STRATEGY DOCUMENT ON DOUBLING FARMERS INCOME IN MEGHALAYA BY 2022

ICAR- Agricultural Technology Application Research Institute, Zone-VII, Umiam, Umroi Road, Meghalaya- 793103

भाकृअनुप
ICAR

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ICAR- Agricultural Technology Application Research Institute, Zone-VII, Umiam, Umroi Road, Meghalaya- 793103

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Preface

In Northeast India, the farming system is complex and characterized with high degree of risk and uncertainty. The Socio-Economic Caste Census (SECC), 2011 shows that 24% households in Meghalaya possess land and the rest is landless. The farmers in the state cultivate fruits, vegetables and spices as homestead farming (particularly at upland cultivation) and therefore, the opportunity to enjoy large scale economy is highly restricted, unlike in plain areas. Moreover, due to limited labour mitigation and limited scope for farm mechanization, the agricultural operations are primarily performed by the available family members and these features also restrict area expansion for large scale cultivation.

ICAR-ATARI, Umiam, ICAR Research Complex for NEH Region, Central Agricultural University are implementing various research projects and centrally sponsored programmes in collaborative & participatory mode to achieve the farmer centric growth in agricultural and allied sectors through application of appropriate technologies in specific agro-ecosystem perspective in last few years. The flagship programmes like National Food Security Mission, National Mission on Oilseeds and Oil Palm, Seed Hub, Integrated Farming System Models, Skill Development, Mera Gaon Mera Gaurav, Farmers FIRST, Attracting and Retaining Youth in Agriculture, Tribal Sub Plan, etc. are the major initiatives in doubling the farmers' income. The role of KVKs functioning under ICAR-ATARI, Umiam is very critical in implementing all these programmes in a mission mode so as to fulfill the dream of the honorable Prime Minister of India.

Looking into the perspective of doubling farmers' income in Meghalaya, this strategic document has been prepared after a series of meeting with different stakeholders including farmers of the state. In this document major thrust is being given to small and marginal farmers of the state. Reduction in cost of cultivation, Integrated farming system, double/ triple cropping, organic production system, effective marketing and insurance, per drop more crop, quality seed production, entrepreneurship development etc have been given due importance while preparing the document. We express our sincere thanks and gratitude to Dr. Trilochan Mohapatra, Secretary, DARE & Director General, ICAR, Govt. of India, Dr. K. M. Bujarbaruah, Vice Chancellor, AAU and Chairman, of SLCC, other members of SLCC, Heads of KVKs of Meghalaya, officers from various line Departments including Secretary, Deptt. of Agriculture, Govt. of Meghalaya for their valuable input during the preparation of the document. We also thankfully acknowledge the commendable efforts and contributions made by Dr. M. Mokidul Islam, Sr. Scientist & Head, KVK, Ri-Bhoi, scientists and all other administrative and supporting staff including the RA/SRFs/DEOs of ICAR-ATARI, Umiam in bringing out this document within a stipulated time period.

(Bidyut. C. Deka)
Director

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1. Introduction

It has been seen that during last thirty years the real income from the farm sector rose by only 3 times. It is, therefore, important that the strategy has to focus on achieving higher growth rate on a consistent basis year after year. In doing so, the sources of income of agricultural households have to be recognized. The farm based incomes are generated from i) food grains, as also oilseeds; ii) horticulture including fruits & vegetables; iii) milk, meat & eggs and iv) fishery etc. All these sectors have to register growth rate higher than those achieved so far so as to double the income of the farmers by 2022. The growth trends over the last decade indicate that higher growth can come from horticulture, dairy, livestock & fishery sector compared to field crops. However, the latter, i.e. the field crops too contains growth potential in respect of many crop categories and in particular the Eastern region of the country. The growth strategy has to focus on harvesting these potentials.

The honorable Prime Minister of India, Shri Narendra Modi in a Kissan Rally on February 28, 2016 at Rai Bareilly in Uttar Pradesh talked about doubling farmers' income by 2022, when the country shall complete 75 years of its Independence. He emphasized for shaping of his vision through farmer centric approach. The broad approach towards achieving the vision of 'Doubling of Farmers' Income by the year 2022 would be by increasing the net income from each unit of farm by reducing the cost of cultivation, increasing per unit yield and ensuring higher market return on the farmers' produce. For doubling farmers income agriculture has to be converted from production based activities to an income and job generating enterprise. To achieve this, the following approaches may be adopted.

- Policy and regulatory reforms to remove obstacles
- Technology generation and dissemination
- Investment in infrastructure and capacity development
- Business model innovations
- Convergence through PPP mode
- Entrepreneurship development and greater participation of masses.

Dr. M.S. Swaminathan during his presentation on 3rd December 2017 at ICAR Headquarters, New Delhi had made an elaborate presentation highlighting the roadmaps for Doubling Farmers Income. The main components of the road map are:

- An agro-ecological approach involving attention to the farming systems adopted in the following zones: coastal zone; hill zone; arid zone; semi-arid zone; wet zone and islands.
- A farming systems approach which involves crops, horticulture, plantation crops, livestock, fish, forestry and agro-forestry. The doubling of the income will have to be in relation to the farming and agro-processing systems adopted by small producers
- Income can go up if the pricing formula suggested by the NCF namely C2 plus 50 is adopted. Further income depends on the quality of the food material, attention paid to avoid losses at the production, post-harvest stages and to value addition to primary products.

1.1 Present status of Agriculture in Meghalaya

The economy of Meghalaya is basically agrarian as 81% of the state's population depend on Agriculture. Though, 81% of the population depend on agriculture, the net cropped area is only about 9.87 % of the total geographical area of the State. The state is deficit in food grains by 1.22 lakh tonnes annually to feed a population of 2.9 million. The major food crops are Rice and Maize, however, the State is also renowned for its Horticultural crops like Orange, Lemon, Pineapple, Guava, Litchi, Banana, Jack Fruits and Temperate fruits such as Plum, Pear, Peach etc. Potato, Ginger, Turmeric,

Black Pepper, Areca nut, Tezpatta, Betelvine, Short-staple cotton, Jute, Mesta, Mustard and Rapseed etc. are some of the important cash crops in the State. Today the State has 42 percent area under paddy with HYV having the average productivity of 2.3 t/ha. So also is the case with Maize and Wheat where the productivity have increased tremendously with the introduction of HYV from 534 kg/ha during 1971-72 to 1218 kg/ha of Maize and from 611 kg/ha to 1508 kg/ha of Wheat during 2015-16.

The potential for Agro-based industries in the state of Meghalaya is very high. The state produces substantial quantities of oranges, peaches, pineapples, pears, guavas, plums and bananas of superb variety. It also grows plenty of potatoes, tapioca, bay leaves, ginger, maize and jackfruit. Meghalaya's turmeric, particularly the variety that is grown in Shangpung in the Jaintia Hills, is considered the best in the world and its curcumin content is as high as 7.5%. One of the areas in which there is tremendous potential for investment and development is food processing. There is ample scope for setting up a large scale fruit processing unit.

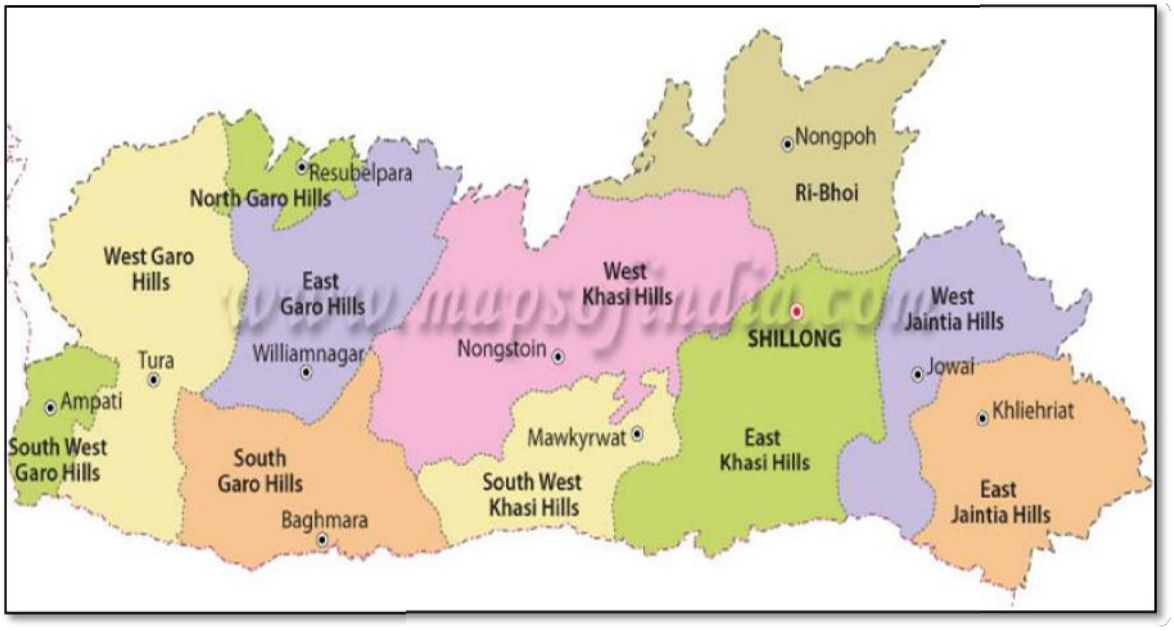

Fig 1: Map of Eleven Districts of Meghalaya State

1.2 Coordination committee meeting for doubling farmers' income in Meghalaya

A number of brainstorming sessions on doubling farmers' income in Meghalaya was organized by ICAR-ATARI Umiam to finalize an action plan for doubling farmers' income by 2022. The first meeting was held on March 21, 2017 in the Conference Hall of ICAR Complex Umiam under the chairmanship of Dr. K.M. Bujarbaruah, the honorable Vice Chancellor, Assam Agricultural University and Chairman of the Coordination Committee. Dr. Bujarbaruah, the Chairman narrated the background of the theme and emphasized on systematic approach to formulate an appropriate strategy for doubling farmers' income in Meghalaya. He further stated that the present status of the farmers' income should be assessed realistically so as to set the target for the next five years.

Members Present:

1. Dr. K. M. Bujarbaruah, Vice Chancellor, AAU and Chairman
2. Dr. S.V. Ngachan, Director, ICAR Research Complex of NEH Region
3. Dr. Bidyut. C. Deka, Director, ICAR-ATARI and Convener, Umiam Meghalaya,
4. Dr. S.M Deb, Director, ICAR-NRC Yak,
5. Mr. H.K Patnayak, Under Secretary, Ministry of Food Processing, represented Secretary, Food Processing, Govt. of India
6. Dr. D. Biswas, Regional Officer, Animal quarantine and Certification Service, Kolkata represented Secretary, MAHDF, Govt. of India
7. D. B. Kharwanlang, Principal MSFRTI, Mawpun represented Director, Fisheries, Govt. of Meghalaya
8. Dr. J. Langstang, Dy. Director ,Regional Pig breeding farm, Kyrdemkulai represented Director, Animal Husbandry and Veterinary, Govt. of Meghalaya
9. R. Longstier, Joint Director(R&T) represented Director, Agriculture Govt. of Meghalaya
10. Dr. R. Bordoloi, Principal Scientist(AE) ICAR-ATARI, Umiam
11. Dr. Dodo Pasweth Sr. Scientist and Head KVK West Khasi Hills.
12. Mrs. I .Kharkongkar, Sr. Scientist and Head KVK East Khasi Hills
13. Dr Tanmay Samajhdar Sr. Scientist and Head KVK West Garo Hills
14. Dr. M Mokidul Islam Sr. Scientist and Head KVK Ri Bhoi
15. Dr. Bagish Kumar, Scientist(AE), ICAR-ATARI Umiam
16. Y. Sohtun SMS (Hort), KVK West Khasi Hills
17. Ms. Banyla Kharbanon SMS(Hort), KVK Jaintia Hills

After threadbare discussion, the following points emerged out.

