

Sustainable homestead gardens and resilience: Case study of Milandhoo island of Shaviyani atoll, The Maldives*

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Home gardens generally cover small areas near to home but have wider diversity of crop species which are crucial to brining resilience in vulnerable regions by reducing the risks. Apart from this, management of home gardens helps to increase food availability and better nutrition through food diversity, income and rural employment and environmental benefits of recycling water and wastes and provide shade and alter the microclimate around the house. In general home garden is defined as "a small scale, supplementary food production system by and for household members that mimics the natural, multi-layered ecosystem" (Hoogerbrugge and Fresco 1993).

Home gardening is one of the strategies for addressing malnutrition and micronutrient deficiencies. Studies of Reddy, (1995), Bloem *et al* (1998) and Talukder *et al* (2000) showed that though animal products provides required micronutrients, vegetables and fruits may be the only source of micronutrients that are reliably available to poor households. Home gardens have been reported to provide 18-40 percent of household calories on Java (Christanty 1981 and Stoler 1978, cited in Hoogerbrugge and Fresco 1993) and 50-58 percent of the recommended daily allowance for calories in the Philippines (Sommers 1978, cited in Christanty 1990). Apart from micronutrients, it provides protection against food insecurity especially among poor households. Kumar (1978) studied among poor households in Kerala, India and reported that poor households use home garden as a 'buffering effect' for household consumption when there is a shortfall in wage income. Soemarwoto (1985) oserved that home gardens in Java island provided economic stability for poor households especially during the period between two rice crop harvests. The study among Russian households have shown that among the poorest households home garden is vital part and serve as insurance against food insecurity (tho Seeth et al 1998: 1621).

Apart from nutritional and food security, it helps to improve the financial income of the households by marketing the produces and reduced the purchase of food like fruits and vegetables. A study by Marsh (1998) in Bangladesh had shown that the income value of home garden production increased from 14 percent of average monthly income to 25 percent after taking into account purchased fruits and vegetables. Miura (2003) study among urban households in Philippines indicated that families maintain home garden spend less on food compared to non-garden households. Vasey (1985) reported that in Papua New Guinea, urban households sell fruits from home garden in the local market and purchase rice. In addition the environmental benefits of home garden on nutrient and water recycling, soil conservation and increasing the soil flora and fauna by altering the local micro climate.

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Experiences from south Asian countries clearly show that eco agriculture approaches, agronomic, livelihood diversity and community networks were found to strengthen the capacity of the households to withstand and recover from disaster (Melissa Harvey, 2007).

In Maldives, home garden is one of the traditional agricultural systems, supplies around 30% of the food needs of the households. In Maldives, on average home gardens occupies 100 m² to 500 m² area adjacent to home. Apart from providing food and nutrition, it ensures ecological biodiversity and more numbers of economically important plant species provide income to the household. The major crops cultivated are vegetables like chillies, beans, eggplant, few greens, maize, cucumbers, water melon etc, tubers like tapioca, taro, spices, other trees like curry leaf, drumstick, coconut, arecanut, and a few fruit trees like banana, papaya, bread fruit, *Muntingia calabura* (*jeymu*), guava, mango etc. Survey studies indicate that a home garden has around ten to twelve different species with different varieties of the same. Home garden provides plant based vitamin, fibre and organic compounds from fruits and vegetables to supplement rice and fish based diet.

The major objective of the intervention is to understand the constraints on home gardening evolve and implement appropriate strategies to improve the resilience of homestead farming to disasters especially in island conditions considering its geographical positions, resources available and vulnerable situation. Global studies and experiences showed that the sustainable home gardens support the promotion of resilient Island communities. This paper elaborates the modest attempt in strengthening home garden for improved resilience implemented by the SEEDS ASIA, a civil society organization with the collaboration of National Disaster Management Centre, Male, United Nations International Strategy for Disaster Reduction (UNISDR), Atoll development authority in Shaviyani atoll Maldives. The paper is divided in to three parts, first part explain the current status of the home gardens and constraints, second part is how to strengthen the home gardens to improve its resilience capacity and the final part deals with the perspective of influencing the policy and institutionalizing the activity in the island development plan.

