Preliminary Situational Analysis of Impacts and Risks of COVID-19 Pandemic on Crop Production in Parambikulam Aliyar Basin, South India: Need for Capacity Building

Dhanya Praveen*, Vellingiri Geethalakshmi* and Ramasamy Jagannathan*

Abstract

The present paper deals with the risks associated with Coronavirus (COVID -19) pandemic- an infectious disease, faced by the farming communities of Parambikulam Aliyar Project (PAP) Basin areas, Tamil Nadu, South India. The cascading impacts of the pandemic have resulted in a crisis situation for agriculture in many parts of our country. Owing to the severe global crisis imposed by the COVID-19 across India, participatory research work has been undertaken to comprehend and validate the local specific risk in crop production systems in Parambikulam Aliyar Areas. We assess the immediate challenges that COVID-19 has posed to the farm sector and suggest mitigation measures to ensure a sustainable food system in the post-crisis period. Contact details of around 300 farmers were gathered from Regional Coconut Research Station Aliyar, Agriculture offices of Anaimalai, Pollachi north and Pollachi south block of Coimbatore District. Questionnaires were prepared in vernacular language 'Tamil' and responses were collected. Questions related to their knowledge, attitude and practice were prepared and forecasted as SMS through social media like whats-app & messenger. It was also an attempt to understand the technology adoption in these areas whether the farming communities are able to respond to the available agro advisories services. A 4-point rating scale was used for measuring Attitude and Problem Confrontation Index score (AMI & PCI) on COVID-19 risks and impacts on crop cultivation. Farmers were randomly selected and a telephonic survey was also conducted

* **Dhanya Praveen**, **Vellingiri Geethalakshmi** and **Ramasamy Jagannathan**, Tamil Nadu Agriculture University, Coimbatore. Corresponding Author Email: dhanyaeptri@gmail.com

for 122 farmers across the grain-producing blocks in PAP basin. As indicated by Attitude Measurement Index (AMI), majority of the respondents were moderately favourable for taking up farm risk management measures and adaptations in these challenging times. Based on the Attitude Measurement Index (AMI) score, using farm machineries for harvest got first ranking as 44 percent of the respondents showed highly favourable attitude towards using it to cope with the challenges of labour shortages. Risks due to cessation of monsoon rainfall got the first highest score (PCI-325), hence it was considered as the 1st ranked problem prevailing in this area. The risk of lockdown on Kharif Production and yield is expected as a serious issue over PAP as many of the respondents have either left their arable lands fallow or utilised only half of their land under Kuruvai cultivation got the second-highest score (PCI-308) respectively. It was found that the pandemic has impacted their farming and posing several risks for the forthcoming cropping seasons. The multitudes of risks may be mitigated through capacity building and timely implementation of resilient strategies.

Keywords: Situational Analysis; Agriculture; Impacts Risks COVID-19; Pandemic; Crop Production; Parambikulam Aliyar Basin; Capacity Building.

Introduction

The health crisis due to coronavirus disease (COVID-19) has impacted nooks and corners of lives in developed and developing countries almost alike (WHO, situation report and scientific brief 2020). Cropping systems in developing countries may have more impacts due to COVID -19 lockdowns induced economic slow-down than those in developed countries, FAO (2020). All spheres of economic activities were shut down and the production and supply of goods and services are disrupted across the world. COVID-19 poses critical challenges for the well-being and normal functioning of all economic sectors.

Along with the pre-existing challenges of the rise in land surface temperature, evapotranspiration, unexpected vagaries in rainfall distribution, increasing desertification, as mentioned by IPCC for dryland areas, IPCC has also cautioned the world of an increasing compound nature of impacts and cascading risks on multiple systems and sectors posed by the climate change (IPCC, 2019, NIDM, 2016, UNDRR, 2017, IPCC, 2012 & 2014)). COVID-19 may worsen the issues for associated economic sectors and livelihood of people (IPCC, 2019; FAO, 2020).

