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# POLICY BRIEF

## STRATEGIES FOR DEVELOPMENT OF AGRICULTURE AND ALLIED SECTORS IN ANDAMAN AND NICOBAR & LAKSHADWEEP GROUPS OF ISLANDS

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## PROLOGUE

Agriculture, livestock and fisheries sector plays crucial role in transforming and developing economies along with their contributory role in food security to the rural populations of the developing countries. They also face critical issues concerning climate change, anthropogenic interventions, unsustainable development practices and lack of innovative approaches. In India agriculture sector is considered to be the backbone along with livestock and fisheries with millions of stakeholders dependent. Particularly, Island groups such as Andaman, Nicobar and Lakshadweep are unique biodiversity hotspots. Owing to very unique ecosystems, these islands gain more attention as customary tourism hotspot. Rising tourism increases the exposure of these islands, demanding more production from agriculture and allied sectors. Tourism sector is mostly concentrated on coral reefs and mangrove ecosystems which harbors more than 80% of the fish diversity and are also more affected by extreme events. More importantly these islands are also considered to be free from several deadly diseases in livestock and fisheries sectors. The challenging scenario emerged due to climate change, increasing tourism, reduced land availability and anthropogenic developments are to be dealt with precautionary approaches. Although specific requirements may vary from Island to Island, this policy brief addresses the overall issues, challenges and need for innovative approaches in the most fragile tropical Islands of India towards ensuring sustainable agriculture and allied sector development for the benefit of Island communities.

**Director ICAR-CIARI & the authors**

## Highlights

- Island ecosystem faces various challenges for future due to anticipated climate change events and anthropogenic developments.
- Andaman & Nicobar and Lakshadweep Islands constitute two important islands ecosystems which are biodiversity hotspots with unique cultural and geographic setting.
- Conservation and sustainable utilization of islands bio resources is the key focus for securing livelihood of Islanders.
- In the light of declining resources and increasing demand for agriculture and allied products, innovative approaches are essential. The potential of the modern science is encouraged with innovative technologies and investment support.
- Robust policy directives are most essential as a guide map for development and progress of agriculture and allied sector.


### Citation

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The impetus of the policy brief was developed as an outcome of the workshop on “Strategies for Development of Agriculture and its allied sectors of Island Region” held on 18th November 2015 at ICAR-Central Island Agricultural Research Institute, Port Blair. The workshop was planned towards developing progressive ideas, innovative approaches and policy directives/roadmap for holistic development of agriculture and allied sectors in Andaman and Nicobar & Lakshadweep group of Islands. Post workshop, the contributing authors till date were proactively engaged in various forums concerning policy issues pertaining to agriculture and allied sector development for islands ecosystems.

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# INTRODUCTION

Agriculture is essential for food security, livelihood, income generation and provides role in ecosystem services and greenhouse gas mitigation (Meridian Institute 2011). Climate change is a major challenge to agriculture and allied sector more particular in case of islands. Livestock and fisheries are other important sectors next to agriculture that substantially supports livelihood and employment. Farming systems in the Islands mainly include rice crops, highland mixed, rain-fed mixed, artisanal fishing, plantation crops, root tubers, tree crops, coastal plantation and mixed farming (Swarnam et al 2018).The demand for food production through these components keeps rising steadily and there is an acute deficiency in terms of productive technologies which could augment the production to cope up with the rising population. Demand for livestock products are expected to be doubled by 2050 (Rojas-Downing et al 2017) and fisheries sector continues to be an important sector for food security for poor coastal island fishers. Protecting these resources against unsustainable ways of exploitation and harnessing them in sustainable means for food security and livelihood is crucial. However, several drivers are influencing their sustainable utilization which mainly falls under natural and anthropogenic events. Climate change is predicted to impact the agriculture, livestock and fisheries sector which would further impact the livelihood dependent on these sectors. Islands face more severe challenges from the grunt of climate change. Small Islands especially are more vulnerable to climate change impacts and necessary means to tackle these issues are crucial for sustainable development and livelihood.

# ABOUT THE ISLANDS

Andaman & Nicobar Islands in Bay of Bengal and the Lakshadweep Islands in Arabian Sea are the two major group of islands which are biodiversity hotspots in India (Fig 1). Lakshadweep Island are low lying flat islands whereas Andaman and Nicobar Islands, consists of flat as well as hilly regions. The Andaman and Nicobar Islands is an archipelago consisting of 572 islands, islets, rocks and rocky outcrops with outstanding natural beauty and ecological diversity (ANDFISH 2005). The Andaman Islands are separated from Nicobar Islands by 10 degree channel, and are geologically and ecologically quite distinct. Agri-horticulture, livestock and fisheries forms the mainstay of livelihood in these islands. The Union Territory of Lakshadweep comprises of 36 Islands having area of 32 sq km, out of which only ten islands viz., Androth, Amini, Agatti, Bitra, Chetlak, Kadmat, Kalpeni, Kavaratti, Kiltan and Minicoy are inhabited. Agriculture in Lakshadweep is coconut husbandry and the people of these Islands are mostly dependent on coconut for their livelihood (DOA 2014-15). These islands are highly vulnerable to climate change impacts and extreme events. Marked change in surface temperature, rainfall, evaporation, and extreme events linked to climate change are severely affecting these tropical islands (Velmurugan et al 2016). The soils of Lakshadweep are unique requiring special attention for their management for crop production (Vadivelu et at 1993).