Study area and its characteristics

The Milandhoo Island is situated on the eastern rim of Shaviyani atoll an uninhabited island first populated during the year 1999 covering an area of 126.23 hectares. Shaviyani atoll is geographically located within the naturally occurring northern most atoll formation of Thiladhunmathi and it is around more than 700 kms from Male and can be reached only through boats. A homogenous group of around 400 households reside in the island with the total population of 1978. Primary occupation of the islanders especially men is construction work in the resort islands supported by fishing with traditional dhonis. Women play multiple roles such as attending all household chores, managing home gardens and mat weaving from coconut fronds to generate income.

According to the baseline study conducted in November 2007 (SEEDS Asia, 2007), the island has been identified as the second vulnerable island to natural disasters in the Shaviyani atoll.

Similar to other four islands in Shaviyani, the highest disaster risk in Milandhoo Island is sea level rise and coastal erosion. Such slow-onset disasters, by definition, give more time for community and government agencies to take necessary mitigation measure, but in reality, they are not given sufficient priorities in many cases compared to rapid on-set disasters (such as earthquake and tsunami), which requires immediate humanitarian intervention.

In collaboration with the National Disaster Management Center (NDMC) authorities and the Atoll Ministry, Shaviyani Atoll was selected for UN/ISDR – SEEDS Asia intervention activities on Disaster Risk Reduction. An effort was made to integrate Disaster Risk Reduction in to Environmental Management in order to build resilient communities in the project island, with three core objectives: a) to promote Environmental management, livelihood enhancement as part of Disaster risk reduction b) to promote adaptation activities to climate change through Disaster Management Planning and Disaster Reduction activities and c) to build local women and youth groups capacities towards self management.

Vulnerability: The island is prone to disaster due to its geographical isolation and its extreme openness to external shocks etc. Apart from geographical location the island is heavily dependent on Male for food items and the island lack storage mechanism that pose sever food security risk. The share of home gardens in household food supply is limited since it is being practiced without any awareness and knowledge on improve agronomic methods. In the island ‘at risk population’ like women, children and aged are staying back, majority of the men are working in far away resort islands as construction workers, which makes the situation more vulnerable.

Agro Ecosystem of the Island

Soil: The cultivated soils are derivatives from calcareous coral formations with a soil depth of 50-70 cm deep, the top soil (15-20 cm) is dark in color with high good percentage of organic matter and has slightly alkaline pH. The soil has low water and nutrient adsorption capacity due to lower percentage of silt and clay proportions and high infiltration capacity. The local community adopts the ‘settled low input home garden system’ which is rejuvenated with household waste, leaf litters and soil taken from regions where tree density is higher i.e rich in organic matter. The women locally express this as *‘if the plant growth is stunted in garden they apply soils taken from eastern part of their islands which is black in colour with less weight’*. Local women use soil colour as well as weight of the soil as indicators of good soil fertility.

Traditionally home garden is part of the local culture in Maldives, play a vital role in providing household vegetable and fruit needs; access to diversified nutritionally rich foods. Women play a critical role in managing the diverse species ranged from tubers, vegetables and fruits, legumes, herbs and spices to cater food needs of the family. On an average each household maintaining the garden in an area of around 20-40 M².

Methodology:

The study adopted the process mode and involved three steps which were

- I. Carrying out a detailed situational analysis and understand the different dimensions of the constraints in practicing the home gardens.
- II. Design and implement the program based on the FAO Resilience framework
- III. Discussion at the policy level and sharing the experiences

The methodology adopted in each of the step was

Step I: situational analysis

A detailed explorative visit to the village as well as 38 individual home gardens were carried out to understand the kind of species, techniques adopted for the cultivation, space available for the cultivation and to identify the criteria for situational analysis. The identified criteria's are number of years of habitation in the village (families settled more than five years back and families settled less than five years), socio economic status, space availability etc. Apart from that observation as well as personal discussions were held on cultivation methods like soil health management, composting methods, pest management, seed management etc. A questionnaire was designed and administered among 50 households (10% of the populations) to assess the situation and to know the potential for improvement.

