

Nayakrishi Experience: Addressing Food Crisis through Biodiversity – based Ecological Production Systems¹

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About Nayakrishi

Nayakrishi Andolon literally means New Agricultural Movement of farming communities. Farmers are practicing 10 simple rules² of biodiversity-based ecological agriculture to achieve joyful, prosperous, and secured life. The sovereignty over food production and seed systems is the strategic area of work to achieve the goal. Nayakrishi insists on dissolving the divide between 'formal and 'informal' knowledge practices to shift the paradigm of food production.

Food sovereignty is the sovereign command and control of peoples, communities and countries to produce their own food and right to take any measure to ensure safety, cultural and ethical acceptability and distributional mechanism to guarantee nutritious and safe food for all members of the community, with or without the mediation of the market.

Farmers across the world produced a record amount of 2.3 billion tons of grain in 2007, up 4% on the previous year. The global food crisis is not the problem of production. It is not related to population increase as some quarters think. Since 1961 the world's cereal output has tripled, while the population has doubled. But why stocks of food for human consumption are at their lowest level in 30 years? Less than half of the food produced are available for people who needs it, the rest is diverted to feed animals and in recent years to biofuels.³ In this context the demand for food sovereignty is extremely important.

Bangladesh can't buy the rice they need now because the prices are so high. For years the World Bank and the IMF have told countries that a liberalised market would provide the most efficient system for producing and distributing food, with the result that Bangladesh has destroyed its own capacity to produce food and distribute it equitably. To purchase in from the global market is almost impossible because of speculation on these hot commodities. In some estimates the amount of speculative money in commodities futures – markets where investors do not buy or sell a physical commodity, like rice or wheat, but merely bet on price movements – has ballooned from US\$5 billion in 2000 to US\$175 billion to 2007.

The demand for food sovereignty is grounded on the perception that the capacity of the states to address the need of the people has been seriously curtailed by multilateral and bilateral regimes and treaties, particularly the trade regimes and World Trade Organization. The systematic erosion of communities or people as the sovereign foundation of State has been seriously marginalized and people must interrogate the existing relation of States with Corporations, since both works against the people and communities in unison. Extent to which

² Ten Rules are: (1) absolutely no use of pesticide (2) in situ and ex situ conservation of seed and genetic resources, (3) production of healthy soil without external inputs, particularly chemical fertilizer, (4) Mixed cropping (5) production and management of both cultivated and uncultivated spaces (6) no extraction of ground water and conservation of water and efficient surface water use and management (7) learning to calculate the output both in terms of single species and varieties as well as system yield (8) Integrating livestock in the household to produce more complex household ecology to maximize benefits and well being of both humans and life forms (9) Integrating water and aquatic diversity to generate more ecological products and (10) integrating non-agricultural rural activities to ensure prosperity of the local communities as a whole.

³ See Making a Killing from Hunger by GRAIN. 2008

States might defend the interest of the communities depends on the intensity of the peoples' movement and constructive engagement with the policy makers both nationally and globally⁴.

The strategic concern for the seed sovereignty arose because of increasing destruction of farming seed systems that have been the founding stone of agriculture, genetic evolution and agro-biodiversity. The threat of biopiracy and globalization of intellectual property rights regimes have increasingly becoming the barrier in the farming communities for the free flow of genes.

The divide between the 'formal' and 'informal knowledge' systems, privileges the so called 'formal' knowledge despite the fact that scientific innovations contain strong element of intuition, contingencies and accidents just like 'informal' knowledge of the farmer. Farmer's or indigenous knowledge has also 'formal' elements just like any valid knowledge that can be repeated with the objective of producing similar result if put into practice. Nayakrishi challenges this divide to create new horizon for science of knowledge practice that could be benefitted from bridging the gap between literate and non-literate knowledge practice.