i. The state's farmers need to be clearly delineated on the basis of:
   A. Altitudinal variations like Farmers from Valley zone, Mid altitude zone, High altitude zone and Shifting cultivators.
   B. Crops and cropping pattern followed while identifying niche and commercially attractive crops.
ii. Initially for the first and second year, we need to identify 2 cereal, 3 horticultural, 2 spice and 2 flower crops in each zone besides pig and poultry across the zones and fishery in valley eco-system for making the interventions to double the income.

iii. While carrying out this assignment, we need to start concurrently the soil quality assessment from the selected farmers/ villages together with nutrient application schedule, water availability and quality, quality of seed (including animal and fish seeds) and planting materials used and determine intervention points.

iv. Based on the intervention points decided, assess support needs in a realistic way taking into consideration the accessible support from the already launched GoI schemes like Pradhan Mantri Krishi Sinchai Yojana, Pradhan Mantri Fasal Bima Yojana, Soil Health Cards, RKVY, MNREGA, Technology Missions both on Animal and Horticulture as well as programmes under NFDB etc and also articulate the linage chain among these schemes.

v. Village wise awareness and training programmes with the experience from PRA type of techniques has to be arranged and also decide to the entry point.

vi. Since entire North east is being converted to organic mode of agriculture, interventions have to be planned accordingly right from seed to other inputs like fertilizers/ pesticides.

vii. Having done this, we need to foresee the likely output and strengthen procurement machinery as wells as storage infrastructure.

viii. Assessment of post harvest infrastructure and competitiveness of the existing manpower has to be made to effectively handle the produce, add value to them, Since they are, by and large, very weak, we need to draw up a plan to first train the manpower and then infrastructure updating and/ or creating newer ones as the need be.

ix. There is need to encourage the youths to adopt secondary agriculture covering the areas of seed, organic fertilizer/ pesticide production, start ups with farm implement manufacturing, food grading, packaging, branding and marketing thus providing the backstopping support need to tighten both the back end and forward end linkage chain as well as for creating the missing platform for non-farm earning and employment and also for doing away with the middlemen involved in supplying inferior inputs or taking away the major profit portion at the cost and labour of the farmers. Each penny so saved shall add to the income of the farmer.

x. The state should to take the advantage of GoI initiative for establishing the Primary and Secondary agricultural markets – Primary markets at least 2 in each district and 2 Secondary markets in each block. Also plan has to be prepared for linking the state with e-NAM after a year or two.

xi. There should be a plan to develop the village community halls with electronic facilities, the facilities for custom hiring centres for farm machineries as well as with e-choupals to translate farm information at their door steps.

xii. Skillful empowerment of extension agents both for technology technique delivery and market intelligence gathering so as to pave the way for regional market within the NE Region specially through the trading of niche area crops/ commodities of one state to plug the weakness of the other states in producing the same, ie., promote complimentary and supplementary agriculture trading within the region.

xiii. Explore the possibility of roping in private players in a partnership mode to translate the currently pursued CDR form of agriculture to a commercial mode.

xiv. Promotion of multi cropping and exploration of the areas for diversification

1.3 Discussion on doubling Farmers' income during Annual Zonal Workshop of KVKs

The Annual Zonal workshop of KVKs of Northeast India held at Agartala during **April 21-23, 2017** discussed various issues related to doubling farmers' income by 2022 and resolved to initiate activities for doubling farmers' income in one of the adopted villages in each of the district of the region as pilot project of KVKs in convergence mode with other stakeholders. The workshop issued the following guidelines for preparation of the action plan for doubling farmers' income.

1. Each KVK should identity 1(one) village among the adopted villages for a Pilot Project on doubling farmers' income.
2. PRA should be completed by April 15, 2017 so as to collect the benchmark information including total income of the farm family from farm and non-farm activities per year.
3. Based on PRA KVKs need to formulate strategies to double the income of the farm family of the identified village by 2022.
4. While formulating strategies, participation of stakeholders like farmers, bank, line department, NABARD, Insurance agency, marketing organization and such other organizations may be ensured so as to work on a convergence mode.
5. While identifying the enterprise for doubling income of the farm family, the strategy should be to increase the productivity of each of the enterprise through efficient use of available resources, reducing cost of cultivation, minimizing post harvest losses, value addition through processing and value chain along with market linkages.
6. Each KVK should prepare a blue print so as to identify right partners to fund, implement and scale-up to achieve the goal for doubling income of the farmers by 2022 in the project village.
7. For this pilot project the Sr. Scientist & Head of the KVK shall be the Chief Executive Officer (CEO) and a district level committee for monitoring & guidance may be framed immediately.
8. Midterm corrections if any may be made immediately by the CEO in consultation with the district level committee.

1.4 Discussion on doubling Farmers' income at ICAR-ATARI, Umiam

Based on the supplied guidelines, the KVKs of Meghalaya prepared the action plan and presented the same in second brainstorming meeting held on July 21, 2017 in the training hall of KVK, Ri-Bhoi for approval in presence of the following participants. The meeting suggested for correction of the action plan based on the guidelines prepared by ICAR-ATARI and proposed another meeting of the Heads of KVKs with ATARI for finalization on July 24, 2017 at KVK, East Khasi Hills. The meeting accordingly finalized the action plan and proposed to have the final interface meeting with all the line Departments of Meghalaya in presence of Agriculture Commissioner/ Secretary, Govt. of Meghalaya for final approval.

Members present:

1. Dr. Bidyut C. Deka, Director, ICAR-ATARI, Umiam
2. Dr. A.K. Singha, Principal Scientist, ICAR-ATARI, Umiam
3. Dr. R. Bordoloi, Principal Scientist(AE) ICAR-ATARI, Umiam
4. Dr. Dodo Pasweth Sr. Scientist and Head KVK West Khasi Hills.
5. Mrs. I .Kharkongkar, Sr. Scientist and Head KVK East Khasi Hills
6. Mr S.A. Singh Sr. Scientist and Head KVK West Garo Hills
7. Dr. M Mokidul Islam Sr. Scientist and Head KVK Ri Bhoi
8. Mr. M.J. Syngkon, Sr. Scientist and Head KVK, Jaintia Hills
9. Y. Sohtun SMS (Hort), KVK West Khasi Hills
10. Ms. Banyla Kharbanon SMS(Hort), KVK Jaintia Hills

1.5 Interface meeting on doubling Farmers' income at Directorate of Agriculture, Govt. of Meghalaya

The Interface meeting to finalize the action plan for doubling farmers' income in all the districts of Meghalaya was held on August 22, 2017 under the chairmanship of the Secretary, Department of Agriculture, Govt. of Megahlaya. Dr. M. Islam, Sr. Scientist & Head, KVK-Ri-Bhoi made the presentation on behalf of the Director, ICAR-ATARI, Umiam. The meeting after detail deliberation finally approved the action plan for the districts of Meghalaya.

Members present:

1. Mrs. M.N. Nampui, Secretary Agriculture, Govt of Meghalaya
2. Dr. Bidyut C. Deka, Director, ICAR-ATARI, Umiam
3. Dr. A.K. Singha, Principal Scientist, ICAR-ATARI, Umiam
4. Shri R. Langstieh, Joint Director, Agriculture (R&T)
5. Smt. H. Lyngdoh, Joint MD (MgSFAC)
6. Dr. K.K Kharmihpen, Joint Director (AHP), AH & Vety Deptt
7. Smt. L. Kharkrang, Deputy Director of Agriculture (P)
8. Smt. S. Nongbet, Deputy Director of Horticulture (P)
9. Dr. K.B. Sahkhar, Deputy Director, AH & Vety Deptt.
10. Dr. C. Shilla, Deputy Director, AH & Vety Deptt
11. Smt. A.M. Lyngdoh, Deputy Director (MAMETI)
12. Mr. M.J. Syngkon, Senior Scientist & Head, KVK Jaintia Hills
13. Dr. D. Pasweth, Senior Scientist & Head, KVK West Khasi Hills
14. Mrs. I. Kharkongor, Senior Scientist & Head, KVK East Khasi Hills
15. Dr. Mokidul Islam, Senior Scientist & Head, KVK Ri-bhoi
16. Shri. L. Sooting, Deputy CE (WR), Shillong
17. Shri. P.S. Kharnaior
18. Shri A. Dkhar, ADA (MgSFAC)
19. Shri. B. Syiem, ADA/AM (MgSFAC)
20. Smt. B. Nongbri, ADH (P)
21. Smt. B.M. Umloy, ADA (PP) Shillong
22. Smt. J.C. Lyngdoh, ADA (R&T)
23. Smti. Mariana Dkhar, ADA (Hq)

24. E.M. Suchiang, ADA (Fert)
25. Shri. V. Khonglah, HDO (Hqr), DOH
26. Shri. P.J. Dutta, HDO (Mkt)
27. M.D. Shadap, HDO (Mkt), Hq
28. Smt. L.N. Sangma, P.D, ATMA, Ampati
29. Shri. M.D. Aveng, P.D, ATMA, Resubelpara
30. Smti. V. Renthlei, H.O. (FP).
31. Mr. W. Marbaniang, A/O (Hq.)
32. Dr. K.D. Phawa, CE Water Resources
33. Shri. B. Shylla, R.O, East Khasi Hills
34. Shri. Ereneus. K. Marbaniang, SMS (Agri. Extension), KVK West Khasi Hills
35. S. Tariang, S.C. NFSM
36. Yvonne Sohtun, SMS (Horticulture), KVK West Khasi Hills
37. Bakordalin Chyne, SMS (Plant protection)
38. Smt. R.W. Rangad, SMS (Plant protection)
39. Dr. Rimiki Suchiang, SRF, ATARI-Umiam

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1.7 Broad Objectives of the document

- Emphasizing integrated farming system mode of production and double/ triple cropping
- Organic production system in select crops including organic input production
- Reduction in cost of cultivation and post harvest losses
- Area expansion and productivity maximization of cereals, pulses, fruits &vegetables including piggery, poultry and fisheries.
- Strengthening marketing mechanism and Post harvest management system linked with e-NAM.
- Livelihood improvement and doubling farmers' income by 2022

2. Meghalaya State Profile

Meghalaya emerged as a full-fledged state within the union of India on 21st Jan 1972. The State lies within 25º1′ and 26º5′ North latitudes and 85º49′ and 92º52′ East Longitudes. Shillong, the capital of Meghalaya is located at an altitude of 1496 metres above sea level. It is having an area of 22429 sq. km with population of 2,966,889 (Male -1,491,832, Female-1,475,057) in 6,839 villages, covering 46 CD Blocks in 11 districts (4 new districts) with 86.15% Schedule Tribe Population (Census 2011). Meghalaya is subject to vagaries of the monsoon. The climate varies with altitude. The climate of *Khasi* and *Jaintia* Hills is uniquely pleasant and bracing. It is neither too warm in summer nor too cold in winter, but over the plains of Garo Hills, the climate is warm and humid, except in winter. The Meghalayan sky seldom remains free of clouds. The average annual rainfall is about 2600 mm over western Meghalaya, between 2500 to 3000 mm over northern Meghalaya and about 4000 mm over south-eastern Meghalaya. The temperature range is approximately 2 degree centigrade to 36 degree centigrade depending upon the altitude ranging between 300 mts above mean sea level (MSL) to 2000 mts above MSL.