Among the pre-existing challenges, drought is a complex and least-understood natural disaster, the impacts of which often depend upon the nature of socio-environmental

background of an area and affects more people than any other disasters in India (Gupta & Sehgal, 2011). Mohita (2013) reported that more than 68 percent of net sown area in India is prone to frequent drought, which varies temporally and spatially. Agriculture drought was often leading to decline in net sown area, decreasing the production, fall in purchasing power, rising unemployment, water scarcity, inflation, widespread malnutrition and spread of diseases (Adger et al., 2003). More than a billion people currently live in water-scarce regions, and as many as 3.5 billion could experience water scarcity by 2025 (Joppa, 2018). The present study area lies in the state of Tamil Nadu, south India is known for water scarcity and drought that occurs in every 2.5 years. COVID-19 may exacerbate the already existing challenges for such dryland agriculture systems. Novel coronavirus can also be treated as chronic drought-like situation for human bodies as it is chiefly considered as a respiratory disease that affects lungs. However, it is found that the virus also affects the liver, kidney, heart, brain and blood of humans (Puelles, 2020), weakening the entire system. However collective and co-ordinated actions may support in achieving timely resolutions for unprecedented challenges.

IFAD, 2020 has reported the possible impact of COVID-19 on the achievement of the Sustainable Development Goals (SDGs), particularly on SDG-2: food security – both in China and globally. Informal sectors, agriculture and the rural economy of India have also been impacted by the COVID-19 lockdown. World food programme of FAO (2020), reports that India is home to a quarter of all undernourished people worldwide, making the country a key focus for tackling hunger on a global scale. The agriculture sector was already strained and the pandemic is adding-up the impact on the depending sectors. Regardless of high agricultural production, the yield of many crops in India is already lower than in other developing countries like Brazil, China and the USA. According to Food and Agriculture Organisation of the United Nations (FAO, UN), even though India is the second-highest rice producer in the world (as of 2013), its yield is lower than China, Brazil and USA (FAO, 2019).

The demand for food is estimated to grow 50 percent by the year 2050 with reference to the base year 2010 (FAO, 2019, Islam, 2020). Considering that the agricultural sector contributes to about seventeen per cent of the GDP of India and employs about 55 percent of the population, the impact of COVID-19 on India's overall economy would equally affect food security sector. The UN's World Food Program reports (2020) that around 370 million children are at risk of losing school meals due to closures of school which are usually the only meals of millions of children across the globe. The school-going children of our rural population are also facing the same challenges due to closure of school due to the pandemic.

As the stepwise nationwide lockdowns were announced in our country to combat the spread of the covidvirus, the rabi harvest was ready to get harvested in many parts of our country. In South India, especially in Tamil Nadu, rice, maize, sugarcane, groundnut, vegetables and flowers were ready to be harvested. However, harvesting was hit due to the reverse migration of the farm labourers back to their villages. This research seeks to make such an assessment in the context of three agricultural blocks in Coimbatore district in the state of Tamil Nadu. With this existing knowledge on the general impacts of the pandemic on agriculture ecosystems, it was an attempt to assess the immediate challenges that COVID-19 has posed to the farm sector of Parambikulam Aliyar Basin and suggest mitigation measures to ensure a sustainable food system in the post-crisis period.

Methodology

Anamalai, Pollachi north and Pollachi South blocks of Coimbatore district are considered for the participatory research. These blocks come under the Parambikulam Aliyar Basin. The track receives a total rainfall of 802 mm in a year and of this, nearly 300 mm during the south-west monsoon, 333 mm during northeast monsoon and 169 mm during summer. Most of the villagers depend on the coconut, groundnut, sorghum and maize plantation for their livelihood. The main river flowing through this area is Aliyar. ParambikulamAliyar Basin (PAP) has a geographical extension between 10.3617543°N and 77.0920165°E. Parambikulam Aliyar project basin contemplates diversion of surface water from Anamalai hills of Western Ghats to irrigate dry command areas of Coimbatore and Erode districts. The southern part of this region is covered by structural hills – Anamalai hills, Aliyar, Sholayar and lower Nirar reservoirs. Pollachi North and Pollachi south already come under over-exploited category of groundwater developments.

