiply, less water is likely to be available for irrigation. Ways to radically enhance the productivity of irrigation ("more crop per drop") need to be found. Piped conveyance, better on-farm management of water, and use of more efficient delivery mechanisms such as drip irrigation are among the actions that could be taken. There is also a need to manage as opposed to exploit the use of groundwater. Incentives to pump less water such as levying electricity charges or community monitoring of use have not yet succeeded beyond sporadic initiatives. Other key priorities include: (i) modernizing Irrigation and Drainage Departments to integrate the participation of farmers and other agencies in managing irrigation water; (ii) improving cost recovery; (iii) rationalizing public expenditures, with priority to completing schemes with the highest returns; and (iv) allocating sufficient resources for operations and maintenance for the sustainability of investments.

Facilitating agricultural diversification to higher-value commodities: Encouraging farmers todiversify to higher value commodities will be a significant factor for higher agricultural growth, particularly in rain-fed areas where poverty is high. Moreover, considerable potential exists for expanding agro-processing and building competitive value chains from producers to urban centers and export markets. While diversification initiatives should be left to farmers and entrepreneurs, the Government can, first and foremost, liberalize constraints to marketing, transport, export and processing. It can also play a small regulatory role, taking due care that this does not become an impediment.13

Promoting high growth commodities: Some agricultural sub-sectors have particularly high potential for expansion, notably dairy. The livestock sector, primarily due to dairy, contributes over a quarter of agricultural GDP and is a source of income for 70% of India's rural families, mostly those who are poor and headed by women. Growth in milk production, at about 4% per annum, has been brisk, but future domestic demand is expected to grow by at least 5% per annum. Milk production is constrained, however, by the poor genetic quality of cows, inadequate nutrients, inaccessible

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

veterinary care, and other factors. A targeted program to tackle these constraints could boost production and have good impact on poverty.

Developing markets, agricultural credit and public expenditures: India's legacy of extensive government involvement in agricultural marketing has created restrictions in internal and external trade, resulting in cumbersome and high-cost marketing and transport options for agricultural commodities. Even so, private sector investment in marketing, value chains and agro- processing is growing, but much slower than potential. While some restrictions are being lifted, considerably more needs to be done to enable diversification and minimize consumer prices. Improving access to rural finance for farmers is another need as it remains difficult for farmers to get credit. Moreover, subsidies on power, fertilizers and irrigation have progressively come to dominate Government expenditures on the sector, and are now four times larger than investment expenditures, crowding out top priorities such as agricultural research and extension.

2. Poverty alleviation and community actions

While agricultural growth will, in itself, provide the base for increasing incomes, for the 170 million or so rural persons that are below the poverty line, additional measures are required to make this growth inclusive. For instance, a rural livelihoods program that empowers communities to become self-reliant has been found to be particularly effective and well-suited for scaling-up. This program promotes the formation of self-help groups, increases community savings, and promotes local initiatives to increase incomes and employment. By federating to become larger entities, these institutions of the poor gain the strength to negotiate better prices and market access for their products, and also gain the political power over local governments to provide them with better technical and social services. These 14
self-help groups are particularly effective at reaching women and impoverished families.[18,19,20]

3. Sustaining the environment and future agricultural productivity

In parts of India, the over-pumping of water for agricultural use is leading to falling groundwater levels. Conversely, water-logging is leading to the build- up of salts in the soils of some irrigated areas. In rain-fed areas on the other hand, where the majority of the rural population live, agricultural practices need adapting to reduce soil erosion and increase the absorption of rainfall. Overexploited and degrading forest land need mitigation measures. There are proven solutions to nearly all of these problems. The most comprehensive is through watershed management programs, where communities engage in land planning and adopt agricultural practices that protect soils, increase water absorption and raise productivity through higher yields and crop diversification. At issue, however, is how to scale up such initiatives to cover larger areas of the country. Climate change must also be considered. More extreme events – droughts, floods, erratic rains – are expected and would have greatest impact in rain-fed areas. The watershed program, allied with initiatives from agricultural research and extension, may be the most suited agricultural program for promoting new varieties of crops and improved farm practices. But other thrusts, such as the livelihoods program and development of off-farm employment may also be key.