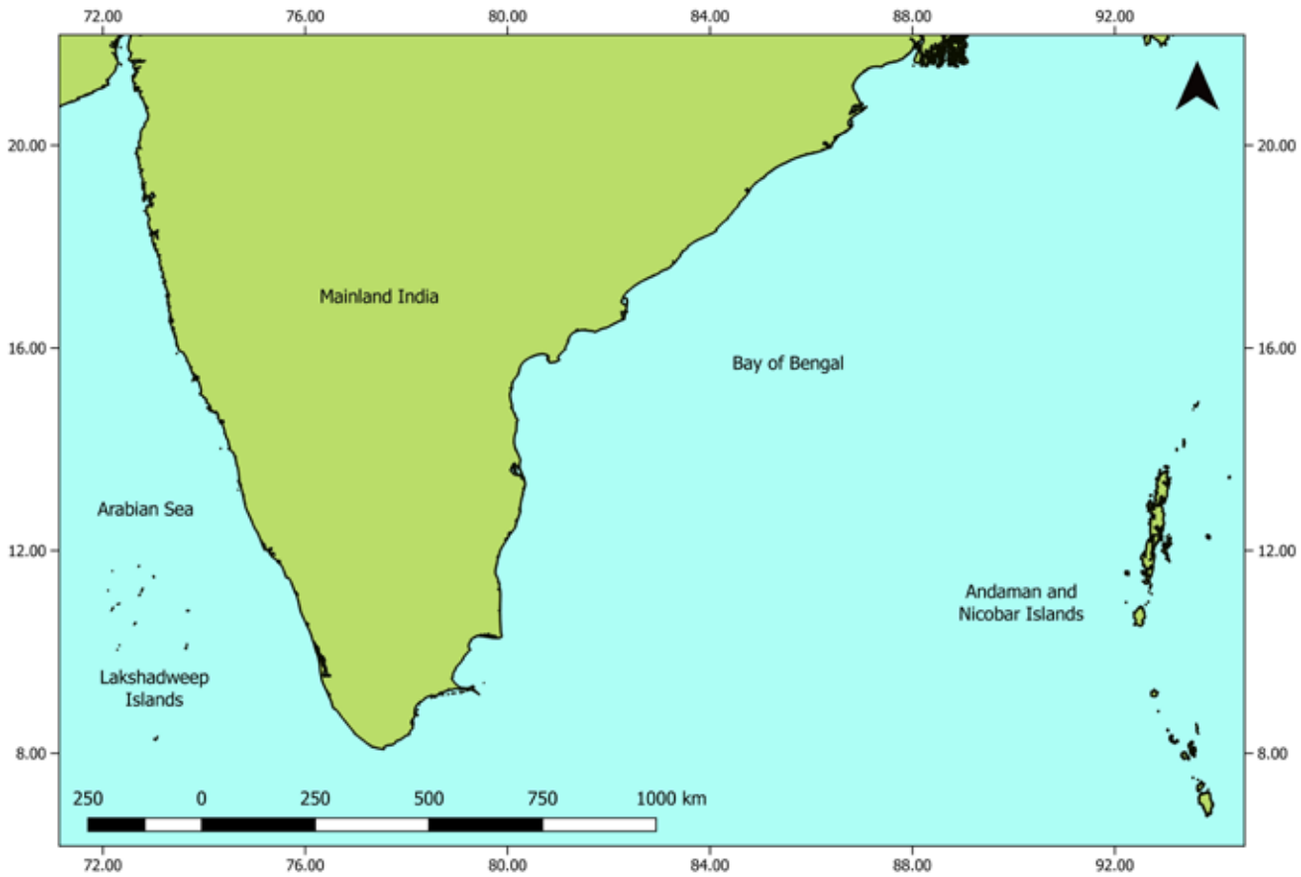


Fig 1. Map showing Lakshadweep, Andaman and Nicobar Islands.
Map was prepared using QGIS, an open source GIS software.

## Agriculture Sector

The agricultural production and productivity of both the Islands shows that coconut forms a major crop in Andaman and Nicobar Islands followed by arecanut and vegetables. In case of Lakshadweep coconut, vegetables and fruits forms major cropping system. Table 1 shows agricultural production & productivity of Andaman Nicobar and Lakshadweep islands.

Table 1 Agriculture production & productivity of Andaman Nicobar and Lakshadweep islands

| Commodity | A & N Islands | | | Lakshadweep Islands | | |
|---|---|---|---|---|---|---|
| | Area (000 ha) | Production (000 T) | Productivity (T/ha) | Area (000 ha) | Production (000 T) | Productivity (T/ ha) |
| Coconut | 21.87 | 128.95 | 5935 nuts /ha | 2.6 | 70.91 | 27591 nuts/ha |
| Arecanut | 4.23 | 5.97 | 1.41 | - | - | - |
| Vegetables | 6.89 | 51.79 | 7.52 | 0.25 | 0.33 | 1.32 |
| Fruits | 3.55 | 29.73 | 8.37 | 0.22 | 0.48 | 2.18 |
| Spices | 1.68 | 3.22 | 1.92 | - | - | - |
| Flowers | 0.13 | 0.29 | 2.23 | - | - | - |
| Rice | 8.1 | 23.97 | 2.96 | - | - | - |
| Pulses | 2.6 | 1.2 | 0.44 | - | - | - |
| Oilseeds | 0.44 | 0.24 | 0.55 | - | - | - |
| Maize | 0.16 | 0.36 | 2.25 | - | - | - |

*Source: DOAC, 2012*

In Lakshadweep, the production of food grains, vegetables and fruits has been far below the local demand necessitating import of rice, wheat, pulses, vegetables and other agricultural commodities from the mainland recurrently. The gap between supply and demand has been ever increasing as per the population growth. This warrants for concerted efforts to develop new agricultural technologies suited to the specific agro-ecological conditions of these islands. The effective transfer of technologies so developed to the farming community is needed to improve sufficiency status in major food items, particularly the perishable commodities like horticultural crops at sustainable scale. The entire Lakshadweep has been under organic method of cultivation since many years. Table 2 shows the agricultural status of Lakshadweep Islands.