Step II: FAO Resilience framework

While promoting home gardens the principles of FAO's Resilience Analytical Framework was followed to design in consultation of the community members

- ✓ Promoting diversity: more number of species with diverse nutritional profiles
- ✓ Building on local knowledge systems: Enhancing the scientific knowledge and skills considering the local knowledge and practices
- ✓ Build the capacities of women and men to adapt and
- ✓ Strengthening the social networks to promote sharing knowledge and resources.

In order to enable the participation of more women the island was divided in to three zones and women from each zone was mobilized in to groups with the support of Women Development Committee members in the respective zone. From each zone a representative garden of one of the participant was chosen for demonstration. It was identified by taking the consensus of all participants for their participation without any hesitation. Training and capacity building programme was organized using the demonstrations (use of compost methods, nursery and planting, seed sources and germination issues, different pest and disease management strategies, simple hydroponics etc.) by adopting learning by doing approach. In order to further enable the learning simple learning materials was prepared in local language (dhivehi) and a presentation was made and hand out the same was given to all the participants. Linkages were facilitated with appropriate institutions in the process to get quality inputs and agricultural advisories.

Step III: Discussion at the policy level

Workshops and discussions were carried out both at the island and atoll level through the Island Management Committee as well as at the National Disaster Management Centre in Mali at the Country level to institutionalize the activity in the disaster mitigation plans.

Results and discussion

Step I - Situational analysis: The baseline analysis indicate that the importance of home gardens and scope for strengthening in this island revealed that home gardens has the potential to provide upto 30 % of inland households food need, but currently in this island it supports 10-15 % only. This means that the present utilization pattern is highly extensive and there is a good scope to further intensify the production. All the surveyed households indicated that the produces are entirely utilized for household purposes and in times when it is excess it is being shared with neighbors and relatives. Few households cultivate chillies and sell in the local shops. The space available varies across households, but it ranges between 20 m² to 60 m². The baseline survey indicates that 64 % of the surveyed houses have more than 40 m², 30 % has 20-30 m² area and only 6 % of the households have limited space of around less than 20 m². On an average each household has around 6- 8 members. The cultivation of crop species is a year round practice, though around 70 % of the households mentioned that southwest monsoon during April- May is the good season for planting tree species. Otherwise seasonal vegetables could be raised throughout the year.

The design and management of the home garden is the sole responsibility of women, in few households elderly men are supporting women in managing the garden in terms of new species introduction and inputs and advices on cultivation practices. But all the physical activities related to cultivation aspects are being handled by women only. In some households it often constitutes a small farm area where intensive crop production occurs with annual crops sown continuously, and perennial crops perpetuate themselves without needing frequent seeding. The agronomic practices like irrigation, weeding and harvesting do not require strict timing and carried out mainly by women as on when they get time and notice it.

Experience in home garden: Since the settlement is relatively recent, the houses on the northern part started the practice of garden around six years earlier, whereas in the southern part around 25 % percent of the houses are still under the process of construction in which the practice is very recent. But women have the experience on cultivation and they had been involved in such tasks in their earlier settlement of other island.

Diversity and species composition: The home gardens are strategic to improve their household supplementary food and nutritional aspects in this island. On an average ten different species are being cultivated but the total number of species cultivated in the home garden is around 35 covering fruits, vegetables, nuts, spices etc. Each of the species has diverse nutritional profiles and varies in bearing seasons. With regard to species dynamics, around 80% of the households

expressed that three years back species like banana, guava, coconut and perennial vegetable species like Ramba, curry leaf, leaf cabbage etc was cultivated. But women are keen in enriching the diverse species composition in their gardens mainly with tree species.

Source of planting materials: of the different sources, around 92 % of the households indicated that they manage and preserve the seeds for next season, sometimes for example in chilles, they take seeds from chillies they purchase from shops for vegetable purpose. But around 6 % of the households expressed that they purchased seeds from shops in the local islands as well as from Male. Only 2 % of the households expressed that they share the planting materials with relatives and neighbours.