World Bank Support

With some $5.5 billion in net commitments from both IDA and IBRD, and 24 ongoing projects, the World Bank's agriculture and rural development program in India is by far the Bank's largest such program worldwide in absolute dollar terms. This figure is even higher when investments in rural development such as rural roads, rural finance and human development are included. Nonetheless, this amount is relatively small when compared with the Government's - both central and state - funding of public programs in support of agriculture. Most of the Bank's agriculture and rural development assistance is geared towards state-level support, but some also takes place at the national level.15

The Bank's Agricultural and Rural Development portfolio is clustered across three broad themes with each project, generally, showing a significant integration of these themes.

Agriculture, watershed and natural resources management Water & irrigated agriculture

Rural livelihood development

Over the past five to ten years, the Bank has been supporting:

R&D in Agricultural Technology through two national level projects with pan-India implementation (the National Agriculture Technology Project and the National Agriculture Innovation Project) coordinated by the Government of India's Indian Council for Agricultural Research (ICAR).

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Dissemination of Agricultural Technology: New approaches towards the dissemination of agricultural technology such as the Agriculture Technology Management Agency (ATMA) model have contributed to diversification of agricultural production in Assam and Uttar Pradesh. This extension approach is now being scaled-up across India.
Better delivery of irrigation water: World Bank support for the better delivery of irrigation water ranges from projects covering large irrigation infrastructure to local tanks and ponds. Projects also support the strengthening of water institutions in several states (Andhra Pradesh, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh) improved groundwater management practices (for instance, in the upcoming Rajasthan Agriculture Competitiveness Project).1. The State of Food and Agriculture 2021. Making agrifood systems more resilient to shocks and stresses. Rome: Food and Agriculture
Sustainable agricultural practices through watershed and rainfed agriculture development (Karnataka, Himachal Pradesh, Uttarakhand), soil reclamation efforts (Uttar Pradesh) and, more recently, improved groundwater management practices (for instance, in the upcoming Rajasthan Agriculture Competitiveness Project).

Improved access to rural credit and greater gender involvement in rural economic activities through rural livelihood initiatives undertaken by a number of states (Andhra Pradesh, Bihar, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu) and soon to be scaled up by GOI with Bank support through a National Rural Livelihood Mission.

Agricultural insurance by advising GOI on how to improve the actuarial design and implementation of the insurance program (e.g. rating methodology and product design, index insurance, use of mobile and remote sensing technology to measure yields, etc.).

IV. CONCLUSION

1. Improved farmer access to agriculture markets through policy reforms and investments under the Maharashtra Agricultural Competitiveness Project which aims to reform regulated wholesale markets and provide farmers with alternative market opportunities.
2. The land policy agenda through analytical work as well as non-lending technical assistance in support of GOI's National Land Records Modernization Program.
3. Better rural connectivity through IDA support to the Prime Minister's National Rural Roads Program (PMGSY), and by connecting rural poor and smallholder farmers through collective action to public services through Self-Help Groups (and SHG federations), Water User Associations and Farmer Producer Organizations. Recently the Bank's Board of Executive Directors approved the National Rural Livelihood Mission, which supports SHG approaches through a pan-India approach.[20]

REFERENCES

1. Organization of the United Nations. 2021. doi:10.4060/cb4476en. ISBN 978-92-5-134329-S2CID 244548456.
2. ^ d Lowder, Sarah K.; Sánchez, Marco V.; Bertini, Raffaele (1 June 2021). "Which farms feed the world and has farmland become more concentrated?". World Development. 142:
105455. doi:10.1016/j.worlddev.2021.105455. ISSN 0305- 750X. S2CID 233553897.
3. ^ "FAOSTAT. New Food Balance Sheets". Food and Agriculture Organization. Retrieved 12 July 2021.
4. ^ "Discover Natural Fibres Initiative – DNFI.org". dnfi.org. Retrieved 3 February 2021.
5. ^ "FAOSTAT. Forestry Production and Trade". Food and Agriculture Organization. Retrieved 12 July 2021.
6. ^ In Brief: The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction. Rome: Food and Agriculture Organization. 2021. doi:10.4060/cc4140en. ISBN 978-92-5- 137588-4.
7. ^ Chantrell, Glynnis, ed. (2002). The Oxford Dictionary of Word Histories. Oxford University Press. p. 14. ISBN 978-0-19-863121-7.
8. ^ St. Fleur, Nicholas (6 October 2018). "An Ancient Ant-Bacteria Partnership to Protect Fungus". The New York Times. Archived from the original on 1 January 2021. Retrieved 14 July 2020.
9. ^ Li, Hongjie; Sosa Calvo, Jeffrey; Horn, Heidi A.; Pupo, Mônica T.; Clardy, Jon; Rabeling, Cristian; Schultz, Ted R.; Currie, Cameron R. (2018). "Convergent evolution of complex structures for ant–bacterial defensive symbiosis in fungus-farming ants". Proceedings of the National Academy of Sciences of the United States of America. 115 (42): 10725. Bibcode:2018PNAS..11510720L. doi:10.1073/pnas.1809332