Table 2. Agriculture area and Production In Lakshadweep Islands

| S. No | Horticultural Crop | Area (ha) | Production( mT) |
|---|---|---|---|
| 1 | Fruit | 438 | 432 |
| 2 | Vegetable | 311 | 649 |
| 3 | Floriculture | - | - |
| 4 | Plantation crop | 2570 | 48,000 |
| 5 | Spices | - | - |
| 6 | Total | 3,331 | 49,881 |

Source: NHB 2014-15

## Marine Fisheries Sector

Fisheries sector in current discussion is mainly restricted to marine fisheries sector being an important livelihood and employment generating sector in both the Islands with maximum dependent stakeholders. While ANI is comprised of multi species fishery, Lakshadweep islands are predominantly tuna based fishery. The fishing gear, crafts and other fisher details are given in Table 3. A comprehensive policy brief on marine fisheries sector of Andaman and Nicobar Islands (Kiruba-Sankar et al 2019) projects major issues such as data collection, pressure on coastal fisheries, underutilization of deep sea fisheries etc

Table 3 Fisheries status of Andaman Nicobar and Lakshadweep Island

| Particulars | A&N Islands | Lakshadweep Islands |
|---|---|---|
| Coastline (km) | 1192 | 132 |
| EEZ (million sq km ) | 0.6 | 0.4 |
| Continental Shelf (sq km) | 16000 | 4336 |
| No of islands | 572 | 36 |
| Fishing village | 97 | 10 |
| Fishing population | 15320 | 34811 |
| Registered fishing crafts | 2808 | 1372 |
| Beach landing centers major fishing gears | 57 | 11 |
| Major fishing gear | drift gillnet | pole & line |

*Source: Fisheries at a glance, A&N Administration; ANDFISH, 2005; Planning commission report of Lakshadweep)*

Being tropical islands, both these islands possess enormous potential in marine fisheries sector particularly tunas. Tunas are most economically underutilized fisheries in Indian waters with more than half of their potential located around the Lakshadweep waters (Vinay et al 2016). Sustainable exploitation of tuna fishery, bait fishery issue, remoteness, logistics, are some of the issues faced in Lakshadweep Islands.

## Livestock Sector

The Island agriculture and animal husbandry activities are barely 150 years old endowed with farm animal genetic resources comprising of cattle, goat, buffalo, pig and poultry. Among them the Nicobari fowl, Teressa goat, Nicobari pigs are the important indigenous germplasm of the islands (Kundu et al 2010). All livestock population except buffalo and pig is present in Lakshadweep Islands. The livestock population status is given in Table 4

Table 4 Animal Husbandry status of Andaman Nicobar and Lakshadweep Island

| Particulars | A&N Islands | Lakshadweep Islands |
|---|---|---|
| Cattle | 45625 | 3100 |
| Buffalo | 7863 | 0 |
| Goat | 65324 | 46497 |
| Pig | 35921 | 0 |
| Poultry | 1165363 | 164541 |
| Milk production (MT) | 15.52 | 2.1 |
| Meat production (T) | 4708 | 380 |
| Egg Production ( lakhs/annum) | 868 | 139.99 |
| Per capita availability of milk (g/day) | 110 | 82 |
| Per capita availability of meat (kg/annum) | 11.2 | 5.89 |
| Per capita availability of egg ( egg/annum) | 225.2 | 189 |

*Source: Personal communications, Unpublished data, A & N and Lakshadweep Administration*

# CHALLENGES FOR SUSTAINABLE ISLAND DEVELOPMENT

**Shrinking agriculture land holding:** The average size of the agriculture landholding in the Islands is declining rapidly and if this trend continues the average size of holding will be reduced to threshold level in next few decades. With the limited land availability only vertical expansion is possible to facilitate increase in yield per unit area to meet the food demand of the increasing population. Lack of high-tech agriculture farming and other innovative practices is a challenge to be addressed. Crop diversification possibilities are less as most of the land under Agriculture is locked with coconut and arecanut, removal of those plantations may adversely impact the eco-system. Most of the other crops could be integrated in the plantation based cropping and farming systems.

**Deteriorating environment:** Degradation of soil due to erosion, lack of irrigation facilities, nutrient depletion, biotic and abiotic stresses are the major factors responsible for the deteriorating agriculture and horticulture production environment. After the tsunami, a huge area of about 4000 ha has been permanently submerged which has resulted in reduction of total agriculture land. The degradation of soil, water quality can be easily overcome by systematic and efficient utilization of the natural resources and recharging of the soil with the macro and micro nutrients sources for long term effective use of the soil.

**Growing food demand:** The requirements of growing population in terms of drinking water, various agricultural commodities including animal products and green fodder need to be met through Island-specific technological innovations. The demand of cereal, tuber crops and milk needs to be increased to more than 200%. The demand of the meat, milk and other by-products of livestock and poultry need to be doubled to meet the requirement of the fast growing population and tourism. The rise in number of tourists over these years was shown in Fig. 2 demanding more production from agri, livestock and fisheries sectors to meet out the demand.