Table 1: Surveyed areas in PAP

Sl.No	Block Name	Area of the block in sq.km in PAP	Full block area in sq km	% of the block in PAP
1	Pollachi North	247.64	285.57	86.72
2	Pollachi South	184.3	206.36	89.31
3	Anamalai with Valparai area	1017.38	1017.38	100

Source: State Statistical Dept, Coimbatore

Table 2: Major Crops cultivated in PAP

Major Crops Cultivated in PAP			
	Total Cropped Area (ha)	**Production (tons/ha)**	**Productivity (kg/ha)**
Paddy	5200	20100	3865
Sorghum	38200	41900	1097
Maize	17500	68500	3914
Groundnut	17050	35600	2088
Sugarcane	2000	270000	135000
Coconut	85831	-	9,000nuts/ha

Figure 1: Study area (a) Use of combined harvesters for Rabi rice harvest; (b) Groundnut and Sorghum Growing Areas in PAP; (c) Aliyar Dam (Photos were taken pre-lockdown period during the field visit)

Materials and Method

The study was conducted in three blocks namely Anaimalai, Pollachi North and South of the Parambikulam Aliyar Basin in Coimbatore district. The study area was

selected purposively for investigation, because a socio-economic vulnerability assessment was already proposed for this area under the DST scheme" "Enhancing climate change adaptive capacity and agricultural productivity in Parambikulam Aliyar Basin areas through ICTs and other technological interventions" for running from the year,2019-2020 (Ref:http://14.139.187.14/directorate-cm/research-projects/). Contact details of around 200 farmers were collected from Regional Coconut Research Station Aliyar, Agriculture offices of Anaimalai, Pollachi north and Pollachi south block of Coimbatore District. Key questions related to attitude and perceptions on COVID-19 impacts were prepared in vernacular language 'Tamil' and English and responses were collected. Simple random sampling was used in selecting the respondents from a total of 300 farmers from the population i.e. about 61 percent of the total population was the sample size of the study. The empirical data were collected using personal telephonic interview method during the COVID-19 lockdown period. It was an interactive community-based descriptive survey conducted during the period of June 10-15, 2020. Questions related to their knowledge, attitude and practice were prepared and forecasted as SMS through social media like whatsapp, messenger. It was also an attempt to understand the technology adoption in these areas whether the farming communities are able to respond to the available agro advisories services.

Measuring the attitude score and problem confrontation score of the surveyed farmers was the focus variable of the study. For this purpose, a 4-point rating scale was used for measuring Attitude and Problem Confrontation Index score (AMI &PCI) on COVID-19 risks and impacts on crop cultivation. The farmers were asked to give their response against 5 selected questions related to impacts. The weights assigned for each response were: 3 for high confrontation, 2 for medium confrontation, 1 for low confrontation and 0 for not at all. The PCI score was obtained by adding weights of responses to the problems and therefore, for making rank order, attitude score and Problem Confrontation Index (PCI) was computed as used by Hossain and Miah, 2011.

Attitude Measurement Index of respondent was computed by using the following formulas:

AMI=AH*3+AM*2+AL*1+AN*0……(1)

The PCI was computed by using the following formula:

PCI=PH*3+PM*2+PL*1+PN×0……..……(2)

[Where, AMI= Attitude Measurement Index & PCI = Problem Confrontation Index; AH and PH = No. of the respondents expressed attitude and problem as "high"; AM & PM = No. of the respondents expressed an attitude and problem as "medium"; AL & Pl =

No. of the respondents expressed problem as "low"; AN & PN = No. of the respondents expressed problem as "not at all"].

Results and Discussion

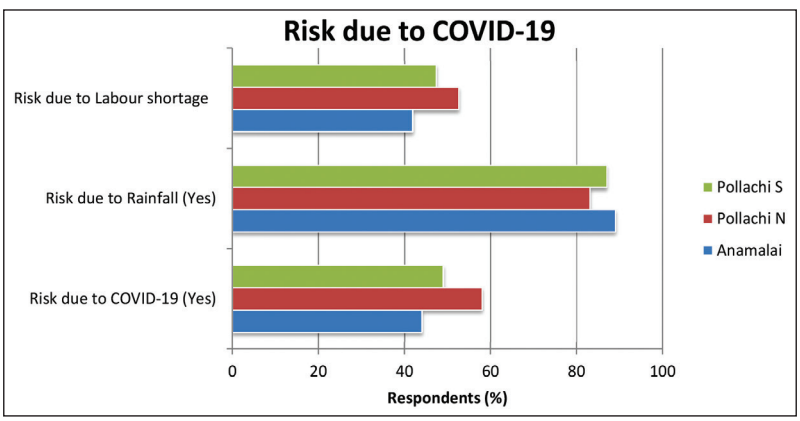
The research employed a combination of quantitative and qualitative methods to meet the proposed objective. Semi-structured in-depth interviews were used as a qualitative tool for data collection in order to get an in-depth understanding of the impacts of a pandemic on PAP's cropping systems. This study brought out that 44.2 percent of farmers had experienced impacts and risks due to the pandemic. The average farm size of the representative farmers was found to be 0.5 Ha to 1.5 Ha categorising them into small and marginal farm structures. In the PAP basin, the surveyed farmers indicated that rice which is a labour-intensive crop is cultivated only in the command areas of Aliyar and Palar dams. Starting from sowing, transplanting till harvest, rice cultivation is labour intensive. In the entire PAP basin, Anamalai block, Pollachi north, Pollachi south and hilly terrains are mostly rainfed and mainly groundnut, maize and fodder sorghum crops are cultivated in these areas. As per the survey, it was clear that land preparations and weeding for the groundnut crop are labour intensive. Especially in a dry land area, land preparation for cultivation is a necessary step for crop cultivation. In perennial crops like coconut, labour is required at the time of manuring, for the timely plucking nuts and for post-processing of the nuts (Copra) for extracting oil and coir products.