Nayakrishi Andolon as the 'new' agricultural movement is not about 'traditional' agriculture, if we contrast the 'traditional' against the 'modern' in order to privilege one over the other. We insist to dissolve the divide between formal and informal or modern versus traditional or indigenous farming systems in order to avoid false dichotomies and set productivity debates to right track. The need to adopt appropriate methodology to assess the performance of various agricultural systems, internalizing the external costs of food production and fatal costs of irreversible damages caused to environment, ecosystems, diversity and health is beyond question now. Mother Nature is a co-producer and not merely a 'factor' production. If 'modern' farming destroys the very foundation of agriculture by destroying Nature, e.g., environment, ecosystems and agro-biodiversity, its ability to resolve food crisis is highly questionable. Nayakrishi takes full advantage of advance knowledge in biological sciences such as environment, ecology or biodiversity as well as landscape designing and techniques to develop complex ecosystem from simple beginning to enhance food production. While we need to be aware of quick technical fix and propaganda of hi-tech agriculture, we should avoid romanticizing 'traditional' agriculture to a point that abstractly contrasts the 'modern' to be an alternative only. Nayakrishi strives to be the future of agriculture that can solve the food crisis for all.

In addition to well-known practices of ecological agriculture Nayakrishi practice is based on conservation, regeneration and enhancement of biodiversity and genetic resources in general and agro-biodiversity in particular, the strategic site of Nyakrishi's activity with the farming community. Nayakrishi attempts to design households, villages and unions as ecological production systems at various levels and scales. Innovative and diverse ecological designs and practices are promoted in order to achieve higher yield both in terms of individual species and varieties as well as system yield. Minimum general indicator to assess the performance of the system is to ensure the reproducibility of the systems, generally known as sustainability. However, the goal is always aimed at achieving qualitatively higher and complex designs or systems to maximize the yield from per unit of land. The 'yield', 'services', 'functions' or 'value' are assessed both in economic terms as well as by benefits of healthy environment and ecology and the capacity to regenerate and enhance biological wealth and genetic resources in

⁴ See 'On Food Sovereignty' by Farhad Mazhar, in New Age. Also see, 'Global Rallying Cry of farmer's Movement' by Peter Rosset. Backgrounder. Vol 5.No 4. 2003.

possession of the farming communities.. In terms of assessing the productivity Nayakrishi focuses on per unit productivity of space where different elements of agriculture forms complex or mosaic ecosystems in contrast with the modern agriculture which usually concentrates on per unit productivity of inputs that includes agricultural inputs, labor and lands as production factors.

Historically the idea of economic system and related notions such as ‘production’, or ‘production factors’ developed prior to the notions related to environment and ecology. Till now notions such as ‘production systems’ remained extraneous to the notions of environment, ecology or biodiversity, as if an ecosystem is not a ‘production system’ on its own term. One of the major challenges of Nayakrishi is to demonstrate the economic and productivity performance of ecological agriculture to solve food crisis, availability of safe water and reducing hazards to all life forms. The ability to address environmental degradation, ecological erosion, risk of pests attacks and diseases, health and nutrition problems, challenges of seasonal variability, natural disaster and climate change and livelihood of the people are inherent within the principle, strategies and operational culture of Nayakrishi Overall result is immanently directed at the eradication of poverty and reach extremely vulnerable section of population that can not be reached by any other development program. Nayakrishi therefore strategically highlights the value of ecological production practices that are biodiversity-based to ensure higher yield and good economic return to farmer.

While Nayakrishi can be discussed from various angles, for example, from ethical and cultural perspective where dignity of all life forms and responsibility to others are critical in reconstituting peaceful and harmonious communities and lifestyles -- the present article would like to highlight economic and yield performance of biodiversity-based ‘production’ systems capable to address food crisis that we are facing now, an area that has not been fully appreciated by the policy makers. We will also highlight the seed and genetic conservation strategy of Nayakrishi and some results o the performance of various rice varieties to provide example where should we strategically reorient of focus to increase food production.