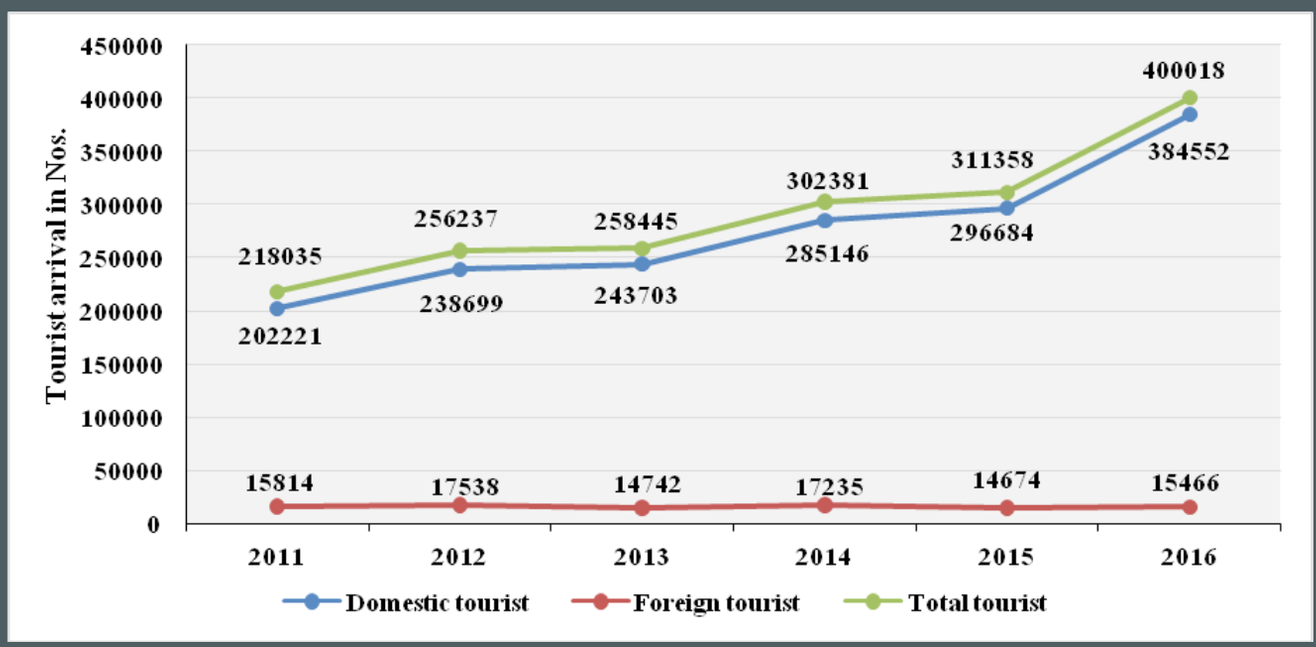


Fig 2. Growth of tourist arrivals to ANI during 2011-16 (Tourism statistics, 2016)

**Climate change:** The island bio-resources are very vulnerable to climate change which would indirectly affect the island agriculture and the livelihood of the farmers (Srivastava 2012; Velmurugan et al 2016). The projected changes in mean temperature and precipitation for Andaman and Nicobar region indicate that the rainfall pattern is all set to change significantly during different seasons and the pattern of change in Nicobar would be different from that in Andaman (Velmurugan et al 2015; Roy et al 2017). Issues such as water logging and soil salinity are becoming a serious threat to the sustainability of rainfed agriculture due to sea water inundation and intensive monsoon rainfall Velmurugan et al (2016). Climate change events in future could drastically impact the island agriculture and is one of the major challenge that need to be addressed.

**Poor horticulture productivity:** The potential of horticultural crops is tremendous, however more attention is required on promoting area-specific modern technologies, ensuring timely supply of inputs, adopting high value crops, strengthening post harvest technologies, planning proper marketing strategies, effective disease and pest control (Singh et al 2016). Multi-storeyed cropping system involving fruits, vegetables, tuber crops, flowers and medicinal plants as components has to be popularized in order to get maximum output per unit area. There is a need for developing stable varieties in plantation crops, vegetables, fruits, flowers, medicinal plants and tuber crops through conventional breeding for sustainable production under challenging situations. More attention should be given for spices and floriculture which has vast potential for livelihood and enhancement of farmers' income.

**Underutilization of Island fisheries potential:** The islands have got vast coastline and abundant fishery resources which are presently underutilized. The current level of exploitation in capture fisheries in the Islands is around 28%. Specific intervention in terms of capacity building of Island fishers including the tribal's are building research base for choosing Island-specific craft and gear and developing technology for guided fishing in the Islands. Identifying ways to exploit the oceanic fisheries in a sustainable manner could facelift the fisheries sector as they have potential of 60,000 tonnes wherein the current harvest is just around 4000 tonnes only (Pers Comm Dept of Fisheries). There is huge scope to expand the oceanic fishery sector of the islands, however to be taken carefully considering the Monitoring, Control and Surveillance (MCS) mechanism towards ensuring responsible fishing. The increased fishing pressure in pelagic and demersal fisheries (ANFDISH 2005; Kirubasankar et al 2013) and effective management of these resources in the face of rising tourism and extreme events in a major challenge to be addressed.

**Absence of regulated market:** Sufficient marketing facilities are lacking which is responsible for low remunerative prices for the agriculture products of the farmers.

**Policy directives:** Lack of a comprehensive policy directives and guidelines taking in to consideration of opinions of all the stakeholders is a major issue and challenge that needs to be addressed. An inclusive policy addressing the issues, challenges, innovative approaches and the roadmap for further progress is essential. Adaptation policies should increase the resilience of farming and food systems to climate change impacts while maintaining or increasing food production (Meridian Institute 2011). Recently the trend of importance in policy directives and guideline are very encouraging in the islands and needs to be up scaled to mitigate any possible developmental issues.

# STRATEGIES TO OVERCOME THE CHALLENGES

Considering the existing agro-climatic, edaphic, biotic and socio-economic factors, appropriate strategies to be evolved for agricultural and horticultural crops, livestock, forests, fodder and fishery. These strategies identified for sustainable development are as follows,

i) **Conservation and sustainable utilization of island biodiversity**: The islands are bestowed with wide variety of crop, animal, fish, insects, microbes and horticultural biodiversity. The utilization of the genetic richness of the island diversity for the sustainable production of the agri-horticulture, fisheries and livestock components should be done to harness the bio-resources. Custodian farmers of rare commodities are to be identified and promoted in conserving the rare germplasm. Participatory *in situ* conservation and breeding programmes are to be established to make use of the unique plant biodiversity comprising unique accessions of crops as well as crop wild relatives for crop improvement which will be beneficial not only for the Islands alone but also for the entire country.