Table 1: Population Trend during 1901-2011 in Meghalaya

Year	Population			Female per 1000 Males	Decennial Growth Rate
	Male	Female	Total		
1901	167256	173268	340524	1036	-
1911	195706	198299	394005	1013	(+)15.71
1921	211216	211187	422403	1000	(+)07.21
1931	243993	236844	480837	971	(+)13.83
1941	282666	273154	555820	966	(+)15.59
1951	310706	294968	605674	949	(+)08.97
1961	397288	372092	769380	937	(+)27.03
1971	520967	490732	1011699	942	(+)31.50
1981	683710	652109	1335819	954	(+)32.04
1991	907687	867091	1774778	955	(+)32.86
2001	1176087	1142735	2318822	972	(+)30.65
2011	1491832	1475057	2966889	989	(+)27.95

Figure 2: Decadal growth of population in Meghalaya

2.1 Agro-Ecologies in the State of Meghalaya

Table 2: Agro-Ecologies in the State of Meghalaya

Agro-climatic Zone	Area located	Major Crops grown
Sub-Alpine & Sub-temperate (>1500 m)	Upper shilling, Thawphlang & Mairang of East Khasi Hills	Cole crops, pine trees, potato
Subtropical hill zone (400-1500 m)	Jowai, part of Nongstein, Nokrek and Kailash area of East Garo Hills, Ri-Bhoi, West, South West Garo Hills, part of South Garo Hills	Shifting cultivation, Rice, Maize, Mustard, Wheat, Castor, Pea, Ginger, Turmeric, Tapioca, Cotton
Subtropical plain zone (Valley area)(400-1000 m)	Umkiang area of Jaintia Hills, North, West, South West Garo Hills, Part of South Garo Hills	Irrigated Rice, Maize, Mustard, Wheat, Castor, Pea, Ginger, Turmeric, Tapioca, Cotton
Mild tropical hill zone(200-800 m)	Southern part of Jowai, Eastern part of East Garo Hills and West Khasi Hills, southern part of Ri-Bhoi	Upland rice, maize, pulses, cotton, wheat, tapioca etc.
Mild tropical plain zone (≤ 200 m)	Lower part of Garo Hills, North, West & South West Garo Hills	Rice, oilseeds, mustard, sugarcane, jute & other fibre crops, sweet potato, potato etc.

Table 3: Land use, cropping pattern, food requirement and annual income of farmers

Land Use Pattern	Area(ha)
Geographical area	22,42,900
Forest cover	9,46,197
Cultivable wasteland	5,55,234
Barren land	2,39,041
Fallow land	2,15,331
Net Sown Area	2,85,659
Area sown more than once	57,226
Gross Cropped Area	3,42,885
Cropping intensity (%)	120

2.2 Land use and Cropping Pattern

Besides the major food crops of rice and maize, Meghalaya is known for its oranges (Khasi Mandarin), pineapple, banana, jackfruits, temperate fruits like plums, peaches and pears etc. The popular cash crops, which are traditionally cultivated, include turmeric, ginger, black pepper, areca nut. Strawberry, flowers, etc. are grown commerciality. Temperate zones of Meghalaya face climatic barriers against agricultural growth. High soil erosion also reduces fertility.

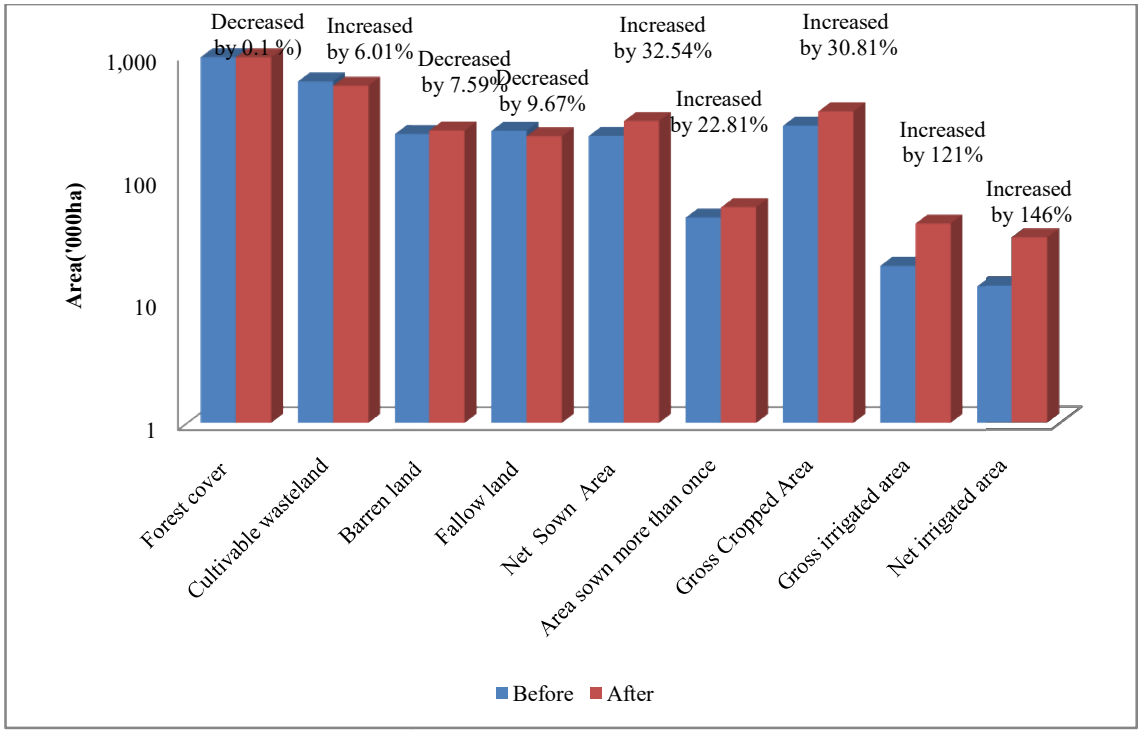

Figure 3: Land Utilization Trends (2003-04 to 2013-14)

Table 4: Land holding pattern and size of holding –India & Meghalaya (2010-11 Census)

Class size	% of holding area	Average holding size(ha)	% of holding area	Average holding size(ha)
	INDIA		**MEGHALAYA**	
Marginal (0.05-1.0ha)	22.5	0.39	16.08	0.45
Small (1.0-2.0ha)	22.1	1.42	26.75	1.33
Semi medium(2.0-4.0ha)	23.6	2.71	39.40	2.79
Medium (4.0-10.0ha)	21.2	5.76	16.40	5.67
Large (above10.0ha)	10.6	17.38	1.37	16.88
Total/Average	**100**	**1.15**	**100**	1.37

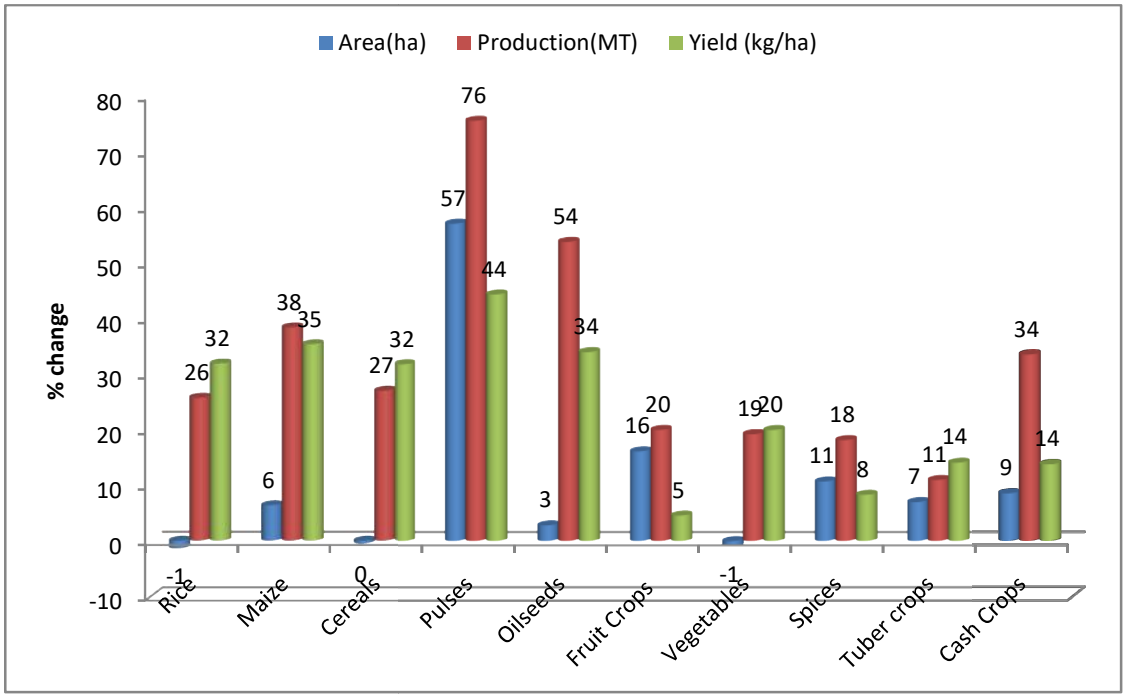

Fig 4: Percent Change in area, production and productivity in Meghalaya (2003-04 to 2013-14)

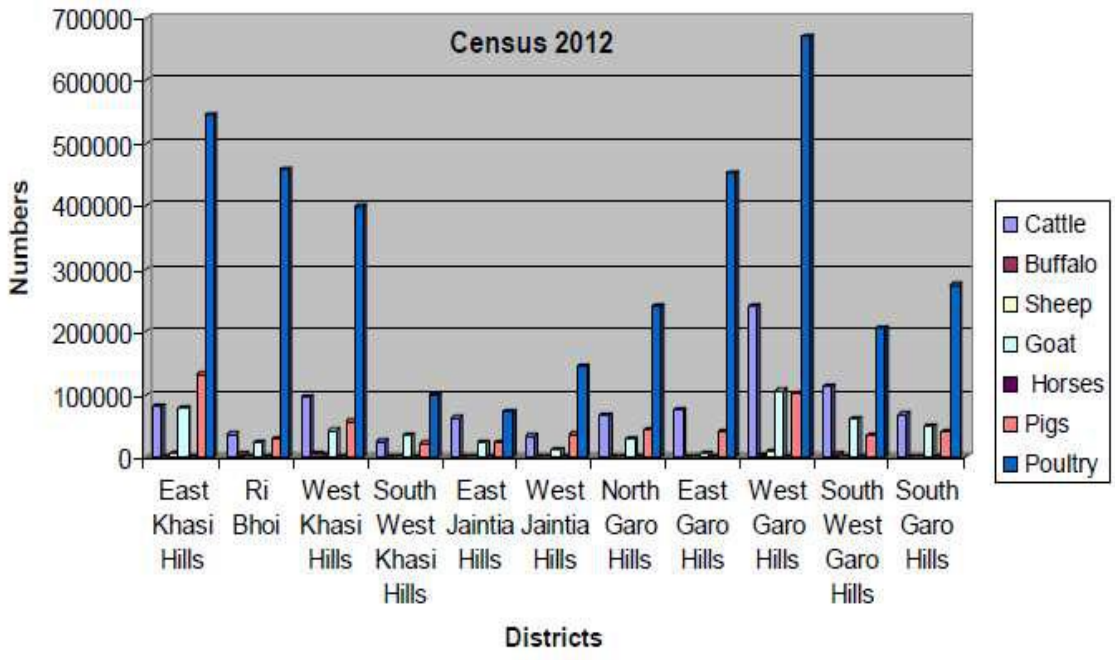

Fig 5: Trends of Livestock Population: (as per 2012 Census)

Table 5: Fertilizer consumption (tonnes) in trend in Meghalaya (10 years)

Fertilizers	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
N	3802	2949	2808	2598	4344	3265	3361	3506	1393
P	2432	1940	1596	693	2012	1239	1146	1033	375
K	257	239	404	392	631	254	342	271	315
NPK	6491	5128	4808	3683	6987	4758	4849	4810	2083
± Percentage variation over the previous year (10 years)									
N	33.50	-22.44	-4.78	-7.48	67.21	-24.84	2.94	4.31	-60.27
P	27.93	-20.23	-17.73	-56.58	190.33	-38.42	-7.51	-9.86	-63.70
K	41.99	-7.00	69.04	-2.97	60.97	-59.75	34.65	-20.76	16.24
NPK	31.66	-21.00	-6.24	-23.40	89.71	-31.90	1.91	-0.80	-56.69

Source: Statistical Abstract Meghalaya 2016, Directorate of Econmics & Statistics, Govt. of Meghalaya