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

115. ISSN 0027-8424. PMC 6196509. PMID 30282739.
10. ^ Mueller, Ulrich G.; Gerardo, Nicole M.; Aanen, Duur K.; Six, Diana L.; Schultz, Ted R. (December 2005). "The Evolution of Agriculture in Insects". Annual Review of Ecology, Evolution, and Systematics. 36: 563–595. doi:10.1146/annurev.ecolsys.36.102003.152626.
11. ^ b "Definition of Agriculture". State of Maine. Archived from the original on 23 March 2012. Retrieved 6 May 2013.
12. ^ Stevenson, G. C. (1971). "Plant Agriculture Selected and introduced by Janick Jules and Others San Francisco: Freeman (1970), pp. 246, £2.10". Experimental Agriculture. 7 (4). Cambridge University Press (CUP): 363. doi:10.1017/s0014479700023371. ISSN 0014-4797. S2CID 85571333.
13. ^ Herren, R.V. (2012). Science of Animal Agriculture. Cengage Learning. ISBN 978-1-133-41722-4. Archived from the original on 31 May 2021. Retrieved 1 May 2021.
14. ^ :a b Larson, G.; Piperno, D. R.; Allaby, R. G.; Purugganan, M. D.; Andersson, L.; Arroyo-Kalin, M.; Barton, L.; Climer Vigueira, C.; Denham, T.; Dobney, K.; Doust, A. N.; Gepts, P.; Gilbert, M. T. P.; Gremillion, K. J.; Lucas, L.; Lukens, L.; Marshall, F. B.; Olsen, K. M.; Pires, J.C.; Richerson, P. J.; Rubio De Casas, R.; Sanjur, O.I.; Thomas, M. G.; Fuller, D.Q. (2014). "Current perspectives and the future of domestication studies". PNAS. 111 (17): 6139–6146. Bibcode:2014PNAS..111.6139L. doi:10.1073/pnas.1323964111. PMC 4035915. PMID 24757054.
15. ^ Denham, T. P. (2003). "Origins of Agriculture at Kuk Swamp in the Highlands of New Guinea". Science. 301 (5630): 189–193. doi:10.1126/science.1085255. PMID 12817084. S2CID 10644 185.
16. ^ Bocquet-Appel, Jean-Pierre (29 July 2011). "When the World's Population Took Off: The Springboard of the Neolithic Demographic Transition". Science. 333 (6042): 560–561. Bibcode:2011Sci...333..560B. doi:10.1126/science.1208880. P MID 21798934. S2CID 29655920.
17. ^ Stephens, Lucas; Fuller, Dorian; Boivin, Nicole; Rick, Torben; Gauthier, Nicolas; Kay, Andrea; Marwick, Ben; Armstrong, Chelsey Geralda; Barton, C. Michael (30 August 2019). "Archaeological assessment reveals Earth's early transformation through land use". Science. 365 (6456): 897–902. Bibcode:2019Sci...365..897S. doi:10.1126/science.aax1192. h dl:10150/634688. ISSN 0036-8075. PMID 31467217. S2CID 201674203.
18. ^ Harmon, Katherine (17 December 2009). "Humans feasting on grains for at least 100,000 years". Scientific American. Archived from the original on 17 September 2016. Retrieved 28 August 2016.
19. ^ Snir, Ainit; Nadel, Dani; Groman-Yaroslavski, Iris; Melamed, Yoel; Sternberg, Marcelo; Bar-Yosef, Ofer; Weiss, Ehud (22 July 2015). "The Origin of Cultivation and Proto-Weeds, Long Before Neolithic Farming". PLOS ONE. 10 (7):e0131422. Bibcode:2015PLoSO..1031422S. doi:10.1371/journal.pon e.0131422. ISSN 1932-6203. PMC 4511808. PMID 26200895.
20. ^ "First evidence of farming in Mideast 23,000 years ago: Evidence of earliest small-scale agricultural cultivation". ScienceDaily. Archived from the original on 23 April 2021. Retrieved 23 April 2021.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com