Nayakrishi Strategy to Address Food Crisis

The Nayakrishi Andolon covers 19 districts and 73 Upazilla widely spread in Bangladesh. In these districts Nayakrishi Andolon is strongly present in 73 upazillas with the total of 163 unions. Total number of practicing villages with strong presence of Nayakrishi Seed Network is 695. Out of these villages 99 villages are declared by the community as ‘Nayakrishi Villages, i.e. villages strictly following all Nayakrishi rules and strong in agro-biodiversity conservation. Nayakrishi maintains record of nearly 200,000 farming households while more than 250,000 households are practicing Nayakrishi. Total Seed Wealth Centers are 12 and Seed Huts 54.

Nayakrishi's strategy to address food crisis are based on the following principle:

1. Protection of uncultivated food sources and maintaining biodiversity to ensure that people are able collect food from in and around of their households or locality when they need, with or without the mediation of the market

2. Promoting mixed cropping encouraging farmers to select species and varieties to meet ecological and economic needs depending on the quality of the land and the capacity of the farmers.
3. Strongly promoting 'integration' so that a farming household can develop from simple to complex system maintaining aquaculture, livestock, forestry, medicine plants, etc
4. Constantly conducting farmer-led research to select high yielding local varieties of rice and other species and distributing the seed to the farmers.
5. Focusing on the total amount of biomass that is generated by a system that could be used as fodder, fuel wood and composting to reduce the dependence on cereals as animal feed, fossil fuel for energy and chemicals for fertilizers and pesticides.
6. Fully exploring the potential of an ecosystem, rather than 'production factors' as the key indicators of productivity calculations. Productivity of per unit of the physical landscape is crucial in designing appropriate use of land, human resources and external inputs.

Uncultivated Food

For Nayakrishi, agriculture is not about cultivated crops, but management of both cultivated and uncultivated spaces. A Nayakrishi village where no pesticide and chemicals are used and environment and ecology is maintained, at least 40% percent of food requirement can be collected from uncultivated sources. It includes not only various plants but also small fishes⁵.

A typical Nayakrishi farm grows both rice and vegetable crops in each season. Local Boro is sown on some farms during dry winter season but other winter crops are more common in the winter, including a wide range of vegetables, pulses and oil seeds. The diversity of cultivated crops is very high, with some 55 plant species and more than 453 varieties documented in a single village.

The number of uncultivated species used as food is also qualitatively and quantitatively very high. Some 102 species of leafy greens associated with agricultural fields, homesteads and common areas were identified by local people as food, mainly herbs, creepers, aquatic plants, shrubs and trees.

Understanding the dynamic relationship of biodiversity and local food systems allows us to question the inevitability and desirability of a transition to diets based entirely on cultivated diversity. Increases in the production of so-called "staple crops" can only be considered an increase in food production if they really make a net contribution to the availability of food at the household level.

Families in the categories of very poor (no cultivable land, no economically active men) rely on uncultivated foods averaging some 65%, the poor (has homestead land and a small amount of cultivable land less than an acre) derive about 55%, middle families (2 acres of cultivable land, homestead, cows) derive 52% and the better off families (over 3 acres of cultivable land, homestead, several cows etc.) derive 34% of food from uncultivated sources.

⁵ see *Uncultivated Food: The Missing Link*. SANFEC Policy Brief #1. SANFEC Publication 11 November 2004. also see *Our Uncultivated Leafy Vegetables*. Narigrantha Prabantana, Dhaka, Bangladesh. UBINIG. 2002.

Uncultivated food sources make up a large part of the daily diet during a time of the year when cultivated food sources are also relatively abundant. Far from being a minor supplement or simply a crisis food, the leafy greens, tubers and small fish collected by people from the lands and water bodies of their communities are a vital part of their daily diet.

Productivity Experience of Nayakrishi Farmers

Nayakrishi farming communities constantly doing research on the yield performance of nearly 2500 varieties of rice they are cultivating. Among them the following varieties are popular to the farmers because of their excellent performance in Nayakrishi environment. The following table will provide a quick look into the duration of cultivation and the potential yield performance, in appropriate ecological conditions and better farm management. The yield recorded here is based on farmers' experience and extensive field notes and research.