ii) **Land development and water management:** Presently the available land for agriculture is limited. Restoring coastal ecosystems and degraded soils of these islands is essential to provisioning of numerous ecosystem services for the native islanders and ecological functions and services of these hotspots of biodiversity (Velmurugan et al 2015). Efficient utilization of the available land through innovative practices such as broad bed and furrow, rice cum fish, broader pond dykes, ridges and furrow systems, brackish water aquaculture has potential to address the land degradation concerns in the islands (Velmurugan et al 2018). Studies shows that only if 3% of water which flows out is stored in surface and underground storage, the requirement of domestic and agriculture can be met (Srivastava 2009).

iii) **Developing oceanic fishery industry:** Though coastal fisheries are well utilized, oceanic resources remain underutilized. More employment and entrepreneurship can be developed by kick starting tuna fisheries. Appropriate trade linkages are to be established with national and international countries.

iv) **Improving productivity of horticulture:** Thrust should be given for increasing the productivity of the plantation crops mainly coconut with intercropping and efficient utilization of land with suitable technologies. Horticulture and spice crops has got very good potential in the region. Technologies for protected cultivation with structural design and package of practices compatible to Island farmer's socio-economic condition should be developed. Utilizing the coconut diversity in combination with modern technological support have the potential in addressing many of the emerging issues and to provide livelihood (Jerard et al 2018).

v) **Improving productivity of livestock:** Availability of feed, fodder, good germplasm is the major constraints of livestock production in the Islands. Technologies for low cost feed formulation, round the year fodder production and health management is required for enhancing the livestock productivity (Kundu et al 2010).

vi) **Integrated farming system:** The integrated farming system model is the backbone of these islands and should be promoted by developing location-specific farming system models. In view of the agriculture intensification, agriculture waste management will be a major issue. Suitable technologies are to be developed for optimal utilization of agricultural and animal waste mainly the crop residue.

vii) **Institutional credit, marketing and support services:** There are plenty of opportunities for promoting agribusiness by establishing terminal market with hub and spoke model on PPP basis. Workshops to be organized on price discovery through Forward Market Commission since three major commodities viz. copra, arecanut and spices are actively traded in the market. The production to supply chain of the essential commodity shows that there are more than 50% losses in the entire supply chain.

## Priority Setting Tools

To be envisioned for sustainable development in agriculture and allied sectors (Adopted from SPC 2010)

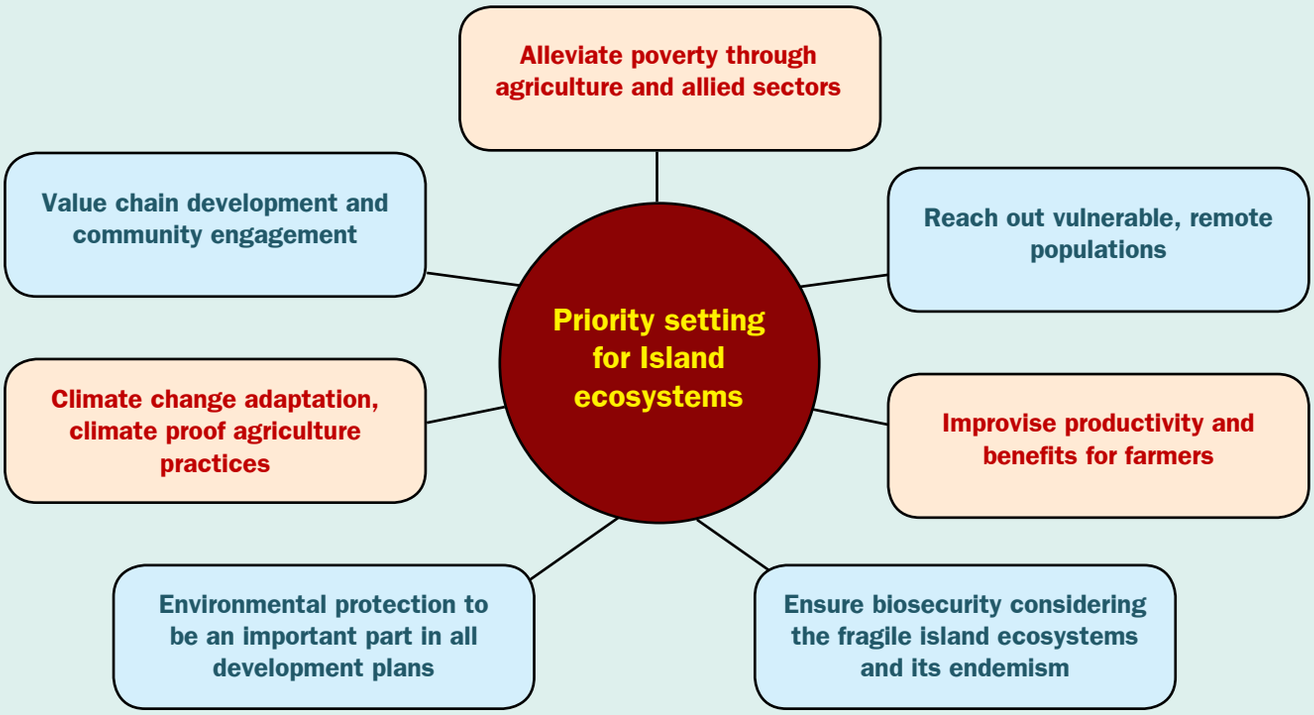


Fig 3. Priority setting for Island agriculture and allied sectors

**Poverty alleviation:** Aiming towards improving the economic standards of poor marginal farmers should be a major goal. Currently existing strategies and schemes such as doubling the farmer's income should be more prioritized.

**Reaching the vulnerable populations:** The flat islands in Nicobar and Lakshadweep are more vulnerable to climate change impacts such as sea level rise (Velmurugan et al 2015; Roy et al 2017; Singh and Bainsla 2015). The livelihood of such vulnerable population in case of extreme events will undoubtedly be a concern for sustainable development. Reaching out the vulnerable population and securing their livelihood through agriculture, livestock and fisheries should be an important upfront task.