An apparent difference in perception levels and the actual COVID-19 impacts were noticed from the survey. Out of the surveyed farmers, 53 percent alone could complete their land preparations during this season for groundnut cultivations with the help of family and community partnership. Almost 81 percent percentage of the farmers expressed non-availability of farmworkers due to lockdown has impacted their current crop cultivation and sale of previous *Rabi* crops. For instance, the entire PAP basin coconut growers faced sweeping fall in the sale of coconuts due to lockdown. Farmers conveyed that they could sell only one-third of their produce. The sale of matured coconut and tender ones were facilitated only through the local intermediaries, as Wholesale traders completely avoided bulk purchases. There was a panic sale at very low cost as people started buying and storing more. Many of the coconut growers have not received value for their sold produce for the past two months. Labour shortage has affected the coconut farmers in PAP. In order to minimise the whitefly menace, the farmers were advised to spray pesticide, due to inadequate farmworkers, it was delayed. Land preparation, sowing, weeding and fertilisation in the current growing

season was negatively influenced by the combined effect of cessation of monsoon rainfall soon after the onset 80.9 percent of the farmers responded that there is an acute shortage of farm labour due to lockdown; however, 19.1 percent responded that labour shortage was not faced in that area. Compared to the respondents of Anamalai blocks, the farmers of Pollachi north and south blocks could perceive the general impacts and risks of COVID-19 on the crop production. Fifty-eight percent of the farmers, among 122 interviewed, had an opinion that COVID-19 lockdown has impacted their livelihood.

The Anamalai block has been suffering severe dry spells even in June 2020 and they fear that combined impacts of COVID-19 and shortage of rainfall may impact their livelihood and local food security. As a matter of precaution from incurring losses, the respondents pointed out that they have either reduced their land area under cultivation or used only half of their arable land for cultivation. This time, the Kharif cultivation is found to be meant only to sustain their individual consumption needs or local sale only. Many of them told that they couldn't travel to the nearby agriculture offices to collect seed supply. Hence they are using their own limited groundnut seeds for sowing. Many farmers completed their farming operations with the support of their communities and family members.

Figure 2: Situational analysis of perceived risks in agriculture in PAP



What is most alarming risk in the current context is the absence of monsoon rainfall after its onset. Hence farming operations are put to a complete halt after sowing of groundnuts and sorghum in all three blocks. Anamalai block is completely dependent upon rainfall as most of them are practicing dryland farming (Figure 2). Respondents

from Pollachi North intimated that COVID-19 has put restrictions on travel, hence the availability of farm labour from nearby locations is hit

Table 3: Timeline/Seasonal calendar of Impacts of COVID-19 in PAP

Crop calendar of PAP that was hit by lockdown in 2020

February	**March**	**April**	**May**	**June & July**
Rabi *(Sambha)* Crop Flowering and grain set for cereal crops in PAP	Rabi rice harvest	Shortage of labourers	Land preparation of Groundnut and Sorghum and Maize crop was hit	Khariff (*Kuruvai):* There were only less area under production *of Kuruvai* crops
	Coconut tree cleaning and nut plucking	Sale of coconut was hit,	Shortage of laboures felt	Labour shortage for large coconut farms
	Rabi groundnut harvest	Sale of groundnut was hit	There were livelihood impacts	Sowing, weeding, fertiliser and pesticide application was hit
	Copra making was hit	Transportation, storage and Sale of rice were hit and transplantation of summer rice was delayed.	Seed supply and seasonal sale and supply of flowers were hit due to lockdown	Cessation of rainfall withered the already sown crops and seedlings in the nursery