Table 1: Yield of Some Selected Aman Paddy Varieties

Sl	Name	Duration in days	Paddy kg/hectare	SL	Name	Duration in Days	Paddy Kg/hectare
1	Raymon	87	4841.20	24	Ghi-gauge	121	6185.96
2	Balia bokri	100	6132.19	25	Durlav	121	6454.92
3	Herali	103	6132.19	26	Arai-ral	122	6454.92
4	Raymon-2	107	6777.68	27	Panai	122	5648.07
5	Lal gati	114	9682.40	28	Muri-amm	122	5648.07
6	Lal dha	116	7530.75	29	Kefu-khandi	122	6454.92
7.	Biran	118	6454.93	30	Najar-shail	122	8760.27
8	Birin tola	118	6454.11	31	Hasful baron	122	5379.11
9	Josoo balam	118	6454.11	32	Kali-gach	122	5446.35
10	Tilak Kochuri	119	6454.11	33	Til-kazol	122	5648.07
11	Ropai	119	6454.11	34	Dudh-shail	122	6454.92
12	Dip-pal	119	8068.67	35	Raghu-shail	122	5648.07
13	Pani-taranga	121	6051.50	36	Changgi	122	6051.50
14	Mal-bhogh	121	5379.11	37	Jal-kumari	122	6051.50
15	Jolokoa	121	5917.03	38	Kanchan-mugi	122	5446.35
16	Lal amon	121	5446.35	39	Dhepi	122	6454.92
17	Tal-magur	121	6454.49	40	Naricia-bochi	122	6051.50
18	Bor-gilan	121	6992.84	41	Moha-rani	122	5917.03
19	Malia-vagor	121	5648.07	42	Sonali-baron	123	5648.07
20	Ban-kolom	121	5379.11	43	Kala-balai	124	5917.03
21	Kalo-moti	121	6454.92	44	Dudh-gora	124	6454.92
22	Dum-raj	121	6454.92	45	Bhabani-Vogh	124	5446.35
23	Sada-bajal	121	6224.40	46	Pan-kaich	124	6454.92

Average national average of HYV Transplanted Aman is 2.303, HYV Aus 1.912 and HYV Boro 3.469 per. hectare. The productivity of Local Boro is 1.942, Local Transplanted Aman 1.550 and Local Aus 1.194

The biomass of the paddy is also considered by the farmers constituting the yield of a variety. This is very important, since rice cultivation does not mean producing food for human beings only, but also for the livestock. Therefore present calculation of the productivity of rice variety is not consistent with farmer's calculation. The following table shows the varieties that farmers prefer both for the rice yield as well fodder.

Table 2: Yield of Local varieties of Aman

SL	Name	Paddy mt/ hectare	Straw mt//hectare
01	Himbali	05.42	19.14
02	Hogla pata	05.38	32.29
03	Chand maloti	05.32	23.92
04	Shung Dawai	05.18	19.93
05	Sadamota	05.18	19.93
06	Jamal mursi	05.15	19.08
07	Kalai	05.05	26.58
08	Raymon	04.78	11.16
09	Nil-kumari	04.47	21.79
10	Indra-shail	04.39	31.89

Table 3: Yield of Local varieties of Boro Paddy

sl	Name	Paddy mt/ hectare	Straw mt//hectare
01	Lahaya	04.54	15.10
02	Bashful	03.95	12.30
03	Aus boro	03.92	13.56
04	Jaki boro	03.80	14.36
05	Nata boro	03.76	15.23
06	Boro kachari	03.46	16.84
07	Burali boro	03.44	16.27
08	Hilali	03.36	14.26
09	Rata	02.47	13.56
10	Jagli	02.96	15.26

In various case studies Nayakrishi demonstrated tremendous potential to design complex ecological systems to produce more per unit of land. In mixed cropping the general practice is to produce (1) crops that contributes to household food security, crops that contributes to ecology and soil health (ecological species and (3) crops and cash crops. Since Nayakrishi does not promote monoculture, each household can mix crops and design the farm to maximize the

ecological and productivity benefit from the practice. (for details see Farmer's Experiences on Biodiversity-based ecological production systems)

Nayakrishi and Nutrition

Food systems promoted by Nayakrishi including uncultivated food have positive impacts on health and environment. Since the movement strictly prohibits use of biocides and chemicals and extraction of ground water the positive effect on health is obvious.