**Maximising productivity and benefits:** Low production and productivity is an important issue in the Islands. Innovative management approaches and technological inventions and modifications to suit the islands conditions should be taken up. The schemes related to sector development should be initiated by local farmers in collaboration with local administration.

**Ensuring biosecurity:** The Island biodiversity possess higher degree of endemism which should be conserved and protected. The issue of pests and invasive species could be a major concern for the Islands if unregulated which might lead to unwarranted consequences. Importing fishes from mainland has already attracted various invasive species in the islands (Kiruba-Sankar et al 2018). In order to evade any possible risks and issues concerning, a proper biosecurity and quarantine facility should be established to monitor the issue of non native and invasive species in the Islands.

**Climate change adaptation:** Impacts of climate changes are inevitable and the Island ecosystems have already faced such consequences due to extreme events (Krishnan et al 2011; 2012; Roy and Krishnan 2005; Roy et al 2017). Climate proof agriculture is an emerging area towards ensuring sustainable progress. Technologies which are climate proof and which could work under any extreme conditions should be readily made available as an alternative in case of extreme events. Some of the climate proof options in various sectors are given in Table 5.

Table 5. Climate proof practices for agriculture and allied sectors

| Crop Improvement and production | Land and water management | Livestock management | Fisheries sector |
|---|---|---|---|
| Promotion of climate resilient crop varieties and associated technologies.<br><br>Development of location specific production technologies utilizing the crop genetic resources.<br><br>Utilization of diverse coconut diversity in Islands for quality planting material production.<br><br>Integration of spices, vegetables, medicinal plants, fruits, floriculture crops and agro-forestry in coconut and arecanut plantations.<br><br>Promotion of biotic and abiotic stress resistance/ tolerance crop varieties.<br><br>Organic mushroom farming.<br><br>Native bio inoculants for plant disease management. | Enhancing soil erodability through liberal use of organic manure with wide C:N ratio.<br><br>Resort to greater adoption of minimum and zero tillage concepts.<br><br>Addition of most limiting nutrients through fertilizers.<br><br>Watershed based agriculture development.<br><br>In situ moisture conservation through mulching and timely weed management.<br><br>Effective use of conserved water through pressurized irrigation systems.<br><br>Conjunctive use (saline and freshwater) of water needs to be emphasized. | Promoting indigenous livestock and poultry germplasm viz. Teressa goat, Nicobari fowl, Nicobari pig, Andaman local goat and Andaman pig.<br><br>Integration of fodder in the existing cropping pattern (intercropping in the coconut and areca nut) should be encouraged for improving fodder production.<br><br>Community livestock waste management system like formation of compost pits, vermicompost unit, and liquid manure unit should be created at village level.<br><br>Controlling enteric fermentation, a source of methane emissions through improvement of animal nutrition and genetics. | Ecosystem based fisheries management. More emphasis on coral reefs and mangroves which supports livelihood for fishers.<br><br>Promoting industrial fishing activities.<br><br>Responsible fishing practices to be disseminated.<br><br>Check on non native and invasive species.<br><br>Conserving and maintenance of indigenous endemic aquatic germplasm.<br><br>Promoting small scale backyard fish farming.<br><br>Product development and value addition in fisheries.<br><br>Community management and citizen science approaches. |

**Community engagement:** Conservation and management action of natural resources are best when taken up with involvement of public citizens. Such citizen involvement might provide a holistic view of the issue and could provide innovative management strategies to tackle the issue with the inputs of public citizens. A sense of responsibility can also promoted by scientific organizations to public on environmental issues and further progress.

**Coordinated development:** Engage the scientific and administrative resource personnel from various departments in addressing the issues concerning agriculture, livestock and fisheries sector. Such team work might be more progressive rather than working in solitude. Suitable schemes may be developed for coordinated efforts towards addressing the prevailing issues. For coordinated development in agriculture and allied sector consider the following points discussed in Table 6.

Table 6 Scientific and administrative role playing in fragile Island conditions

| | |
|---|---|
| Advantages | • Less polluted environment<br>• higher endemism, disease free nature<br>• diverse biodiversity |
| Limitations | • Remoteness, Logistics, Infrastructure<br>• Land availability |
| Scientific role | • Technical backstopping and improvisation<br>• Providing policy support<br>• Guidance in decision making<br>• Expanding livelihood based on resources<br>• Advocating best management practices |
| Administrative/ Governance role | • Producer centric policy development<br>• Stabilizing product prices<br>• Involve and engage scientific resource personnel and stakeholders in decision making<br>• Prioritize the interests of local farmers than mainland entrepreneurs |
| Stakeholders role | • Engage actively in decision making processes<br>• Adopt best management practices<br>• Develop sustainable production goals considering the fragile island environment<br>• Promote responsible agricultural practices |

# POLICY RECOMMENDATIONS

## ANDAMAN AND NICOBAR ISLANDS

- **Upgradation of ICAR-CIARI, Port Blair as "Deemed University on Tropical Island Agriculture**" towards promoting agriculture and allied sector.
- Thrust should be given on increasing the productivity of the agri-horticultural crops mainly plantation crops such as coconut and arecanut through **Good Agricultural Practices** & **multi-tier cropping** systems.
- **Technologies for protected cultivation** with structural design and package of practices compatible to island farmer's socio-economic condition should be developed.
- **Location/crop specific organic farming** should be promoted and product certification system should be developed to help farmers to fetch relatively higher prices for their products.
- **Island wise soil resource database** should be prepared for effective resource management and maintaining soil health.
- **Three tier water resource development plan** for each drainage line should be developed: Plastic film lined tanks on the top of hills, recharge structure-cum-well system in the mid-hills, development of open dug wells in the valley areas.
- **Conservation, propagation and utilization of indigenous germplasm**, viz. unique horticultural crop accessions and wild crop relatives of several horticultural crops, Nicobari fowl, Nicobari pig, Teressa goat etc. should prioritized.
- Island-specific eco-friendly IPM and IDM modules should be developed for management of major pests and diseases, with special reference to **rodent control.**
- **Develop low cost alternate feed** with the available feed resources to avoid dependency through import from mainland, India.
- **Integration of fodder in the existing cropping pattern** (in the coconut and arecanut) for availability of green fodder round the year.
- **Develop a comprehensive fisheries information system** for real time fish landing data collection and analysis.
- **Promoting alternative fish production sectors** such as mariculture, brackish water aquaculture to reduce the fishing pressure on coastal fisheries.
- **Participate in standard fishery certification programmes** to ensure sustainable harvest of the commercially exploited fisheries.
- **Agribusiness and agri-preneurship** should be promoted and popularised among the rural youth in the field of seed/sapling production, mushroom spawn production, fish seed, value added products and agro-tourism.