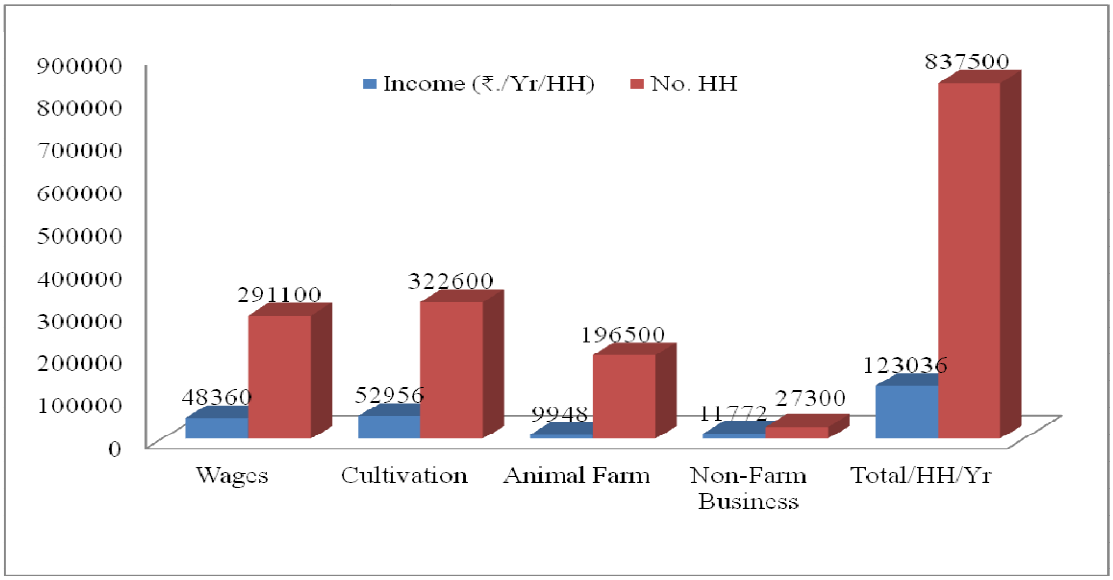

Fig: 6 Average Annual Family Income (₹.) in Meghalaya

2.3 Natural Resource Endowments

A comparative picture of resource endowments and land occupational patterns between Meghalaya and the other north-eastern states with India shows that Meghalaya has 42 per cent forest land, slightly less than the forest coverage for the north-east region (52 per cent) as a whole, but certainly above the Indian average of only 23 per cent. The net sown area is only 9 per cent in Meghalaya, which is not only significantly lower than the country average which is 46 per cent, but also much lower than the north-east region as a whole (17 per cent). Similarly, area sown more than once is much lower than some of the other hill states such as Manipur and Arunachal Pradesh, although it is far higher than in Nagaland. However, 83 per cent of Meghalaya's net area sown is devoted to crop production, which is much higher than even Assam. On the other hand, the area sown more than once (17 per cent) is relatively low in Meghalaya, suggesting the severity of the impact of Jhum cultivation in Meghalaya.

Meghalaya has a very high percentage of cultivable wasteland compared to the total net sown area, indicating the scope for expansion of crop cultivation in the state. It is next to Mizoram in terms of the availability of forests to net area sown area, which means that forestry income should play a much bigger role in the GDP of Meghalaya. Interestingly, it has a very high percentage of land under trees and groves not included in the net sown area. A district-wise analysis of resource endowments reveals wide variations across regions within Meghalaya. For instance, South Garo Hills has the highest proportion of forest land (54 per cent) and Ri-Bhoi the lowest forest coverage (35 per cent). Area under non-agricultural uses in all districts is very small, ranging between 2 to 6 per cent. A striking feature of land use in Meghalaya is that area under cultivable wasteland is quite high (20 per cent), with the highest figure of 31 per cent in the Jaintia hills. Apart from West Garo (9.4 per cent) and South Garo (12 per cent), the rest of the districts have on average more than 20 per cent cultivable wasteland. Total fallow land ranges between 4 per cent (East Khasi Hills) and 15 per cent (West Garo Hills).

Meghalaya as a whole has 10.3 per cent fallow land. District-wise, the major producer of both livestock and poultry is the West Garo Hills (28 and 25 per cent, respectively). It accounts for 28 per cent of the cattle, 45 per cent of buffaloes, 34 per cent of sheep, 36 per cent of goats, 24 per cent of fowls, and a staggering 64 per cent of ducks, all being the highest in terms of district wise production levels. The West Khasi Hills and East Khasi Hills are at the top in the 31 population of horses and ponies (57 per cent) and pigs (25 per cent), respectively. On the other hand, the South Garo Hills is at the bottom of the list for all the livestock categories considered. Meghalaya is relatively better off in terms of per capita availability of livestock products compared not only to the NER but also to India, except for the production of milk, and the population of buffaloes and sheep. Meghalaya seems to have a comparative advantage in livestock products in comparison with both the north-east and India. This means it can specialize in production for export to other regions and can also develop meat processing industries to increase value addition in its GDP.

2.4 Important development indicators

The following development indicators have been considered for the document:

- Area expansion in hectares of major cereals, pulses and horticultural crops.
- Area in hectares under double/ triple cropping.
- Area in hectare under integrated farming system approaches per block.
- Production of major agricultural and horticultural crops including pig poultry and fishes.
- Cost of cultivation of various crops (Rs/ha) in 2022 as compared to 2017.
- Number of primary/ secondary market established per district during 2017-2022.
- Establishment of number of units for processing and value addition with their capacity per district.
- Income of farm family per annum.

3. Infrastructure for Agriculture and Government Programmes

The availability of basic infrastructure, such as roads, bridges, processing/ marketing/storage facilities, in the NER is far below the national standards. The overall infrastructure index for the region (at 93) also falls short of the national average of 100. The only exception is Assam, which has an index of 104 (CMIE, 2000). The geographical terrain hampers communication and connectivity, and producers and residents rely on good transport and telecommunication networks to ease these constraints. The dismal state of rural roads, obstructing the easy transportation of agricultural inputs/produce; poor connectivity with other parts of the country; weak infrastructure for post-harvest management and marketing linkages; Inadequate ancillary units and cold storages—all these factors have inhibited the growth of the agricultural sector in the region. However, the following infrastructural facilities are available in the state.

3.1 Infrastructure under Agriculture/ Horticulture Department

The Department is composed of different technical units, namely Plant Protection, Research, Training, Soil Survey, Agricultural Engineering (Mechanical), Agricultural Information, Planning, Statistics, Monitoring-Cum-Evaluation Cell, Agricultural Census, General Establishment, Development and Account Section, each having specific functions to perform. The following are some of the existing infrastructure available with the Department.

- District & Local Research Station & Laboratories: 3 nos.
- Integrated Agricultural Training Centre: 1 no.
- Farmer's Training Institutes: 4 nos.
- Custom Hiring centre (Agricultural Mechanical Engineering): 5 nos
- Model Floriculture Centre-cum-Horticulture Hubs: 5 nos.
- Seed farm: 1 no.
- Seed Testing Laboratory: 1 no.
- Soil Testing Laboratories: 3 nos.
- State Soil Survey Organisation: 3 nos.
- Mobile soil testing vans: 3 nos.
- Automatic Weather Stations (AWS): 7 nos.
- Horticulture Farms & Nurseries : 26 nos.
- Fruit Farm: 14 nos.
- Vegetable Farm: 1 no.
- Ginger Farm: 1 no.
- Tea farm: 2 nos.
- Cold storage: 1 no.
- Primary market: 2 nos.
- Secondary market: 1 no.
- Fruit & Vegetable Processing Unit: 2 no.

3.2 Infrastructure under Veterinary and Animal Husbandry Department

1. Intensive Cattle Development Project = 2 nos
2. Stockman Centre (with A.I. facilities) = 34 nos
3. Stockman Centre (without A.I. facilities) = 28 nos
4. Key Village Centres (with A.I. facilities) = 6 nos
5. Key Village Centres (without A.I. facilities) = 10 nos
6. Veterinary dispensaries (with A.I. facilities) = 23 nos
7. Cattle Breeding Farm = 4 nos
8. Buffalo Farm = 1 no
9. Poultry Farm = 13 nos
10. Pig Farm = 13 nos
11. Sheep and Goat Farm = 2 nos
12. Fodder Demonstration Farm = 3 nos
13. Fodder Demonstration and Seed Production Farm = 2 nos
14. Feed Mill= 2 nos
15. Rabbit Farm = 1 no

16. Vocational Training Centres = 2 nos
17. Dairy Plant = 3 nos
18. Chilling Centre = 3 nos
19. Creamery and Ghee Making Centre = 1 no.

3.3 Infrastructure under Fisheries Department

- Fish Farm: 11 nos
- Fish seed farm: 5 nos.
- Fish feed mill: 3 nos.

3.4 Government schemes under operation in Meghalaya in Agriculture and allied sector

a) Department of Agriculture/ Horticulture

- National Food Security Mission (NFSM)
- National Food Security Mission (NFSM)
- RKVY (Flagship Scheme)
- NMSA - Rainfed Area Development (RAD)
- Soil Health Card Scheme
- Soil Health Management
- ATMA(Submission on Agriculture Extension)
- National e- Governance Plan for Agriculture (NeGP-A)
- Mission on Seeds and Planting Material (SMSP)
- Mission on Agricultural Mechanization (SMAM)
- Agriculture Census(Central Sector)
- Mission for Integrated Development of Horticulture

b) Department of Veterinary and Animal Husbandry

- Dairy Farming -50% Subsidy
- Poultry Farming (50% Subsidy)
- Goatary Unit (50% Subsidy)
- Piggery Farming (50% Subsidy)
- Subsidy Schemes for Special Livestock Breeding Programmes
- Subsidy of feed for Livestock and Poultry farmers of cooperative/ individual - Poultry Layer
- Assistant to Self Help Group / Co-operative Society on Poultry Farming
- Assistant to Self Help Group / Co-operative Society on Piggery Farming

c) Department of Fisheries

- Area and Productivity Expansion- Construction of Community Water Bodies
- Area and Productivity Expansion- Construction of Individual Fish Pond
- One time financial assistance of Rs. 5.00 lakhs for establishment of Fish Sanctuaries through community participation

4. Productivity Gaps and Major constraints

Analysis of productivity gap of major crops reveals that the gap between average productivity in farmers' field and Front Line Demonstration varies from 24-205 %. The data presented in the following figure reveals that the maximum yield gap of 205 % is recorded in spices followed by pulses (142 %) and lowest is recorded in fruits (24 %).

It has been observed that the percent share of agriculture in GDP has been decreasing over the years in Meghalaya. The share in GDP has been decreased from 20.15% in 2007-08 to 15.54 % during 2014-15. This is very alarming situation for a state like Meghalaya where in more than 80 % of its population depends on Agriculture.