In the study of 'Traditional food systems of indigenous people of Bangladesh' (UBINIG study: 2001-2003), related to community nutrition it shows that, uncultivated plant and vegetables have good nutrient values. in terms of iron content, vitamin C content, Vitamin A and Zinc.

Without pesticide and chemical fertilizers soil is not damaged and plants can grow smoothly and safely. Some diseases like anemia, Vit A deficiency, general weakness, premature birth, malnutrition, anorexia, gastric, skin disease, kidney problem etc., can be prevented to some extent. Gastroenterological, respiratory, kidney, reproductive, nervous, immune, eye, skin etc. malignant disease like cancer may be caused by pesticide and chemical input in agriculture where most of them remains in the environment and consumed by human beings and animals through food chains..

In Bangladesh Pregnant women are particularly prone to iron and other micronutrient deficiency in rural areas. The children are suffering from protein energy malnutrition, night blindness, scurvy, rickets, goiter etc. Green leafy vegetable (shak) can play an important role to prevent these diseases. A study shows that Nayakrishi practice has improved the nutritional status of the children at Chokoria. (UBINIG & INFS study-Traditional Food Systems of Indigenous Peoples of Bangladesh, 2001-2003).

Anthropometric and clinical examination of 100 children at Badarkhali, Chokoria upazila under Cox's Bazaar District shows the following disease prevalence much lower than national average. Night blindness – 1 only

- Anemia – 12
- PEM – Nil
- IDD – Nil
- Vit. C deficiency – 2
- Vit. D deficiency - nil

In INFS (Institution of nutrition & food science) sample study which was a part of UBINIG's main study (Prof. Salamatullah/Khurshid Jahan, INFS, Dhaka University, Prof. Harriet, McGill University, Canada) shows good micronutrients values in 30 leafy vegetables sample contained of rich in iron, beta-carotene, vitamin C, Zinc etc. Nutritional analysis of some uncultivated varieties was not done before. In the coastal areas, people consume more fish and uncultivated food which helps them to prevent malnutrition and other complicated diseases. Nutritional status of Rakhain community in was found good as they are involved in Nayakrishi practice since many years.

Iron was found rich in Girmitita, Nilinchi, Almush, Aien, Hachu, Lal shak, Khatkhate, Mamuni, Dondokolosh. Doaa, Batua, Notehshak, Waterlily stem, Phoolcopy leaf etc.

B- Carotene was found rich in Girmitita, Almush, Lalshak, Helencha, Kochu, Khatkhate, Mamuni, Dandokolosh, Batua, Doaa, Boprboti, Kilomi, Notehshak.

1. Vit. C was also found rich in Batya, Noteh, Kamranga, Lalshak etc.

In Nayakrishi areas of Tangail, Pabna, Cox's bazaar, Chapainawabganj & Kushtia district the disease patterns (2002 – 2007) are Fever, common cold, allergy, cough, dysentery, diarrhea, worm, gastric, back pain, body pain, shoulder pain, burning syndrome, malaise, anorexia, asthma, RTI, skin problem, tonsillitis etc, white discharge, UTI etc. But liver, gallbladder, colon, pancreas, prostate, urinary bladder and kidney diseases were not found which has a link somehow with pesticide & chemical fertilizers. Also malignant disease (cancer) was not found. Only one case of breast cancer was found at Chapainawabganj

Seed and Genetic Resource Conservation:Nayakrishi Seed Network

The precise responsibility of the NSN, within the ecological food production practices and organizational activities of Nayakrishi Andolon is to ensure collection, conservation, distribution and enhancement of seeds/germplasms among the members of Nayakrishi Andolon. Therefore, the NSN is the active farmers' network within Nayakrishi Andolon with specific responsibility of ensuring both in-situ conservation of biodiversity and genetic resource in the farming field and ex-situ conservation at the household and community level.