# POLICY RECOMMENDATIONS
# LAKSHADWEEP ISLANDS

- **Promotion of dwarf tender coconut varieties** in home gardens and public places to increase the availability of tender coconuts.
- **Promotion of organic coconut products** and formation of product based clusters for coconut processing and providing value chain management strategies.
- **Promotion of container gardening and roof top gardening** for vegetable production.
- **Mini refrigerated storage chambers** may be provided to the farmers in the Islands for storing fruits and vegetables grown in the Islands.
- **Integration of location specific vegetables and fruits** in open cultivation, intercropping in coconut gardens and in home gardens. Promotion of papaya, sapota, guava, acid lime, moringa and vegetables as per location suitability. Optimum spacing of coconut would favour incorporation of fruits, vegetables and spices crops for the domestic consumption as well as export to mainland.
- **Production of coconut leaf vermicompost**, vermiwash to be taken up by govt and private organizations to ensure the supply of organic manures for open field cultivation as well as grow bag vegetable culture. The poultry manure available at the Islands from poultry units could also be utilized after proper curing.
- **Enhancing the health of coconut plantations** through effective rodent control methods, basin management, removal of senile palms, coastal sandy soil management with coconut husk application.
- **Internal quarantine**: Checking the arrival of vegetables and fruits from mainland for any accidental introduction of plant pests and diseases.
- **Promotion of protected cultivation structures** suitable for vegetables and herbs production to provide nutritional security.
- **Assessment of the baitfish resources** and promoting alternative bait fishes for sustainable tuna fishery.
- **Diversify the fishery through appropriate craft and gear modifications**, capacity building, and developing a value chain for the exploited resources.
- **Integrated pest and disease management programmes to be scaled up**
- **Soil and fresh water availability** being a limitation in these islands are to be supported through water harvesting structures.
- **Coastal bioshield plantation structures** using agro forestry programmes should be taken up to reduce the vulnerability of these islands to extreme events.
- **Promotion of backyard poultry and goatery** for providing nutritional and livelihood security.
- **Promotion of locally available fodder tree and fodder** to promote small dairy and goatery.

# REFERENCES AND SUGGESTED READINGS


- ANDFISH (2005) Draft roadmap for the development of Fisheries in Andaman and Nicobar Islands. pp. 87.
- Annual Reports- ICAR-Central Island Agricultural Research Institute
- Anonymous reports and publications concerning Island agriculture and allied sectors
- Forbes, D.W. A. (1979) Sources towards a history of the Laccadive Islands. J. South Asian Studies 2(1-2):135.
- Jerard B.A., Rajesh M. K., Regi Jacob Thomas, Niral V and Samsudeen K (2017). Island ecosystems host rich diversity in coconut (Cocos nucifera); Evidences from Minicoy Island, India. Agricultural Research, 6(3):214-226.
- Jerard BA, Damodaran V, Jaisankar I, Velmurugan A, Swarnam TP (2018) Coconut biodiversity- Nature's gift to the tropical islands. 145-185. In Sivaperuman et al (eds). Biodiversity and climate change adaptation in tropical islands. Academic press. https://doi.org/10.1016/B978-0-12-813064-3.00006-5
- Kiruba Sankar, R., Utpal Kumar Sar, Vinith Kumar, N.V., Abdul Nazar, A.K., Raymond Jani Angel, J., Dam Roy, S., Saravanan, K., Zamir Ahmed, S.K. and Kundu, A (2019) Expanding open sea cage culture in Andaman and Nicobar islands: Blue growth perspective. CIARI Policy Brief/01 pp. 16.
- Kiruba Sankar, R., Utpal Kumar Sar, Vinith Kumar, N.V., Raymond Jani Angel, J., Dam Roy, S., Lohith Kumar, K., Saravanan, K., Zamir Ahmed, S.K. and Kundu, A (2019) From theory to practice: Sustainable marine fishery perspective for Andaman and Nicobar Islands. CIARI Policy Brief/02 pp. 12.
- Kiruba-Sankar R, Praveenraj, J, K Lohith Kumar, K Saravanan, A Velmurugan, J Raymond Jani Angel, S Dam Roy (2018) Invasive species in freshwater ecosystems: threats to ecosystem services. In Sivaperuman et al (eds.) Biodiversity and climate change in tropical Islands, Academic Press, Elsevier 257-296. http://dx.doi.org/10.1016/B978-0-12-813064-3.00009-0.
- KirubaSankar, R., Dam-Roy, S., Grinson-George, Kamal-Sarma, Krishnan, P., Ram-Kumar, M., Kaliyamoorthy, M., Goutham-Bharathi, M.P. (2013) Fishery and exploitation of Malabar Grouper, *Epinephelus malabaricus* (Bloch & Schneider, 1801) from Andaman Islands. Asian Fisheries Science, 26(3): 167-175.
- Kiruba-Sankar, R., Kumar, K. L., Saravanan, K. and Praveenraj, J (2019) Poaching in Andaman and Nicobar Coasts: insights. Journal of Coastal Conservation, 23: 95-109.
- Krishnan P, George G, Vikas N, Immanuel T, Goutham-Bharathi MP, Anand A, Kumar KV, Kumar SS (2012) Tropical storm off Myanmar coast sweeps reefs in Ritchie's Archipelago, Andaman. Environ. Monit. Assess. 185(6): 5327-5338 https://doi. org/10.1007/s10661-012-2948-7.
- Krishnan P, Roy SD, George G, Anand A, Murugesan S, Kaliyamurthy M, Vikas N, Soundararajan R (2011) Elevated Sea Surface Temperature (SST) induces mass bleaching of corals in Andaman. Curr. Sci. 100(1): 1800-1804.
- Krshnakumar V., Jerard B.A., Josephrajkumar A and George V. Thomas (2014) Four decades of CPCRI interventions on coconut-based Island ecosystem at Minicoy, Lakshadweep.CPCRI Technical Bulletin No. 86. 32p.
- Kundu A, Jaisunder, Jeyakumar S, Verma SK, Kundu MS, De AK, Srivastava RC(2010) Livestock and poultry production policy for Andaman and Nicobar Islands: A scientific perspective. Central Agricultural Research Institute, Port Blair. pp55
- Lakshadweep State development report. Economic issues. Planning commission. Govt of India. pp22
- Meridian Institute. (2011) "Agriculture and Climate Change Policy Brief: Main Issues for the UNFCCC and Beyond" Edited by Donna Lee; Adapted from "Agriculture and Climate Change: A Scoping Report" by Bruce Campbell, Wendy Mann, Ricardo Meléndez-Ortiz, Charlotte Streck, Timm Tennigkeit, and Sonja Vermeulen. Available at www.climate-agriculture.org
- National Horticulture Board report 2014-15.
- Perspective Plan of CARI, Published by CARI, Port Blair
- Rajan PT, Sreeraj CR, Immanuel T (2013) Fishes of Andaman and Nicobar Islands: A Checklist. Journal of Andaman Science Association. 18(1) 47-87.
- Rojas-Downing MM, Nejadhashemi AP, Harrigan T, Woznicki (2017) Climate change and livestock: Impacts, adaptation and mitigation. Climate risk management. 16: 145-163
- Roy SD, Krishnan P (2005) Mangrove stands of Andamans vis – à – vis tsunami. Curr. Sci. 89(11): 1800-1804.
- Roy, S D, Krishnan P, Sarma K, George, G (2009) Proceedings of brainstorming session on development of island fisheries. CARI Publication pp 121.
- Roy, SD, P Krishnan, A Velmurugan, A Anand, Grinson George, R Kiruba Sankar, TP Swarnam (2017) Wetlands