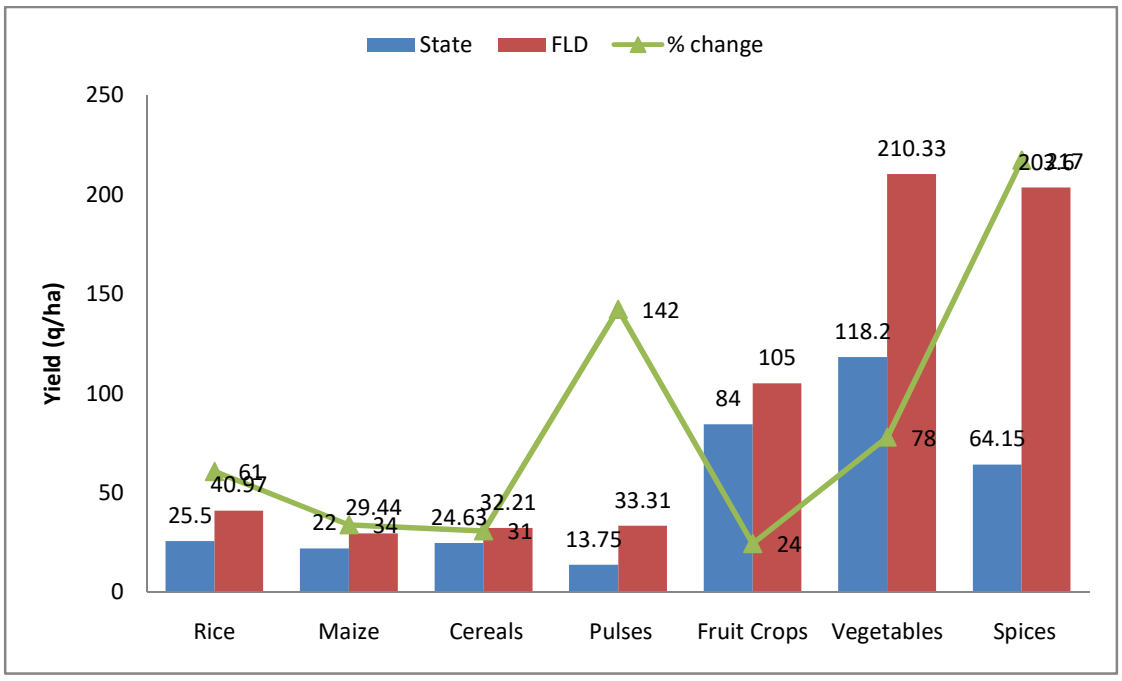

Fig 7: Comparison of average yield of state with yield in FLD

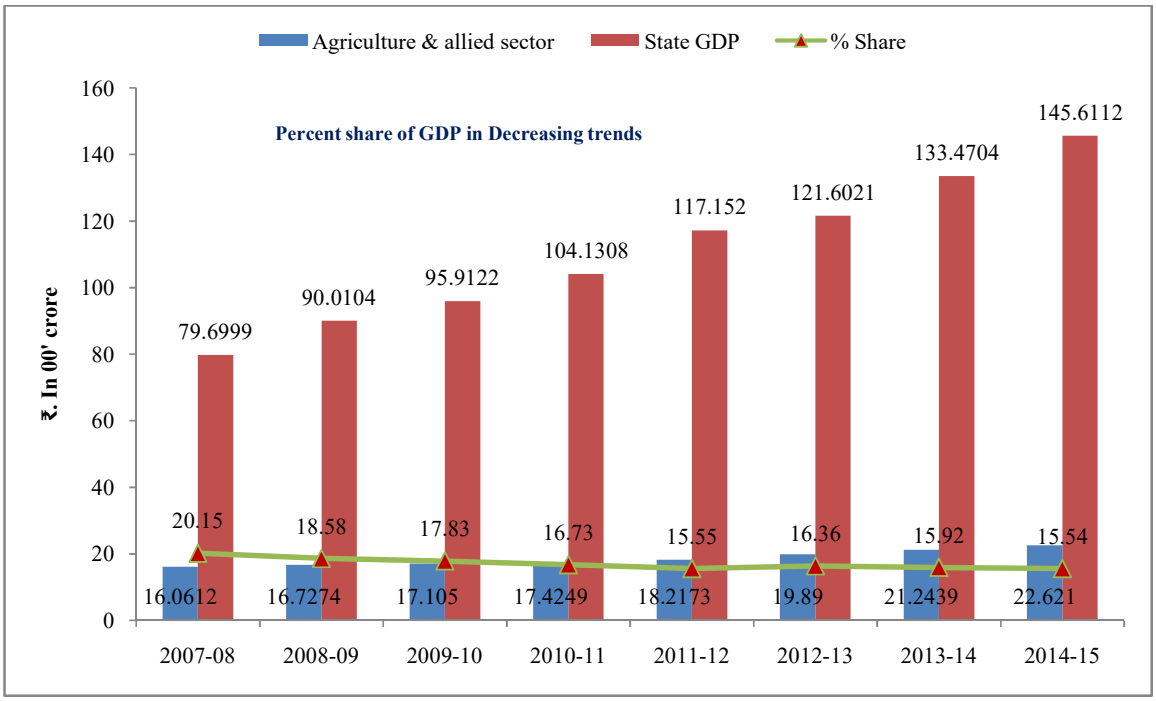

Fig 8: Trends of Share to State GDP from Agriculture & allied sector

Major Constraints/ gaps are grouped in four sub-heads to understand the situation in a more elaborate way. The following are some of the constraints/ gaps identified by various stakeholders meeting.

TECHNOLOGICAL GAPS

- Unscientific & Traditional method of crop cultivation
- Minimal use of improved cultivars/HYV/hybrids
- Poor soil management practices
- Traditional rearing of livestock & animal breeds
- Poor utilization of available resources

KNOWLEDGE GAPS

- Poor knowledge of pest and disease management
- Poor post harvest management of farm produce
- Inadequate knowledge about processing and value addition of farm produce
- Inadequate Knowledge of proper housing and management of livestock, breeds
- Lack of Knowledge on improved bee keeping techniques

SKILL GAPS

- Poor skill of scientific Mushroom production
- Poor skill of scientific Beekeeping
- Poor skill of Knitting & Tailoring/ handicraft

- Poor skill on Value addition

INPUT/RESOURCE GAPS

- Inadequate availability of quality seeds/ planting materials/ breeds of livestock
- Rainfed agriculture & Water scarcity during winter months
- Marketing through middleman, High Cost of inputs, Non - availability of critical inputs at village, Non- Profitable price from the produce, Absence of Group/organised Marketing

5. Potential for Development of Horticulture, Livestock, Fisheries, Agroforestry and Post-Harvest Processing etc.

Meghalaya is basically an agricultural state and about 80 per cent of its population depends entirely on agriculture for their livelihood. The hilly terrain and land conditions of the state do not offer much scope in bringing additional area under wet cultivation, but the state has vast potential for developing horticulture. The agro-climatic variations within the state offers much scope for cultivation of temperate as well as tropical fruits & vegetables. The state is known for its horticultural fruits like orange (Khasi Mandarin variety - gets the name from the place of origin), lemon, pineapple, guava, banana, jack fruit, arecanut, betelvine and temperate fruits such as plum, pear, peach etc. potato, ginger, turmeric, cauliflower, cabbage, radish, carrot are the important vegetables grown in the state.

Agro climatic condition of Garo hills (Mild tropical Hill zone & Mild tropical plain zone) in Meghalaya is conducive to produce a wide range of vegetable crops and these vegetable crops qualify for off season vegetables. Production belts happen to be close to the consumption market as well as exit points/ distribution transit points. More than half of the horticulture produce is contributed by vegetable production, but the productivity of vegetable crops is half of the national average productivity and even less than the NER vegetable productivity, however, paradoxically cole crops recorded the highest productivity. A substantial quantity of vegetable finds its way to Bangladesh through unofficial channels. Over a period of time, due to the climate and its strategic location, Meghalaya has emerged as an off season vegetable production hub, not only for NER, but also for the neighbouring countries of Bangladesh along with the distant Kolkata market. However, during discussions with stakeholders, it has emerged that climatic changes have started making a detrimental impact on the seasonality and productivity which can lead to its losing the competitive advantage of off season vegetables. Lack of post-harvest infrastructure, specifically modern vegetable packing houses is a major impediment in maintaining the comparative advantage in the changing market scenario.

Table 6: Horticulture crops having commercial importance in national and international market

Group	Crops	Market
Fruits	*Khasi* mandarin, Pineapple, Banana, Guava, Litchi, Papaya, Plum, pear, Peach, Strawberry *etc*	Indonesia, Bangaladesh, Phillipines, Vietnam, Laos, Middle East *etc* besides metro cities in India
Vegetables	Spine gourd, Bitter gourd, Ash Gourd, Chow chow, Cabbage, Cauliflower, Beans, Tomato, Potato, Colocasia, Casava, leafy vegetables, cucumber, pumpkin, melons *etc*	Indonesia, Bangaladesh, Phillipines, Vietnam, Laos, China, Middle East *etc* besides metro cities in India
Spices	Ginger, Chilli, Turmeric, Black pepper, *etc*	European market & metro cities in India
Flowers& other ornamentals	Orchids, Anthurium, Rose, Lillium, Tube rose, Ferns, Gerbera and Heliconia *etc*	European market besides local market
Medicinal & Aromatic plants	Tulsi, Bay leaf, Pudina, Coriander *etc*	Patanjali, Dabor and such other industries

The state has lot of prospects in agro-forestry and post harvest processing of horticultural crops as the state is surplus in fruits and vegetable production. Likewise, Livestock and fisheries have lot of potentials in the state as more than 95 % of total population is non-vegetarian. The table indicates that the state is deficit in fish (65.09%), egg (80.88&) and milk (48.09%) production besides cereals and pulses.

Table 7: Production and requirement of food items in Meghalaya

Crops	Production ('000 tonnes)	Requirement ('000 tonnes)	Surplus/ Deficit	Surplus/ Deficit (%)
Cereals	323.53	433.17	-109.64	-33.89
Pulses	10.98	23.74	-12.76	-53.75
Oilseeds	14.43	32.49	-18.06	-25.16
Fruits	348.00	108.29	239.71	68.88
Vegetables	515.34	324.87	190.47	36.96
Fish	5.40	15.47	-10.07	-65.09
Meat	38.0	32.49	5.51	16.96
Milk	77.0	148.34	-71.34	-48.09
Egg(lakh nos)	1021	5340	-4319	-80.88

ICMR RDA 2010: Per capita consumption: Milk-50kg/yr ; meat:10.95kg/yr; egg:180nos/yr; pulses:8kg/yr; rice; 73kg/yr; vegetables:300g/day; oils:30g; fruits:100g; Rice:73kg; cereals: 400g/day; Fish:100g/week.

6. Role of Technology

Technology plays an important role in enhancing the productivity of any sector and agriculture is no exception to that. The following table reveals that during last 10 years there has not been any increase in area in both rice and vegetables. Perhaps, this is a clear indication of the role of technology in enhancing the production and productivity of these two crops.

Table 8: Trends of Area and Production of crops in Meghalaya during 2003-14

	Area (ha)		Production (MT)		Yield (kg/ha)	
Crops	**2003-04**	**2013-14**	**2003-04**	**2013-14**	**2003-04**	**2013-14**
Rice	111550	110033	208277	280546	1737	2550
Maize	16875	18025	24424	39655	1422	2200
Cereals	131939	131334	236171	323528	1679	2463
Pulses	3426	7988	2672	10981	765	1375
Oilseeds	135365	139322	6655	14425	695	1054
Fruit Crops	25929	30929	208803	261094	8053	8442
Vegetables	44000	43600	416000	515340	9455	11820
Spices	10904	12217	64117	78376	5880	6415
Tuber crops	26236	28227	204141	229404	5545	6459
Cash Crops	809	885	694	1045	1691	1962

6.1 Strategy and action plan for enhancing production, cost reduction, quality improvement, generating additional income.

Strategy I: Area expansion and productivity enhancement of crops, Livestock & fisheries.

Action points:

- Popularization of new varieties/ breeds of fish and livestock for commercial cultivation with INM and IPM approach.
- Bringing more area under double/ triple cropping in paddy/ maize fallow in cluster approach linked with PMGBY and PMKSY
- Integrated Farming System in cluster approach
- Organic crop production & certification of selected crops like ginger, turmeric, Pineapple, Orange, beans, cole crops etc including input production in cluster mode
- Promotion of protected cultivation of high value crops and medicinal and aromatic plants in cluster mode linked with e NAM.
- Establishment of nurseries/ pig breeding units/ fish & poultry hatchery involving youth
- Construction of check dams, irrigation channels, micro water harvesting structures (Jalkund), sprinkler and drip irrigation etc

- Group farming by SHGs/ FPOs/ Co-operatives for promotion of double/triple cropping

Strategy II: Reduction of Cost of Cultivation

Action points:

- Mechanization with small farm implements through custom hiring approach.
- Mission mode production of enriched FYM, vermicompost and bio-fertilizers/pesticides.
- Promotion of mulching (bio or degradable plastic) in crops.
- Promotion of Drip/ Sprinkler irrigation in crops.
- Introduction of Zero/ Minimum tillage for double/ triple cropping.