With regard to the awareness on soil health status 88% of the respondents expressed that they are aware of this and indicators they expressed is poor and stunted growth indicates the low soil fertility. The remaining 22 % of them expressed that they do not know the reason for poor growth and doesn't correlate with the soil fertility status. With regard to the restoration strategies, only 30 % of them practice application of compost (dried leaves/twigs/fish waste) and soil from dense forest area in the island. According to them colour and texture of the soil is the indicator of its fertility status. Black colour with good amount of humus and lightweight are good for plant growth.

Pest and diseases: With regard to awareness and knowledge on pest management nearly 100 percent of the respondents expressed that they do not know to differentiate between pest and disease, identification of pest as well as its remedial measures. From the poor stunted growth and yellowing and curling of leafs around 90% of them indicated that due to the pest attach the productivity is very low. The local shop which sells pesticide is the only information provider to them, around 40 % of them point out that they have used the pesticide from the shop based on the guidelines given by the seller. The visit and interaction with the particular shop shows that only carbofuran is recommended which is retailed according the quantity requested. But further probing provided information that the person selling the pesticide doesn't have any knowledge about it. Also, it is surprised to note that around 45 % of the households used aerosols which used to control mosquitos and according to them the result on control is good without knowing its consequences.

Table 2. Common pest and diseases

Crops	Pest and disease
1. Chilies	Leaf curling, yellowing, sucking pests like aphids and white fly
2. Guava, custard apple	Sucking pests like mealy bugs
3. Curry leaf	Aphids and caterpillars, rust
4. Lemon	Caterpillar
5. Betel vine	Leaf curling, leaf rot
6. Banana	Corm rot
7. Leaf cabbage	diamond moth
8. Mango	Rust

Access to technical training: Technological information and options available to the women and men on home garden species especially on pest and disease management is very limited. 96 % of them expressed that they learnt the skill from parents through observation and involved in the actual practices. Six percent of them indicated that they sometimes see the television in which improved practices are being shown. The interaction with the agricultural ministry indicated that though they have charted programmes and modules on home garden management, this island is not being listed in their list. Thus there is no formal means of institutional extension services imparted to them. The mobility of women is highly restricted to the island in contrast to men (going as a labour to other islands), which restricts their access to improved technologies and scientific inputs in management. In Maldives, Ministry of Fisheries, agriculture and Marine resources is the agency promotes agricultural development, but the Milandhoo island is not categorized as agricultural island and hence their support is right now almost limited. Otherwise the ministry facilitating need based training and capacity building programmes through demonstrations and other communication tools to provide awareness and information.

Composting: There is no exclusive compost pit is maintained, but banana is grown largely in a pit method, in which the domestic waste water and leaf litters and kitchen wastes are dumped. Apart from that women are applying coconut coir and leaf front wastes near the root surface wherever soil is harder and sandy. Few households exclusively used coconut husks both as a bunding material to hold soil in a raised bed position against water stagnation as well as organic waste. Two of the respondents expressed that they consciously apply leaf waste especially from breadfruit (bigger in size and more leaf fall) in front of their house front yard and apply it in banana pit for composting.

Major constraints: Nearly 98 % of the respondents expressed that pest and disease is the major constraint they are facing in the garden management. None has mentioned that soil health as a constraint, only 2 % of the women expressed that both pest and disease and quality planting materials as a constraint.

Natural hazards: Heavy wind during June – July is the major hazard which uproots or lodges the banana trees, apart from this temporary water stagnation during heavy rainfall season is the major difficulty they are facing in crop management.

The situational analysis revealed the following major constraints in home gardening which are categorized in to technical, social and policy.