The results show that majority of the respondent farmers were not able to appreciate the social distancing norms (Figure 3). Almost unanimously they felt that such things are not possible at farm sites. Very few had responded that they were not bothered about social distancing as family members and friends are engaged in farm operations. It was difficult for many to even comment on social distancing. Hence, it was seen that following the guidelines on social distancing, sanitising and wearing masks may not be practical for primary activities. A few farmers pointed out that a few large scale farmers who have the luxury of deploying technology for harvesting Paddy are relatively more insulated as it reduced their dependency on large numbers of manual labour.

Figure 3: Shows the respondents' attitude regarding following social distancing during farm operations

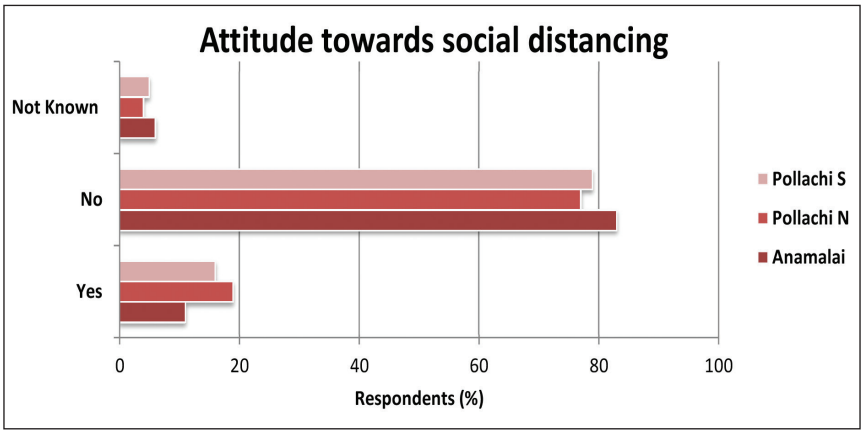
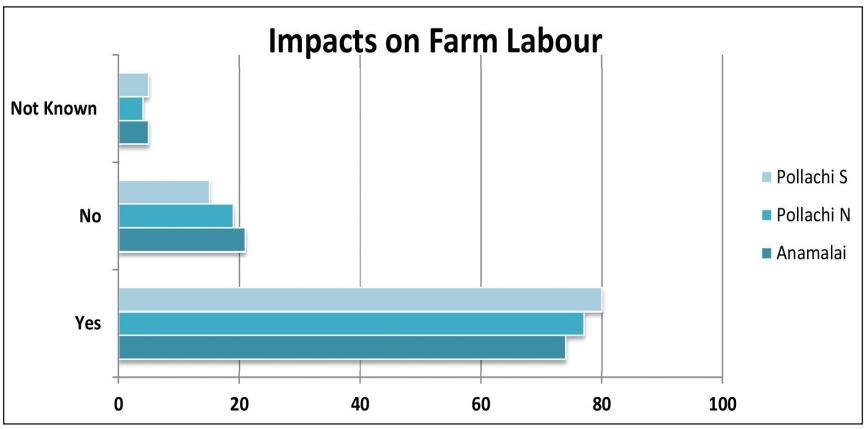


Figure 4: Shows the impacts of COVID-19 on labourers to carry out farm operations



Groundnut and sorghum have been extensively grown in these semi-arid tracts over many years. Farmers are foreseeing COVID-19 and shortage of rainfall as a major reason for the decline in the forthcoming seasonal crop output. The reason for the low yield may be due to inefficient farm operations due to labour shortage, less availability of quantity and quality seed, inadequate farm technologies and farming techniques, small farm size, and irrigation facilities. As the south-west monsoon rains for the month of June shows 52 percent deficiency for Tamil Nadu. In PAP basin, the surveyed areas do not come under canal irrigation.