Strategy III: Reducing Post Harvest loss and enhancing marketability

Action points:

- Awareness for harvesting of crops at appropriate maturity based on use.
- Establishment of pack house and cold storage facilities in production belt.
- Establishment of cluster based common processing / storage facility with branding.
- Establishing FPOs for direct marketing through contract farming.
- Establishment of primary and secondary market in district/ block level linked with e NAM in a phased manner.
- Linking growers with business house like Patanjali, Dabor etc at national/ international level.

Strategy IV: Off Farm Income and Enhancing Knowledge & Skills

Action points:

- Skill development in machinery repairing, handicraft, Knitting & embroidery, bee keeping, Retail marketing of field produces, container gardening, organic input seed production including seeds and planting materials.
- Promotion of small scale enterprises like pickle making, jam/jelly making, spice processing & packaging, mushroom production, homemade value added products (candy, slices, papad, potato & tapioca chips, biscuits), Waste utilization etc
- Capacity development programme for School drop outs/ educated youth/ SHGs for commercial farming, IIFS and value addition etc.

Strategy V: Enabling Policies for Doubling Farmers Income

Action points:

- Introduction of agriculture as one of the subjects in school education
- Designing programmes for popularization of Integrated farming system
- Community based approach for mode of production and process of production
- Assured institutional support to small and marginal farmers with minimum interest.
- Implementable policies for controlling wild animal/ free grazing in agricultural areas.

□ Legislation for appropriate convergence among Departments relating to Agriculture

6.2 Potential contribution to farmers income and strategy for scaling out these technology

The above mentioned strategies and action need to be implemented in a more planed and systematic way by bringing more area under cultivation in different crops and focused programmes for livestock and fishery development.

(i).Technologies identified for doubling farmers' income in Meghalaya

Table 9: Technologies identified for doubling farmers' income in Meghalaya

Sl No.	Details of Technologies	Net Returns (Rs/ha/unit/yr)	B:C ratio
1.	***Rice- fish farming system*** Digging canals or trenches in side of paddy field at 0.5 - 0.6 m deep and 1 m wide. After two weeks of transplantation, fingerlings of common carp (main species), catla, rohu, mrigal, silver carp, grass carp, gonius are stocked @ 5000-8000 nos/ha of paddy area.	Rs. 70315	1.90
2.	***Oyster Mushroom production*** Straw is cut into pieces of 5cm long. Straw is boiled for 30 minutes in a sauce pan A polythene bag of 40cm×60 cm size used & 10 cm straw in the bottom 6 cm in height.25 g of spawn is sprinkled over the straw putting more towards the side, punctured to make a hole. Oyster mushrooms (*Pleurotus sajorcaju./ Pleuotus florida)*	Rs. 14500	2.9
3.	***Ginger + soybean intercropping system*** Intercropping ginger with soybean under rainfed terraces or slope up 50%	Ginger-208q/ha, soybean-15 q/ha NR: Ginger: Rs. 24500 + soybean: Rs. 90000 Total: Rs.335000	2.64
4.	***Fish- pig Integrated Farming System*** • **Pigs**: Crossbred pigs (Large black and khasi local) @ 30 piglets/hectare • **Fish species:** Catla, rohu, mrigal, silver carp, grass carp, common carp, gonius • **Stocking density of fish**: 10,000 nos/ha • **Species ratio**: 30-40 % surface feeder, 15-20 % column feeder, 40-50 % bottom feeder and	Rs. 35320	2.20

	5-15 % macro vegetation feeder depending upon the depth and productivity status of the pond and can even vary with the altitudes.		
5.	***Low cost protected cultivation of vegetables and flowers*** Low cost polyhouse of size 20x5 m, top with UV stabilized film of 200µ (800 gauge) and 75% shade net on the side walls. (a). Vegetables: capsicum (Royalwonder), tomato (Megha Tomato-3) brinjal (Chaya), bittergourd (Avishek), cabbage(wonderball) (b). Tissue cultured plug gerbera plants (4-5 leaves) were planted (var. **Fanna** , **Deep purple** , **Shania** , **68385, Jaffna, Wall street, Venice, Lion, Daphane)** with a spacing of 30 x 30 cm.	Rs. 1, 83,800 Rs. 268700	2.48 3.5
6.	***Low cost water harvesting technology*** Jalkund (4x5x 2 Cu.m) of capacity 40,000 litres 0.34 ha/Jalkund for vegetable cultivation (Cabbage: H – 139, Cauliflower: White Contessa Tomato: Megha Tomato 3, Broccoli: Green Magic, Coriander etc)	Rs. 89,700	2.9
7.	***Beekeeping for income generation*** *Apis cerena indica* (Indian bee). Bee box size: 100cm length, 45 cm width and 25 cm height, thickness of wooden wall 2cm.	Rs. 19500	2.1
8.	***Backyard poultry farming with Vanaraja /kuroiler birds*** Twenty (20/unit) Vanaraja birds (4-6weeks old, body wt ranges from 600 to 875g). Fed on household food waste, fallen grains, insects, green grass, broken rice, etc Twenty (20/unit) Kroiler birds (4-6weeks old, body wt ranges from 535g to 875g). Fed on household food waste, fallen grains, insects, green grass, broken rice, etc	Vanaraja: Rs. 35450 Kroiler: Rs. 25000	4.2 2.89
9.	***Deep litter system of housing in pig with improved breed*** Deep litter house size of the shed is 8 feet in breath, 14 feet in length of which 7 feet is the closed area and 7 feet the open area. The flooring is covered with saw dust having the thickness of 2ft in closed and 1ft in open area.	**Improved pig:** Body wt:72.66 kg/9month Litter size: 9-11nos Mortality: 8%, NR:57350	2.75 1.58

		Local pig: Body wt:42.5 kg/9month Litter size (local): 5-7nos Mortality:12% NR: Rs.29700	
10.	***Paddy(RCM 10) –pea (Arkel/Praksh) cropping system***	Rs. 20580	1.90
11.	***Maize +French bean intercropping system*** Maize (RCM 75/local) + Frenchbean (Anupam): 1:2 ratio	Rs. 81700	2.19
12.	***Double row planting of Pineapple using mulching with black polythene*** Double row spacing of 90x60x30 cm across the slope to accommodate plant population of 44500/ha and black polythene with thickness of 50µ	Productivity 750q/ha as compared to 400 q/ha in control **Gross return**: Rs. 5.75 lakhs/ ha **Cost of Cultivation**: Rs. 1.85 lakhs/ ha	3.11
13.	***Vermicomposting for income generation*** Weed Biomass (30%) + Kitchen waste (30%)+ Agricultural Waste(40%) in 3x2.5x1.5 Cu.m size unit	Rs. 26,614	2.38
14.	***Value addition in fruits and vegetables*** Value addition to jackfruit (Pickle/ papad) Ginger candy/ slices Chow chow tuiti fruiti	-	2.10-3.30
15.	***Seed and planting materials production***- paddy (RCM 10), pea (Praksh), French bean(Anupam), turmeric (Megha turmeric 1), ginger	Rs. 30000-200000	

(ii).Agro-climatic Zone wise Technologies Identified for Doubling Farmers Income

Table 10: Agro-climatic Zone wise Technologies Identified for Doubling Farmers Income

Sl No.	Technology	Agro-climatic Zone
1	Agri-horti-fish-pig IIFS	Sub tropical plain zone, Mild tropical plain zone and mild tropical hill zone
2	Paddy (RCM 10/ Gomati)– pea (Arkel/Praksh) cropping system	Sub tropical plain zone and Mild tropical plain zone
3	Maize (RCM 76/DA-61A)+ French bean	Subtropical hill zone and Mild tropical

	(Anupam) (1:2) cropping system	hill zone
4	Low cost protected cultivation of vegetables and flowers	All zones
5	Ginger + soybean (JS-335) intercropping system	Subtropical hill zone and Mild tropical hill zone
6	Double row planting of Pineapple using mulching with black polythene	Sub-tropical hill and Mild tropical hill
7	Oyster Mushroom production	All zones except Sub-Alpine & sub-temperate
8	Low cost water harvesting structure (Jalkund)	All zones
9	Raised and Sunken Beds	Sub-tropical plain zone and Mild tropical plain zone
10	Rice- fish farming system	Subtropical hill zone, Sub tropical plain zone and Mild tropical plain zone
11	Backyard poultry farming with Vanaraja /kroiler birds	All zones except Sub-Alpine & sub-temperate
12	Low cost improved pig production with Deep litter housing system	All zones except Sub-Alpine & sub-temperate
13	Vermicomposting for income generation	All zones
14	Beekeeping for income generation	All zones except Sub-Alpine & sub-temperate
15	Ginger candy/slices, turmeric powder, chow chow tuti fruiti, pickles for better income	Sub-tropical hill and Mild tropical hill
16	Seed and planting materials production-paddy (RCM 10/ Gomati), turmeric (Megha turmeric 1), ginger (Nadia), tomato (Megha tomato 3)	All zones except Sub-Alpine & sub-temperate

Besides these technologies, there are some other technologies which have been adopted by the farmers may also be promoted in cropping system mode to popularize double/ triple cropping in paddy/ maize fallows. The details of which are presented in the following tables.

Table 11: Areas to be expanded in different crops (2017-22)

Crops	**Existing Area (ha)**	**Area to be expanded/yr**	**Total area to be expanded by in 5 years**
Cereals	131334	3940	19133
Pulses	7988	400	2000
Oilseeds	13680	410	2052
Fruit Crops	30929	1550	7750
Vegetables	43600	2180	10900

Spices	12217	1200	6000
Tuber crops	28227	611	3054
Plantation crops	18472	350	1750
Cash crops (Sugarcane & Tobacco)	885	18	90
Total area	**309953**	**8965**	**55724**

Table 12: Detail of year wise expansion of area under different crops

Crop	**Technology**	**Additional area to be expanded (ha)**				
		2017-18	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Paddy- pea	Paddy (var. RCM 10/Meg-2)- pea (var. Vikash) cropping system + INM +IPM	17	22	22	22	22
Paddy-Carrot	Paddy (var. Meg-2)- Carrot(var -new Koroda) cropping system + INM+IPM	5	10	10	10	10
Paddy-Blackgram	Promotion of Paddy (var. RCM-10)-Blackgram (var. TMK) cropping system + INM	20	20	20	20	20
Paddy-Broccoli/ Cabbage	Promoting crop rotation Paddy (var. RCM 10) - Broccolli/Cabbage (var. Aishywarya/Mahyco 139) cropping system + INM	2	2	2	2	2
Paddy-Potato	Promoting crop rotation Paddy (var. RCM 10)- Potato (var. Kufri Jyoti) cropping system + INM	5	5	5	5	5
Groundnut-vegetables	Popularization of HYV of groundnut (Var. ICGS 76)	5	5	5	5	5
Maize + french Bean/green gram	Maize (RCM 1-3/ RCM 76) + French Bean/greengram (Var- Anupam,S-9, Meha) intercropping System	10	12	13	13	13
Maize-winter vegetables	Cropping intensification through popularization of Maize (var. RCM-76) – Winter vegetables	10	10	10	10	10
Maize intercrop with	Promoting of intercropping of Maize(local) and Soyabean (var JS 335)	5	5	5	5	5

soyabean – French bean+ Lime	-French bean (var. Local pole) using stalk of maize as support + INM					
Maize – toria/ black gram + Lime	Popularization of HYV of Maize (RCM 76/ DA-61A) -Toria var. TS-67 cropping system	5	5	5	5	5
Broccoli-Tomato	Introduction of hybrid variety + INM	5	5	5	5	5
Ginger/ Turmeric - French bean	Ginger (Nadia)/Turmeric (MT 1) – French bean (Sel-9) cropping system	5	5	5	5	5
Okra-Frenchbean /broccoli	Popularization of Okra var. Arka Anamika –frenchbean/broccoli	8	8	8	8	8
Ginger/ Turmeric + Soyabean	Promoting of intercropping of Ginger (Nadia)/ Turmeric (Lakadong) with Soyabean (var JS 335)+INM	5	5	5	5	5
Vegetable Nursery	Community nursery (100 m^2& 200 m^2) for winter vegetables	8	8	8	8	8
Bitter brinjal-cabbage+frenchbean-cabbage	Promoting vegetable based cropping system Bitter brinjal-cabbage intercropped with french bean followed by brocolli intercropped with pea	1	1	1	1	1
Pineapple	Promoting Pineapple cultivation	1	1	1	1	1
Blackgram - Tomato	Introduction of blackgram (var. TMK) followed by tomato (var. Megha Tomato 3) in Pre- rabi and rabi season 5 x 4 x 1.5 $m^{3)}$	5	5	5	5	5
Nursery Raising & Homestead Gardening	Introduction and Popularization of vegetable crops and Nursery Raising in Pro trays	19	10	10	10	10
Tea	Package of Practices of tea	1	1	1	1	1
Fodder	Popularization of QP Maize Variety, Napier Hybrid	1	1	1	1	1
Protected cultivation	Protected cultivation for round the year vegetable production (unit size:100 ^{m2} & 200 m^2)	15	15	15	15	15
Peach	Introduction of Peach- Pratap,	0	0.2	0.4	0.4	0.4