Technical: The most technical constraints are

1. Pest and disease infections due to the cultivation practices like dense planting, use of seeds from the infected crops, lack of crop rotation practices to break the pest life cycles and agronomic practices like close planting,

2. *Availability of good quality planting materials/seeds:* As on now there is no proper source to purchase quality seeds in the island. The major sources are self i.e seeds taken from previous harvest in their own garden or through local shops which sells in small packets. The quality of these seeds is very poor thus they are not getting adequate yield as well as prone to pests and diseases attack.
3. Poor soil health due to its origin, lack of sufficient soil fertility augmentation practices as well as local practice of mixing with fine coastal sand due to aesthetic reasons has severely compromised the land productivity
4. The species composition of the garden is dominated by perennial tree species and generally less intensive, consequently it has less impact on household food and nutritional security as well as land productivity
5. *Closure spacing of trees:* Every plant needs sufficient amount of sunlight, water and nutrients for the better growth. If any one of these three is not available in required quantity the growth is stunted and would not give expected benefits. In the island due to insufficient knowledge within the available species they plant more species without giving required amount of space.
6. The island does not have access to technology and information especially on planting materials, nutrient and pest management practices. There is an absolute lack of extension services from government as well as private agencies because the Department of agriculture in Male identified certain islands as Agriculture island and extension services are planned and provided only to those islands. Thus the unclassified islands does not get adequate attention.
7. *Water logging and Poor drainage:* Few households there are no proper facilities for the drainage of water from high rainfall and outlet for domestic waste water. The stagnation of water affects the root growth by reducing the air circulation as well as making a conducive atmosphere for the growth of soil borne fungal and bacterial diseases. As a result the root rot and whole plant damage occurs especially during rainy season.

Social:

1. In sufficient knowledge and skill of women to manage different constraints, especially among middle aged women and awareness on the nutritional qualities and benefits of consuming vegetables
2. Poor dietary habits, erosion of traditional food habits coupled with less interest on developing and utilizing local knowledge to strengthen the home gardens.
3. Limited mechanism/ social structures to promote sharing and transmission of local knowledge temporally, laterally and frontally.
4. Local culture and gender issues strongly limit the active participation of women in local institution, ultimately village level organization that is responsible for promotion of home gardens are managed by young girls whose knowledge, awareness and interest is limited.

Policy:

According to the Agriculture Development Master Plan (2006-2020) of Ministry of Fisheries and Agriculture, few islands were declared as non-agricultural islands, such islands do not receive

financial and technical outlays and extension and input support even though home gardening is practiced by all the households. Ultimately it denies the access to technical inputs and information necessary for the promotion of self contained home gardens.

The results of the situational analysis indicate that the home gardens play a vital part in local culture and maintain crop genetic resources. Diversified crops with species of an immediate use in the household are the main feature of milandhoo home gardens (Hoogerbrugge and Fresco, 1993). Higher proportion of perennial fruit trees (passion fruit, citrus, goose berry, custard apple, papaya) and parts of the trees/plants which are very often used in food preparations (curry leaf, moringa, brinjal, greens) is common which meet the nutritional requirements especially vitamins and fibre. Few households focus and cultivate crops which are used in daily diet and demand for fresh products is high like chillies, cabbage and banana.

Species richness and abundance of Milandhoo island showed diversity indexes (Shannon - Weiner) 2.66 to 3.24 as against 3.84 in upland Mexico (Gliessman, 1990a), 3.55 in Costa Rica (Gliessman, 1990b) and 2.44 in India (Eyzaguirre and Linares, 2004).

The role of cultural and socio economic factors which generating and maintaining the species richness varies from food, medicine, shade, ornamental, aromatic, spice, aesthetic etc. women particularly who are in the age group of above 35 to 40 years are the managers of home garden, maintain seeds and posses deep knowledge of the plants. Introduction and experimentation with new plant species, inputs and methods of cultivation is done by women and passed to the younger generation by involving them in the process. Similar studies were reported in Andean region for potato (Brush, 2000), southern Italy for tomato (Silvery, 2007) and beans in northern Italy (Tonutti, 2008). Women execute plan in such a way that they get produces throughout the year, and few households focus on small scale marketing with specialized products such as cabbage, chillies, banana etc though large number of households maintain garden to meet their subsistence needs.

In the context of enhanced access to market, increase in logistical facilities, changes in land use patterns coupled with improved livelihood options, people give less importance to diversified species and resort to few perennial trees and plants which needs less care. Similar situation has been reported in Eastern Europe by Birol *et al.*, (2005a). It has been reported about the direct correlation on the access and availability of land and higher income to richness of diversity in Nepal (Adhikari *et al.*, 2004).