As reported by Khatam et al. (2010), Attitude Measurement Index (AMI) and Problem Confrontation Index (PCI) score has been calculated. A few of the surveyed farmers have shown a highly favourable attitude towards taking up Kharif (*Kuruvai)* crop cultivation, following social distancing and using farm machineries for harvest amid all risk and challenges. However, majority of the respondents were moderately favourable for taking on-farm risk management measures and adaptations (Table 4). Based on the Attitude Measurement Index (AMI) score, using farm machineries for harvest got first ranking as 44 percent of the respondents showed highly favourable attitude towards using it to cope with the challenges of labour shortages. Very few farmers have shown interest to work in the near-by coconut husk coir manufacturing small scale industrial units.

Table 4: Attitude Measurement Index (AMI) score of the surveyed farmers

	Highly Favorable to not at all Favourable No of Respondents							
Attitude (AMI)	**Problems**	**High**	**Medium**	**Low**	**Not at all**	**Total**	**AMI**	**Ranking**
	Have you taken up *kuruvai* farm operations?	26	79	10	7	122	246	2
	Are you following social distancing?	15	74	14	19	122	207	3
	Are you using farm impediments for harvest?	44	62	14	2	122	270	1

Table 5 shows that "Risks due to the cessation of monsoon rainfall" got the first highest score (PCI-325) and hence were considered as the 1st ranked problem prevailing in this area. The onset of the Southwest monsoon rainfall happened on the expected date, however soon after that, it got stopped. The respondents had an opinion that dry spells during the cropping season are posing havoc for farm operations. Availability of canal irrigation is limited to them only during margazhi months (Rabi Seasons alone). Risk of lockdown on Kharif Production and yield is expected to be the next serious issue over here as many of the respondents have either left their arable lands fallow or utilised only half of their land under Kuruvai cultivation got the second-highest score (PCI-308). The problems may also raise risk of lockdown on Kharif Production and the farmers opined that there is a lack of adequate farm labourers due to lockdown. Impacts due to Labour shortage has got the third highest score (PCI-306). Impacts on the sale of Rabi and Summer Produce has got the fourth-highest score (PCI-301). However when asked

about the general impacts, respondents were not able to connect it as a major problem, hence got the fifth rank (PCI-270). As it is a new pandemic, taking a risk in farming is also a pragmatic learning process (Pontius et al., 2002).

Table 5: Problem Confrontation Index (PCI) among the surveyed farmers

Problem (PCI)	High	Medium	Low	Not at all	Total	PCI	Ranking
General Impacts of COVID-19 on crop cultivation	58	40	16	8	122	270	5
Risks due to cessation of monsoon rainfall	91	21	10	0	122	325	1
Impacts due to Labour shortage	84	19	16	3	122	306	3
Impacts on the sale of Rabi and Summer Produce	77	28	14	3	122	301	4
Risk of lockdown on Kharif Production and Yield	81	26	13	2	122	308	2

Discussion

COVID-19 is a disease that is highly infectious and spreads rapidly through society (Hedberg, 2020). It can be seen that in PAP, commercial Kuruvai cultivation is drastically hit as it is more dependent on labour. The social impressions of COVID-19 may not end all of a sudden with this cropping season. On the contrary, the risk and impacts may be compounded and transferred from this Kharif season and may be extended to the forthcoming Rabi and summer crop productions also. India's Meteorological Department has officially announced, the year 2020 to have a favourable monsoon as it is a neutral phase and anticipating a weaker La. Nina this year (the El-Nino weather phenomenon, that interrupts rainfall in India, is not apparent). This can be treated as a positive thing in the midst of COVID-19 scenario, to gain on-farm productivity and nutritional security and farmer's livelihood. It is significant to propagate sustainable agricultural extension and outreach strategies that goes beyond sharing technical knowledge to the producers but to showcase a leading role in helping small scale farmers, organise themselves for sharing production and protection technologies, marketing and advocacy in such a way that empowers the farming community (David, 2007). Farmers who have taken agricultural loans may face a burden on repaying their crop loans this year. Even though there are many beneficial schemes like providing Rs. 2000 directly to the farmers under the scheme Pradhan Mantri Kisan Samman

Nidhi (PM-KISAN) scheme by Central ministry of agriculture, many of the farmers are waiting for that amount. Another positive move of the government is raising the wage rate for workers engaged under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) by the government to provide them a decent income. Government of Tamil Nadu has also provided Cash worth Rs. 1500 and food grains and groceries to all the beneficiaries through public distribution systems. Farmers who have taken loan have been granted a moratorium of three months as well. Farmers' empowerment has to happen on a regular basis so as to equip them to face multitudes of ever-changing challenges, Nederlof and Odonkor (2004). The extension workers at Krishi Vigyan Kendras (KVKs) can play a major role with their constantly attempt to enhance the cognitive abilities and farm operations as well (FAO, 2015a & b). Government support on Small scale enterprises (SSE) and industrial units are very critical during this pandemic time. PAP being a coconut belt, the coir manufacturing small scale industries in the vicinity can be considered as a good source of diversified livelihood option for the farmers of PAP to enhance their socio-economic resilience during the crisis.