of tropical islands under changing climate: a case study from Nicobar group of Islands, India. Wetlands Science. In Prusty et al (eds) Wetland Science. 205-226. Springer.

- Singh S, Bainsla NK (2015) Analysis of Climate Change Impacts and their Mitigation Strategies on Vegetable Sector in Tropical Islands of Andaman and Nicobar Islands, India . J Horticulture 2: 126. doi:10.4172/2376-0354.1000126
- Singh S, Singh D R, Chand S, Roy SD (2016) Horticulture as a Reliable Source of Livelihood in Andaman and Nicobar Islands, India. In Ganpat et al 2016. Agriculture development and food security in developing nation. pp370.
- SPC (2010) Developing a policy framework for extension systems. Policy Brief 12/2010. Secretariat of the pacific community.
- Srivastava RC (2012) Ecological Threats to an Islands Ecosystem due to Climate Change: The Andaman Experience. Proceedings of the National Academy of Sciences, India. Section B 82(2): 1-9
- Srivastava, RC and Ambast, SK (2009) Water Policy for Andaman & Nicobar Islands: A Scientific Perspective. CARI, Port Blair, p 18.
- Swarnam TP, Velmurugan A, Ravisankar N, Singh AK, Ahmed SK (2018) Diversification of island agriculture: A viable strategy for adaptation to climate change. 553-575. In Sivaperuman et al (eds). Biodiversity and climate change adaptation in tropical islands. Academic press. https://doi.org/10.1016/B978-0-12-813064-3.00020-X
- Tourism statistics (2016) Directorate of Tourism. Andaman and Nicobar Administration pp 63
- Unpublished data and Personal Communications, Department of Fisheries, Andaman and Nicobar Administration.
- Vadivelu S, Muralidharan and Bandyopadhyay A.K. (1993) Soils of Lakshadweep Islands. Research Bulletin No.9. Central Agricultural Research Institute, Port Blair, Andamans.
- Velmurugan A, Ambast SK, Swarnam TP, Burman D, Mandal S, Subramani T (2018) Land shaping methods for climate change adaptation in coastal and island region. In Sivaperuman et al (eds) 577-596. Biodiversity and climate change adaptation in tropical islands. Academic press. https://doi.org/10.1016/B978-0-12-813064-3.00021-1
- Velmurugan A, Roy SD, Dagar JC, Swarnam TP, Jaisankar I (2016) Innovative technologies to sustain saline island agriculture in scenario of climate change. A case study from Andaman Islands, India. Innovative saline agriculture. 387-417, Springer.
- Velmurugan A, Swarnam TP, Lal R (2015) Effect of land shaping on soil properties and crop yield in tsunami inundated coastal soils of Andaman Island. Agriculture Ecosystems and Environment. 206:1-9.
- Velmurugan Roy SD, Krishnan P, Swarnam TP, Jaisankar I, Singh A K, Biswas TK (2015) Climate change and Nicobar Islands: Impacts and mitigation strategies. Journal of Andaman science association. 20(1): 7-18.
- Vinay A, Ramasubramanian V, Kumar BTN (2016) Constraint analysis of tuna fisheries in Lakshadweep. Indian Journal of Ecology 43(2): 789-792.
- Vision 2030 and 2050. Published by CARI, Port Blair.


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