It was concluded that the analysis helped to understand the situation and provided a framework for preparation of home garden management plans and development of home gardens in the study area to bring resilience.

Step II FAO Resilience Framework of the intervention: The FAO resilience framework on homestead garden was adopted (Box 1) in order to build and strengthen the resilience for food security and disaster preparedness among island community households

Box 1: The intervention is based on the Resilience Analytical Framework of FAO, in which strategies on improvement of home gardens is based on the following four principles

- I. Promoting diversity: more number of species with diverse nutritional profiles
- II. Building on local knowledge systems: Enhancing the scientific knowledge and skills considering the local knowledge and practices
- III. Build the capacities of women and men to adapt and
- IV. Strengthening the social networks to promote sharing knowledge and

Interventions:

I. Promoting Diversity through reviving the crops cultivated in the past as well as introducing new crops: The information on the species being cultivated across several home gardens in the island was collected, in addition preferential species like cabbage, raddish, beetroot, beans etc were introduced. Considering the extensive cultivation and less diversity in the home gardens, suitable species and varieties have been introduced. Fifteen different species (7 varieties and 8 hybrids) of vegetable seed has been provided to all households. For introducing the species, 25 model home stead gardens were demonstrated in different parts of the island with more than 20 species in each of the garden based on the resources availability and requirement of the house.

The resilience of the traditional home gardening is strengthened through diversification of species with annual and perennial duration crops belong to herb, shrub and tree categories. Species diversity was enhanced by introducing around 12 vegetable species in the island.

II. Building on local knowledge: The chronicling of the local practices on soil health management, land preparation, agronomic practices, pest and disease management practices and post harvest processing indicate that there is a potential to build their knowledge on soil and agronomic measures and need to impart scientific technical measures for the control of pest and diseases and nutrient management practices. For example banana pit based composting is the traditional practice, they don't have an exclusive composting pit in the garden. It is essential to develop and promote simple composting methods using kitchen wastes and other organic sources. During the interaction with the women while carrying out a small demonstration on soil management aspects indicates the scope for vermicomposting of organic wastes. The soil has good number of earthworm and other arthropods population, which are the efficient composers of the organic materials.

III. Enhancing the capacity of the women: Hands-on training during the demonstration phase to the selected women were organized. They act as a local resource person to share the information, knowledge and resources. Apart from that simple training modules both in digital and print form was prepared and shared to provide additional information and knowledge as

learning materials. Efforts were made to collect learning materials developed by the agricultural department and made available at the center for further learning. In addition efforts were taken to develop linkages with agricultural department through the use of available Information and Communication Technologies (email, telephone interaction). In the island methods such as use of mobile phones and exchange of emails are very common among the women. Arrangements were made with the women to have link with experts in the Ministry of Fisheries and Agriculture.

i. Demonstration cum hands on training on nutritional home gardening

The purpose of the programme was explained to the members and their role as local resource and model demonstration garden to the nearby households. The participants were requested to draw a sketch of the garden in their respective houses and requested to find out the diversity status as well as space available for intensify the cultivation in home garden's were discussed. According to them seeds from well ripped fruits from the shop is the major source. Hence the importance of the seeds in getting healthy and good yield was discussed and their local seed sources were explored with the participants.

With this back drop, the importance of differences between varietal and hybrid seeds was explained to the participants. The varietal seeds could be used for subsequent generation by taking the quality seeds but the hybrid seeds could be used only for one generation. Unfortunately all the seeds available in the shops at both Male, the national capital and local are largely hybrid seeds. They could identify this through reading the instructions in the packets. In case of hybrids it is mentioned as F1 seeds. Apart from this, they need to see the germination percentage, expiry date in the packet before buying. Germination percentage indicates the percentage of seeds which could have the ability to germinate (eg if it is 80 % means 80 seeds out of 100 seeds would germinate). Such details were explained to women members during the training.

ii. Seed Treatment and nursery management

The importance of seed treatment was explained to the participants as it is essential to control the root borne diseases in the early stages of germination. Either eco friendly biofungicides viz *Trichoderma viride* could be used @20 g/kg of seeds or chemical fungicides like thiram or captan could be used @ 4g /kg of seeds. The practice of mixing seeds with fungicide was demonstrated and points to be considered (keep out of the reach of children, washing hands properly after the usage etc) while doing was elaborated.