	Flordasun					
Low cost micro-water harvesting structure	Construction of water harvesting structures like pond, jalkunds(5 x 4 x 1.5 m^3 or 5x4x2cum) for provision of irrigation in winter crops	25	25	25	25	25

7. Technology interventions: Major Success stories

(i). Doubling Farmers Income by Protected Cultivation of Vegetables

Introduction

The productivity of vegetables in Ri-Bhoi district of Meghalaya is very low due to diverse climatic condition viz., high rainfall during rainy season, moisture stress, frost during winter season, poor soil nutrient due to losses resulted by the process of leaching, toxicity of heavy metal ions like iron and aluminium inflicts maximum losses to the crops. The protective cultivation is the best alternative for regulating the above factors as per requirement of the crops in order to realize the maximum potential of the crops. It also helps in raising good quality nursery of crops and also protect the crops from extreme and unseasonal weather conditions.

Details of Technology

Keeping the above situation in view, KVK Ri Bhoi introduced low cost polyhouse technology using locally available raw materials like bamboo for off season production of vegetables in Kyrdem village under TSP programme through FLD programme. Hands on training and demonstration were conducted for cultivation of vegetables like tomato, capsicum, brinjal, cabbage, bitter gourd etc. By spending Rs. 15000, low cost polyhouse of 100 m^2 size was constructed. The literature and technical support in terms of consultancy, advisories, training, exposure visits to ICAR KVKs Instructional Farm, farmer and scientist interactions, field days were organized to showcase the technologies to the neighbouring farmers and villagers for large scale adoption.

Output & Outcome

The result showed that the vegetable production in protected condition round the year was increased by 138 per cent as compared to normal cultivation. Similarly the net return was almost double/ triples in most of the vegetables compared to outside cultivation.

Table 13: Vegetable production round the year

Crops	**Variety**	Net return inside polyhouse (Rs/unit/yr)	Net return outside (Rs/unit/yr)	B:C ratio (Polyhouse)	B:C ratio (Outside)
Tomato	Rocky	21000	10600	1.88	1.44

Brinjal	Chhaya	18000	15000	1.67	1.56
Bitter gourd	Abhishek	16500	4500	1.55	1.15
Capsicum	Royalwonder	21700	3700	1.85	1.44
Lettuce	Grand Rapids	1000	475	3.00	1.95
Broccoli	Pushpa	16500	9450	1.89	1.51
Cucumber	Malini	5000	2450	1.31	1.15

Impact

The farmers are very happy with the technology as their crops are protected especially during the nursery stage. The off season vegetables provide good prices to the farmer. The technology has now spread in 3 neighboring villages covering 19.5 ha benefiting 84 farmers of the villages. Demonstration was also done on three lowcost poly houses (0.01 ha each) with vegetable in 1 village.Horizontal spread to 7 SHGs of 66 members in 3 villages.

Photograph 1: Protected Cultivation of Vegetables in Ri-Bhoi district of Meghalaya

(ii). Intercropping of Ginger with Soyabean increases Farmers Income in North-Eastern Hill Region

Introduction

More than 70% of the total population is living in rural areas in North-Eastern Hill Region and most of them have been cultivating crops in jhum field resulting in heavy soil erosion. Ginger is one of the main cash crops where almost every farmer cultivates in their field. Ginger cultivation in jhum land leads to very heavy losses of top fertile soils not only in the current year but also in the next harvesting year.

Details of Technology

Intercropping ginger with soybean under Rainfed terraces upto slope 50%.The recommended dose of NPK along with neem cake was applied. The Technology makes the cultivation more profitable by intercropping soybean with ginger in same plot of land. More over the cultivation is carried out in the terrace land where there is very less erosion of top fertile soils. Mulching is done on the terrace with saw dust/ cut grass; this reduces the weed growth before the soybean grows. When the soybean grows up it acts as a shade as well as the mulch materials for ginger. Soybean being a Nitrogen fixing crop provides Nitrogen, thereby making mutual benefit to each other.

Output & Outcome

Great enthusiasm was aroused amongst the Farmers of different villages after witnessing the results of demonstration. The income of the farmers increased 3 fold after adopting the technology due to decrease in disease and pest intensity, decrease in depletion of soil and nutrient, reduction in weed infestation and increase water holding capacity of soil. This has finally resulted into the higher benefit cost ratio owing to fewer requirements of total man days.

Photograph 2: Intercropping of Ginger with Soyabean

Table 14: Output and outcome of intercropping ginger with soyabean

Technology	Yield q/ ha	Net Return(Rs./ha)	B:C ratio
Intercropping of ginger with soybean under rainfed terrace cultivation	Ginger – 208 Soybean –15	Ginger 2,45,000/+ Soybean 90,000 **Total = 3,35,000.00**	2.64

Impact

More farmers are adopting the technology and the famers who adopted the technology increased their cultivation area. Farmer having terrace land shifted their cropping pattern and changed their crops to ginger cultivation intercropped with soybean.

(iii). Intercropping of Ginger with Soyabean increases Farmers Income in North-Eastern Hill Region

Rice-Fish culture: A new dimension of Farming in Meghalaya

In recent years, many farmers shows keen interest in fish culture and hence, construction of ponds came up in many feasible areas but sadly, there are also many farmers who convert their productive paddy fields into fish ponds since most of them have no choice as they are small land holders. Even though many farmers take up fish culture, yet there is no encouraging results in terms of productivity and profitability due to poor management, lack of technical knowhow and also because they cannot afford to buy fish feed (rice/ wheat bran and mustard oil cake). Integrated Farming Systems hold special position as in this system nothing is wasted, which can also help poor small farmers who have very small land holding to diversify farm production, reduce input cost and exploitation of unutilized resources.

Details of technology

Paddy field was modified by digging canals or trenches of 0.5 - 0.6 m deep and 1 m wide connecting (intersect) to the small central sump in the middle of the field. The dykes had been elevated and installed with inlet and outlet protected with fine screening. Fencing with netting material was also done at the lower part of the field to prevent fish from escaping during heavy rains. Local rice variety (ba lwai) was transplanted when the field is ready. After two weeks of transplantation, fingerlings of Common carp (main species), silver carp, gonius, etc were stocked @ 6000 nos. per hectare of paddy area. Minimal feed were given with rice bran and mustard oil cake in the ratio of 1:1. Liming and manuring were also done regularly.

Output & Outcome

Before intervention, the yield of paddy was about 15 q/ha but after intervention, the yield of paddy enhanced to 20 q/ha and what is more interesting, she also got fish from the same plot. The yield of fish from the paddy field was 500 kg/ha. According to her, this technology is very simple and low cost with high economic return. The increase in rice production is also a result of stocking fish (common carp as the main species) as a component of integrated pest management. Due to the integration of fish in the field, use of pesticides is completely stopped. But there are also difficulties because many paddy fields are not feasible

for fish integration due to the hilly terrain that restricts the size of the field. 1 ha of paddy field having different form and size of trenches (Average: 0.5 m deep and 1 m wide) with common carp as the main species gave a net profit of Rs 70,315.

Impact

The technology is gaining acceptance not only in Nonglwai village but also in other villages because of the simplicity of the technology and improved production. Now rice-fish culture in the district is a regular cropping practice in many of the villages in the district.

Photograph 3: Rice-Fish Culture

(iv). Oyster Mushroom Cultivation enhances farm income in Meghalaya

Introduction

Mushrooms play an important role in the rural livelihood as different species of wild mushrooms are available in deep jungles of West Khasi Hills. Farm women collect seasonal mushrooms grown wild in the jungle during lean period for family nutrition and also earn extra family income. The availability of these wild mushrooms is limited only for few months in a year which is not sustainable. With recent incidents of wild mushroom poisoning in different parts of Meghalaya, collection and consumption of wild grown mushroom is at stake for farming community. In order to promote the cultivable species of mushroom which is safe and rich in nutrition, Krishi Vigyan Kendra, West Khasi Hills has identified oyster mushroom cultivation as a thrust area.

Details of technology

The low cost mushroom house (8mx3m) was constructed using locally available raw materials. The straw was in small pieces (2-5cm) and soaked the in clean water overnight. The water was drained and boiled for half an hour which were then stored in poly bags with a capacity of 5 kg , filling up the poly bag with 3 kg boiled straw in 5 layers putting 100g spawn/bag and making holes and tied properly. It is kept for 15 days in dark room for spawn run. The bags were then Shifted from dark room to ventilated room when the bags become fully white. The plastics and tied portion were removed and the blocks were being hanged. Water is being sprayed twice a day, and after 15 days the mushroom is ready for harvesting.

Output & Outcome

At the onset of the adoption of the technology, Smt. Billinda Syiemlieh invested Rs. 9400/- for one unit of mushroom cultivation which included 50 mushroom beds. The total cropping period was 45 days approximately, where 90 kg of fresh mushrooms were harvested. The gross return was Rs 13500/- and the net return was Rs 4100/-. The benefit cost ratio was calculated to be 1.43. From second year onwards, she expanded her cultivation area by building two more low cost cropping houses. KVK West Khasi Hills has taught her low cost spawn multiplication technique. She has started multiplying mushroom spawn in her own multiplication unit. Now, she is the most successful mushroom grower in West Khasi Hills district, Meghalaya. Smt. Billinda Syiemlieh is now a role model for other farmers as she has come out successfully in adopting the technology. Many farmers got exposure for adoption of the technology as she conveyed the message on importance of growing mushrooms from her own experience in trainings and programmes conducted by KVK, West Khasi Hills. Now the technology has spread to as many as 8 villages in West Khasi Hills covering 30 numbers of mushroom growers in the district.

Impact

Farm women admitted their productive utilization of leisure time which otherwise they spend by chitchatting with other folks in the evening. They also quoted that by working just two hours in the evening for two three days, they can harvest 8 to 10 times in a period of 45 to 50

Photograph 4: Oyster Mushroom Cultivation

(v). Double row planting of Pineapple using mulching with black polythene

Introduction

Pineapple (*Ananas comosus*) is one of the important fruit crops of North-Eastern Region. Pineapples are grown in hillocks with the slope of 30-40% as beyond that soil erosion is very high during rainy season and experienced moisture scarcity during winter. Prior to intervention of the technology, pineapple was cultivated at single row spacing of 1 meter square along the slope for the ease of weeding in an area of 5-6 hectare. In this system of planting the productivity of the crop is very low with higher level of soil erosion.

Details of technology

Double row spacing of 90x60x30 cm across the slope to accommodate plant population of 44500/ha and black polythene with thickness of 50µ

Output & Outcome

With the introduction of double row spacing, the area under pineapple had been increased to 520 ha with or without mulching. The use of black polythene mulching not only suppressed the weed growth but conserved the soil moisture, which leads to early flowering in mulch plot by 6-7 months i.e. flowering started after 9-10 months of planting in Jan-Feb where as in control the flowering was observed only after 15 months of planting in September. First year nearly 7.5-10% plants only flowered. Next season nearly 50% plants flowered. Soil moisture was conserved by polythene mulch which could produce the double size fruits. The average fruit weight was recorded 2.1 Kg/fruit under polyethylene mulch with an average productivity of 750 q/ ha compared to 1.2 kg/ fruit in control plot with average productivity of 400 q/ ha.