Conclusions and Recommendations

In summary, the situational analysis has helped in attaining a deeper understanding of the ways in which farmers of PAP cope with the pandemic. It can be anticipated that some farmers may not get any surplus produce and income due to limited production levels. In PAP the Kuruvai harvest of sorghum and groundnut may be sufficient for self-consumption alone, but seed availability for the next cropping season may be hit. As a matter of support during the pandemic, Minimum Support Price (MSP) can be fixed by the state government for groundnuts. However, at present, procuring seeds from the seed farms (community-owned seed banks) at a slightly higher price than the market would benefit the local seed farmers in sustaining their livelihoods and getting sufficient local inputs for the forthcoming sambha season. Even for coconut, the price is fixed based on the volatility in the domestic market demands and oil price fluctuation. Like copra, the mature nuts and tender coconuts also should have MSPs to withstand the adverse effects from any disasters; hence, looting by the middle man can be minimised to a large extent. Establishing more number of government procurement centres can play a major role in mitigating the supply chain disruptions. However collective and co-ordinated actions may support in achieving timely resolutions for unprecedented challenges like labour shortages at the time of the pandemic. Farm mechanisation and digital agriculture can play

a vital role in agriculture systems during disasters. Efficient and timely use of farm machineries and instruments especially seedlers, combined harvesters weeding equipment, coconut pluckers, etc. and precision farming may help in sustainable farming in these areas. Establishing a community-owned custom hiring centre at block level will serve in a great way in minimising shortages in the supply of labour and machinery to the farms. As around 44.2 percent of the surveyed farmers had experienced risks due to the pandemic. Collective and integrated farming by farmers' family members, friends as a whole can join hands in carrying out farm operations along with coordinated activities agriculture officer at district, block and village level in a in PAP and minimise impacts and risks due to the pandemic.

In connection with new agrarian order, post COVID-19, agroecosystems in our country should give more emphasis on the food and nutritional security of our population. The pandemic stricken economy must give more attention to building healthy and resilient communities at these crucial hours. Achieving sustainability as proposed in Sustainable Developmental Goals-SDG-13 (climate action), SDG-2 (ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture), SDG-15 (protecting, restoring sustainable use of terrestrial ecosystems), SDG6 (ensuring availability and sustainable management of water is critical during this pandemic times) during this pandemic times requires planned reactive actions at the local level.

Acknowledgements

The authors acknowledge the financial support received from Department of Science and Technology – KIRAN division – WOS-B for granting the R&D project entitled "Enhancing climate change adaptive capacity and agricultural productivity in Parambikulam Aliyar Basin areas through ICTs and other technological interventions" in the PAP basin for the year 2019-2022. Authors are also thankful to Regional Coconut Research Station Aliyar, Agriculture offices of Anaimalai block, Pollachi north and Pollachi south block of Coimbatore District for their constant support.

References

Covid Bulletin May 26, 2020 accessed @ https://www.niscair.res.in /includes/images/ covidbulletin/ pdf/26may2020/ 26-may-2020.pdf

David, S. 2007. Learning to think for ourselves: knowledge improvement and social benefits among farmer field school participants in Cameroon. J. Int. Agri. and Ext. Edu, 14(02): 35-49

Douglas J Stewart, John C Hartley, Mae Johnson, Stephen D Marks, Pascale du Pré, JelenaStojanovic. Renal dysfunction in hospitalised children with COVID-19.The Lancet Child & Adolescent Health. (2020)

FAO (2020) http://www.fao.org/news/story/en/item/1287515/icode/

FAO (Food and Agricultural Organization, 2005).Food Safety Risk Analysis, Part II, Case Studies, Food and Agricultural Organization of the United Nations (FAO).