Tray nursery: Right now the local practice is putting the seeds in the small bucket or any other container and the density is very high, thus seedlings are very thin and unhealthy. Since the healthy seedlings are vital it is essential to improve the nursery management practice. The soil is the most important input in the nursery, the repeated use of same

soil for the nursery lead to root rot diseases. In many households such constraint was expressed by the women members. Thus soil need to be sterilized i.e dried under good sun light for two to three days in order to kill the disease causing pathogens and insects eggs and pupal parts. Then soils should be put in trays watered to see the draining of excess water, after that put lines with a spacing of 10-15 cm apart with a depth of 4-5 cm and sow the seeds on the line, cover it with soil. Sprinkle water whenever the bed is dry or on alternate days, care should be taken to avoid excess moisture in the soil. This nursery could be kept in the place where sufficient amount of sunlight is received and if the temperature is high nursery could be covered with dried leaves or coconut fronds. Also, since the seedlings are easily susceptible for sucking pests it could be covered with net to avoid the infestation. The grown up seedlings after 15-20 days of sowing could be transplanted to the main plot or pot. Care needs to be taken to uproot the seedlings while planting.

iii. Hands on demonstration on Biopesticide and low cost compost pits

Practical demonstration was organized on the application of neem leaf extract as a protective measure for the leaf sucking insects. Neem trees are available in the Milandoo island and abundant in their old island from which they migrated. Hands-on demonstration was carried out on this technology. It is a very simple practice and the participants have committed to adopt this simple practice. The application of organic manures and nutrients to the soil is very much limited. Right now the local practice of composting is with the banana planted pit. All the dried leave materials are put in the pit which is open and takes long time for decomposition. Moreover the members are not using the same for the application other plants in the garden. In order to improve the practice of composting small hands-on demonstration was organized. In the compost in order to enrich its quality locally available leaves of calotrophis (locally called as 'rhu') are added along with dried biodegradable organic wastes from the garden. It has good antiviral and pesticidal properties. It is being done in a pit and finally pit is closed with soil, after 45 days good-composted materials collected for application. Considering the space available it could be planned to have two pits in a house which would ensure the continued availability of manure to the garden.

iv. Scope for eco-agricultural practices

The eco-agricultural practices of using neem leave extract and biological products viz trichoderma, pseudomonas etc to control diseases were demonstrated and samples were given for practice. The neem and *Vitex negunda* are the potential biopesticides which is locally abundant in the island/nearby island. The simple locally available resources could help the women to practice the same as protective measure for most of the sucking pests which is the major devastating ones in vegetable cultivation. Simple compost method using the locally available Calotropis and dry organic residues combined with fish waste could be the best combination and the pit method is a simple no cost and for quicker decomposition.

v. Training on multimedia materials on eco-agricultural practices – In order to reiterate the points three PowerPoint based presentation materials (importance of home garden, pest control practices in chillies and brinjal) was prepared in Dhivehi language and explained to the participants. The print materials of the same have been circulated to the members. The multimedia materials are available in the island resource center for the use of other members. The materials prepared and shared are

1. Importance of home gardening
2. Integrated pest management in Brinjal
3. Integrated pest management in chillies
4. Pest and disease management in Betelvine
5. Management of Diamond Back moth
6. Methods of compost preparation
7. Leaf extracts in pest management
8. Management of Sooty mould in trees and crops
9. Management of banana stem weevil and
10. simple materials on hydroponics

Apart from species diversification, intercropping of annual crops with fruit trees and perennial vegetable providing tress like moringa, sesbania was promoted. Intercropping helps to use the resources such as sunlight, water and nutrients more effectively and maintain the soil and surrounding ecosystems. Other agronomic practices such as mulching with available local crop residues, preparing the organic composts in the backyard, adopting no cost pest management strategies like use of locally available botanicals (by preparing leaf extracts), improving the soil texture by adding soil from undisturbed region of the island, growing healthier seedlings etc were demonstrated and promoted.