Impact

Pineapple cultivation with polythene mulch has been gladly accepted by the farmers as this technology has reduced the cost of weeding in subsequent years although the initial cost of cultivation i.e. laying of black polythene sheet and labour cost @Rs 1,85,000/ha was high. Now, the pineapple cultivation with black polythene mulch with double row spacing i.e. 90 x 60 x 30cm having plant population of 44500/ha is gaining popularity in many villages of North Eastern Hill Region

Photograph 5: Double row planting of Pineapple using mulching with black polythene

(vi). Deep Litter housing system of Pig

Introduction

With a small investment on building and equipment, proper feeding and sound disease control programme the farmer can profitably utilize their time and labour in this subsidiary occupation. The carcass return is quite high i.e. 60-80% of live body weight. Pig grows fast and is a prolific breeder, farrowing 10-12 piglets at a time. It is capable of producing two litters per year under optimal management condition. The suitable strategies to improve pig farming are introduction of improved breeds, proper housing and disease management that can help to withstand the climate and disease.

Details of technology

Two numbers of female piglets (Hampshire cross) of 2-3 months of age is in each unit. The floor space area of the pig house suggested was 3m2/pig. Deep litter system using saw dust with a depth of 1 foot was introduced.

Output and outcome:

Table 15: Output and outcome of deep litter housing system of pig

Name of the technology	No. of farmers	Yield	Gross cost (Rs/ha)	Gross income (Rs./ha)	Net income (Rs/ha)	B:C ratio
Deep Litter Housing System of Pig	3	Body weight gain: 148g/day/pig	10,026.00	17,049.60	7,023.60	1.70
Conventional method of pig rearing	3	Body weight gain- 110g/day/pig Mortality- 12.5%	9600	11,640	2040.00	1.21

The farmers earned the profit in an average of Rs. 7023.60 with BC ratio of 1.70 which impacted the horizontal spread to the neighboring tribal farmers. The average body weight of the pigs at 8 months of age was found to be 60 kg. Two nos. of female pigs farrowed 6-8 piglets. Selling of the piglets after the weaning age has given the farmers an opportunity to fetch good economic return. Farmers were very much happy with the demonstrated technology.

Impact

For the first year only three farmers adopted the technology but after seeing the better performance of pigs under the deep litter housing system 10 more farmers from Kyrdem and neighbouring villages have shown interest in adopting the technology in their field. Adoption of technology: 63% Horizontal spread to 6 nos. of villages to 8 SHGs in 92 members.

Benefits

Less stress during winter as the temperature is maintained. Increased growth rate, reduced mortality Used saw dust can be used as compost.

Photograph 6: Deep Litter housing system

(vii). Backyard Poultry Farming

Introduction

Backyard poultry farming is an inseparable part of a rural houshold in the North East region as it plays an important role for improving the economic status and fulfilling the protein requirement of the household. The climate change is affecting the crop production more and more and often pushing the farmer's economy at the verge of collpase. Hence livestock and poultry sectors can help overcome the losses from the crop production in such situation by generating additional income. Backyard poultry farming system requires less money and inputs for rearing of birds and also self sustaining among the rural poor farmers. Moreover, there is an escalating demand for local chicken in the district as well as in the state where consumers are not reluctant to pay higher price for high quality desi chicken meat. Although local chicken are desirable but they are poor performers in terms of meat and egg production. Almost every household rears 2-10 nos. of local chicken under backyard system. Therefore, there is an urgent need to improve the productivity of backyard poultry by introducing improved chicken of Vanaraja variety. The Vanaraja birds are hardy, relatively resistant to various poultry diseases, thrive well on locally available feed resources, good scavengers, they have attractive multicolour feather pattern like desi birds and long legs to escape from predators. A vanaraja bird lays eggs two times higher than a local chicken lays eggs. Therefore, vanaraja is a choice of bird under backyard system to augment the poultry production in the district.

Details of technology

Vanaraja dual purpose birds was used as the technology in backyard. All the selected farmers were provided with information on site selection, construction of low cost poultry house using locally available materials like bamboo, thatch grass, housing management, feeding management, disease management etc. through trainings before the start of the demonstration units. Timely vaccination, monitoring and record keeping have been

maintained. Suggestions and recommendations have been provided as per the farmers need. The farmers have shown keen interest in adopting these birds in their backyard poultry farming system.

Extent of adoption

Due to the high egg laying capacity, higher weight gain, colorful plumage like local birds the farmers have shown high acceptability. The farmers were highly motivated with the performance of the birds and the demand for Vanaraja birds is very high. The farmers have demanded for more trainings and deonstartion on Scientific backyard poultry. Thrity four more farmers have adopted the technology in and around the village.

Table 16: Output and outcome of Backyard Poultry Farming

Technology demonstrated	No. of farmers benefitted	Body weight gain/ egg production	Gross Cost	Gross Return	Net Return	BCR
Backyard poultry farming through Vanaraja birds (20 nos/ unit)	32	Body weight: 610 g/bird/month Egg production: 11 nos/bird/month	3420	9210	5790	2.69
Local (20 nos/ unit)	32	Body weight: 100g/bird/month Egg production: 6 nos/bird/month	1860	3420	1560	1.84

The average body weight gain in Vanaraja has been found to be 610 g/bird/month as compared to 100g/bird/month of local poultry. Even the egg production has been observed to be 11 nos/bird/ month whereas in case of local poultry it is found to be 6 nos. / bird/ month. One of the farmers Mrs. C. Shadap generated an income of Rs. 3840 by selling excess male birds @ Rs. 160/kg after retaining two males for breeding. He also sold 220 eggs @Rs. 8/egg. His total income was Rs. 5600 by selling meat and eggs. His success has motivated many other farmers for rearing Vanaraja birds in backyard poultry system. Horizontal spread to 74 beneficiaries in 7 villages.

Constraints

Local brooder hen is required as Vanaraja birds are not a good brooder. Another constraint is that the birds attain 2-3 kg weight at an early age hence farmer tend to rear the breed for meat purpose rather than for layer purpose causing depletion of the stock.

Photograph 7: Backyard Poultry Farming

8. Value Chain Development, Marketing Linkages and Trade Potential

The chain actors, who actually transact a particular product as it moves through the value chain, include input dealers (e.g., seed suppliers), farmers, traders, processors, transporters, wholesalers, retailers and final consumer. Marketing Infrastructure: rural households face significant difficulties in bringing their products to market, stemming from poor infrastructure at rural markets, and inadequate road connectivity.

Creating a Marketing Framework

Farmers need some support in marketing their products if they are to be induced to make the shift to cash crop production. Further, unless states coordinate their production and storage plans, excessive production can lead to a market crash, as recently observed in the case of ginger production in some of the north-eastern states. The large demand for food items created by the 'captive markets' of the region, such as the army and security forces, could be tapped in a systematic way.

Cluster-based Development

The short-run development approach will be cluster-based production system to realize greater economies of scale and specialization. For this, the cultivated area of the state can be divided into crop-wise clusters based on comparative advantages, with each cluster defined as a Crop Development and Marketing Unit (CDMU) which emphasizes the marketing aspects of the cluster. Collection centres will need to be set up near the clusters with storage appropriate

backup, which will have linkages with clusters in other regions to promote economic linkages with wholesale markets. Marketing intervention, especially for horticultural produce, with a full complement of post-harvest infrastructure and market network is fundamental. These CMDUs would be given appropriate managerial and financial flexibility for assisting producers to realise reasonable profits from their efforts.

Cold Chains

Establishment of a cold-chain along major arterial highways is critical if the region is to exploit its rich horticulture potential and market these products to the rest of the country. While constructing new cold storage care must be taken for maintenance of appropriate temperature and relative humidity (RH) inside the cold store as every commodity has different temperature and RH requirement. The operation of the cold chain could be based on a PPP model or on a lease basis with private entrepreneurs.

Transport Network

An efficient transport network allows farmers to expand their business horizon, resulting in specialization in production and trade. In the absence of such networks and markets, villages have to become self-sufficient, where each farmer is essentially forced to produce everything he requires, without being able to create marketable surplus. The value of surplus production can be realized in the context of trading opportunities.

The facilities mentioned below, if created shall go a long way in developing the much need value chain of various crops with market linkage. The trade potential of various horticultural crops has already been presented in table 4. Likewise, there are huge demands of meat products in other North Eastern states and ASEAN countries. The following action plans are proposed to improve the post harvest management and marketing scenario of Meghalaya in a phased manner.

- Awareness for harvesting of crops at appropriate maturity based on use.
- Crop incubation centre having all the facilities for bank loan, DPR preparation, custom hiring centre including repairing and maintenance, Advisory services etc.
- Establishment of pack house and cold storage facilities in production belt.
- Establishment of cluster based common processing / storage facility with branding.
- Establishing FPOs for direct marketing through contract farming.
- Establishment of primary and secondary market in district/ block level linked with e NAM in a phased manner.
- Linking growers with business house like Patanjali, Dabor etc at national/ international level.

9. Policy and Investment Requirements and Role of the Government

In order to double the farmers' income by 2022, the Government of Meghalaya needs to give top priority on the following.

- A stakeholder meeting for sharing the resources from the already launched schemes of GoI like RKVY, NFSM, MIDH, Pradhan Mantri Krishi Sinchai Yojana, Organic agriculture, Pradhan Mantri Fasal Bima Yojona etc, needs to be convened immediately.

This meeting should clearly identify the implementing agencies, preferably and separately for technocrats and development officers from the line departments.

- A separate cell is to be created to monitor the ongoing works right from soil quality assessment as well as to simultaneously analyze the other support needs like procurement, storage, post harvest infrastructure etc.
- Prepare proposal for additional funding support based on the inputs from technocrats and development department officers and others.
- Ensure timely delivery of inputs like seeds etc,
- Establish Custom Hiring Centres for Farm machineries
- Enlist the selected farmers in Fasal Bima Yojona and assist in KCC
- Attend to disease and pest attacks on priority
- Ensure procurement of the produce from farmers doorstep
- Arrange storage godown
- Facilitate marketing of the produce
- Create a data base for crops that is produced
- Create a market intelligence cell to advice the farmers what crop to grow and how much to grow to fetch better market price
- Gradually develop facilities for food grading, branding and packaging,
- Attend to any other area as might evolve from time to time.

10. Implementation Plan and Institutional Responsibilities

The Government of Meghalaya may come forward to prepare a detail roadmap year wise for implementing the action plan for doubling farmers' income by sharing the responsibilities proposed as under.

(i). Development Departments

- Ensure timely delivery of inputs like seeds, manures etc and irrigation
- Seed/ input certification agency
- Establish custom hiring centre for farm machineries
- Implementation Fasal Bima Yojona, soil health cards etc. and assist in KCC
- Ensure procurement of the produce from farmers doorstep and marketing
- Inventory of farmers with income from Agriculture/ allied sector

(ii). Government for appropriate policy

- Policy formulation and implementation for Cluster based production system including organic farming
- Formation of State Seed certification agency
- Policy for direct procurements of seeds and planting materials from farmers

Facilitate visible convergence among the stakeholders to promote integrated farming system

(iii). ICAR, SAUs and other R& D organization

- Awareness campaign and capacity building programme
- Provide technologies to stakeholders including breeders seeds based on indene

- Facilitate in devising implementable action plan for doubling farmers income
- Impact study of various development projects related to agriculture as and when required with appropriate funding by government departments.

11. Summary Recommendation

- Mission mode programme on integrated farming system and organic agriculture.
- Adoption of cluster based double/ triple cropping in paddy/ maize fallow linked with PMKSY, PMFBY and Farm Mechanization.
- Assured procurement with minimum support price to reduce the gap between farm gate price and consumer price.
- Focused programme on livestock and horticulture development with appropriate post harvest management &value addition and marketing infrastructure with a target for export to ASEANs and other countries utilizing e-NAM platform.
- Strengthening of R&D programme for organic production system.
- Skill development programme for entrepreneurship development