FAO. 2020. *Food Outlook – Biannual Report on Global Food Markets: June 2020*. Food Outlook, 1. Rome.https://doi.org/10.4060/ca9509en

Food and Agriculture Organization.(2015a). Smallholder and rural poverty.Agricultural Development Economics. http://www.fao. org/economic/esa/esa-activities/esa-smallholders/en/ [26 Mei, 2015].

Food and Agriculture Organization.(2015b). Training and technology transfer. Food Safety and Quality.http://www.fao.org/food/foodsafety-quality/scientific-advice/jemra/technology/ en/ [27 Mei, 2015]

Hedberg K. VarfemteanställdpåDanderyds, sjukhushar haft smittan. April 27, 2020.https://www.dn.se/sthlm/var-femte-anstalldpa- danderyds-sjukhus-har-haft-smittan/(accessed on May 30, 2020).

Hossain, M. S. and Miah, M. A. M. 2011.Poor Farmers' Problem Confrontation in Using Manure towards Integrated Plant Nutrition System. Bangladesh Journal of Extension Education, 23(1&2):139-147

https://www.ifad.org/en/web/latest/blog/asset/41828816, (accessed on May 30, 2020).

IPCC, 2019: Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. CalvoBuendia, V. Masson-Delmotte, H.- O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.

Islam, M.M., Jannat, A., Dhar, A.R. et al. Factors determining conversion of agricultural land use in Bangladesh: farmers' perceptions and perspectives of climate change. GeoJournal 85, 343–362 (2020).https://doi.org/10.1007/s10708-018-09966-w

Jyoti, P., &Suthar, C.R. (2012). Disasters Statistics in Indian Scenario in The Last Two Decades. International Journal of Scientific and Research, Volume 2, Issue 5, ISSN 2250-3153, pp.1-5.http://www.ijsrp.org/research_paper_may2012/ijsrp-may-2012-49.pdf

Khatam, A., Muhammad, S., & Ashraf, I. (2013). "Role of farmer field schools in enhancing skills of farming community in Khyber Pakhtunkhwa, Pakistan", Pakistan Journal Agriculture Resources, 26, 59-64

Mohita, N. 2013. Impact of Droughts in India: Physical; Agriculture and Economic Impact.

Nag, O. S. 2018. What Are The Dangerous Effects Of A Hailstorm-World Atlas.Environment. Nair, S. N., National Disaster Management Plan, 2016. A publication of the National Disaster Management Authority, Government of India. May 2016, New Delhi

Nederlof, E.S. and E.N.Odonkor, 2004. Lessons from an interactive research process: the case study of Cowpea Farmer Field Schools. Convergence of Sci. Proj.(WUR/Univ. of Legon), c/o BP 779 Ouagadougou 09, Burkina Faso. Email:suzannecos@yahoo.co.uk Tel: 00 226 70 72 6103

NICRA Highlights, 2016-18; ICAR-Central Research Institute for Dryland Agriculture Pandey, K. 2018.Poor post-harvest storage, transportation facilities to cost farmers dearly.Down to Earth.Last assessed on 14th September 2019.

Phillips, CA, Caldas, A, Cleetus, R. et al. Compound climate risks in the COVID-19 pandemic. Nat. Clim. Chang. (2020). https://doi.org/10.1038/s41558-020-0804-2

Puelles VG, Lütgehetmann M, Lindenmeyer MT et al (2020) Multiorgan and Renal Tropism of SARS-CoV-2. N Engl J Med. https://doi.org/10.1056/ NEJMc2011400

Singh, S and Gupta, A. K. 2014. Traditional Water Management Systems For Drought Mitigation In India. Water Digest: 36-45.

UNDRR.Words into Action Guidelines: Cross-Sectoral and Multi-Risk Approach to Cascading Disasters,2017. Available online: https://www.preventionweb.net/files/52828_ccrosssectoralmultirisk%5b1%5d.pdf

The U.N's World Food Program reports (2020)

WHO (2020) Coronavirus disease 2019 (COVID-2019): situation report — 51. Geneva: World Health Organization, 2020 (https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf. opens in new tab).

World food programme of FAO (2020),https://www.wfp.org/countries/india,and https://docs.wfp.org/api/documents/WFP0000116794/download/?_ga=2.104880131.1215510445.1593242209-1268873948.1593242209

WHO. 2020. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations, Scientific brief. https://www.who.int/newsroom/commentaries/detail/modes-of-transmissionof-virus-causing-covid-19-implications-for-ipcprecaution-recommendations.