IV. Strengthening the local institutions and networks

Social networks: Seed exhibition has been organized by the Women Development Committee to create awareness among women on the diversified crops and quality seeds. The members from all over the island invited for the exhibition and requested to bring and show case the innovative method of practices and rare plants to create an interest and sharing with other women in the island. Simple brochure describing the contents like seed quality, seed storage, seed network etc was prepared in Dhivehi and circulated among the participants. Posters and pictures were displayed in the meeting hall. The team identified the vital role of women and local institutions i.e women's committee in facilitating the process of home garden improvement. Discussions were held with committee members and a plan was executed with the active participation of the members by farming three groups in the island. Apart from that, potential sources for the information, inputs and technological support were explored and the linkages were established with the women leaders through telephone as well as need based training with local resource person.

- i. Male Nursery: It is a government facility under the Ministry of Agriculture, forestry and Marine, central facility to provide the necessary inputs and services to the farmers and needed people. Apart from this the centre supplies seedlings of tree species and tools and machineries needed for cultivation. The center has training materials in Dhivegi language.
- ii. Input availability: Linkages has been established between the communities and Agro service based at Male which is a firm dealing with improved seeds, diversified potential crops of home gardens and ecofriendly pest management products.
- iii. Research center: Hanimandoo Island is the nearest island which has Agriculture Research Center with the main mandate is to develop technologies for the region, apart from this they sell seedlings and seeds on request to the needed farmers. The centre is testing new techniques like drip irrigation, green houses and hydroponics for vegetable cultivation, and also shade nets. The crops grown are chillies (bell, ordinary and pepper), tomato, brinjal, cowpea, green cabbage, cabbage, lettuce and tree crops like sapota, mango, guava, banana, pomegranate, creepers and climbers like passion fruit, pumpkin, watermelon etc.

III step: Policy discussions

The results/progress made in the attempt has been shared with other islands in the Shavayani Atoll and NDMC, Male. The process and approach as well as learning materials developed in facilitating resilience framework were explained to the Atoll leaders. The results of the project were presented at the National workshop on linking environment management with disaster risk reduction at Male organized of policy advocacy. Officials represented different ministries and departments and NGOs attended the workshop. An overview of global climate change the source and the results were presented and the expected consequences in the context of Maldives. The following points were shared with the participants as policy inputs from the learning from the hands on experience. It is vital to improve the extension services to meet the needs and motivate the islanders to enhance the productivity and support the domestic needs. The geographic condition and the nature of the islands cost high transportation cost and very little flow of agricultural information and technologies. Technological advantage, especially in the communication technology could be used to overcome this constrain through developing on line linkages between women islanders and the experts from agriculture department. In the long run these efforts in improving the home gardens could improve the resilience of the island communities. At the island level the women leaders already got the training and gained skill, knowledge and improved biodiversity in their gardens could act as local resource persons. The island office could use effectively to facilitate horizontal transfer of knowledge through sharing their experiences and knowledge with the other women in the island.

Concluding remarks

The baseline study indicated the need for strengthening the home gardens in the context of its vulnerability to natural disaster and attempted to evolve preparedness strategy by adopting the resilience framework of FAO. From the experience it is learnt the following four elements are

crucial to promote resilience in home gardens. The first and foremost important element is social mobilization, considering the local culture there is a need for an effective social mobilization and developing local structures such as neighborhood groups. This would help to provide a forum to share the knowledge and resources to strengthen the garden. Second point was promotion of *simple production process and technologies*: Demonstration of decentralized model with locally available materials, with simple user-friendly processes and practices create interest among women members to adopt the technology and practices. The third one was *enabling access to resources and knowledge especially* quality input services at the local level which provides scope to strengthen the sustainable agronomic practices in the given isolated nature of the island. Here the advantages of modern ICT tools were effectively harnessed to establish linkages with appropriate agencies and island women. The final one is sharing the experiences and institutionalizing the activity by bringing the issue in island development planning to receive the policy support to further augment the support services.

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