The Nayakrishi Seed Network (NSN) builds on the farming household, the focal point for in-situ and ex-situ conservation. Farmers maintain diversity in the field, but at the same time conserve seed in their homes for several years to be replanted in the coming seasons. The seeds that are kept for longer periods generally have lower germination rates, but the technology farmers use to preserve these seeds is varied and effective, both for and short term. For example, specific drying techniques, the use of particular kinds of earthen pots, the use of Neem leaves and other natural pesticides, and experiential understanding of the moisture content of the various seeds. Seed conservation is an art belonging to women, and is the key element in building up a national seed network. The women are the key actors and leaders in the NSN.

In addition, Specialised Women Seed Network (SWSN) is also comprised of women farmers. The leadership of women farmers in seed conservation and community seed wealth centres is almost natural. Emerging linkages of the efforts to the national system for ex-situ conservation of agricultural biodiversity offers a well-developed model strategy for biologically rich countries such as Bangladesh.

General Practice of Seed Conservation and NSN

As a general practice farmers of Bangladesh keep seeds in their household for the next season. Nayakrishi strongly encourages this tradition of the farmers. Control over seed is the lifeline of the farming community and ensures the command of the farmers over the agrarian production

cycle. It is recognised within the Nayakrishi Andolon that break in the cycle within the circuit of circulation of seeds among farmers can be highly detrimental to the overall agro-biodiversity of the production systems. In the light of the increasing commercialisation of seed sector the danger has aggravated in the recent years.

Farmers do not keep seeds for the next seasons only. In many cases some seeds are kept for longer periods, for 3 to 5 years. The seeds that are kept for longer periods generally have lower germination rate. The technology to preserve these seeds is varied and highly sophisticated. Sophistication is required mainly in drying and experiential understanding of the moisture content of the various seeds. The germination depends on the indigenous knowledge of the specific farming household. In this context the first task NSN initiated was the study of indigenous practices of seed conservation and integrate the results into the activities of Nayakrishi Andolon. Consequently the scope for further development of ex situ seed conservation at the level of the farming households expanded. This is an ongoing research area. The technological basis of ex situ seed conservation in a typical farming household under normal condition is always a major research priority. Secondly, the documentation of the findings is available in simple reports written in local language. The farmers share their experiences in various meetings in the villages. The experiences are extensively shared through oral interactions and communications. The experts in seed conservation are recognised, respected and rewarded by nominating them in farmers' exchange programs and many national events.

This initial exercise consolidated the initial grouping for NSN, mainly by the farming women. Once the seed conservation at the household level has been identified as the key element in building up NSN, the next phase was to identify other broad issues of biodiversity.

What happens if a farming household decides to replant a species or a variety in the next season, but not in the current one? She must report her decision to the Nayakrishi group in the village and make sure that some one in her group is replanting the same. The general principle is monitoring of the fact that a species or a variety is not getting lost from the common genetic pool or the biological resource of the village. The unplanted seed can be kept in the household for the next season, or deposited in the common pool.

If some household decides to try a new species or a new variety, she can always ask for it from the common genetic pool, and it is provided free. As a general principle diversity is always encouraged as long as it does not become an economic stress on the farmer. It also directly contributes to the mixed cropping practice of Nayakrishi. Integration of a new variety into the current system also offers opportunity to do research from both ecological and economic angles.

How to ensure the quality of seed? The monitoring of the collection and preservation ensures the quality of seed by the experienced members of NSN, who also receives training. If somehow the seeds of the same variety of one village are considered inferior compared to the overall standard of Nayakrishi, Nayakrishi farmers from the other village provide the seeds. This is done mainly through the network of women in NSN. Sharing of seeds and germplasm are always encouraged. The strategy of Nayakrishi Andolon in the maintenance and regeneration of biodiversity and genetic resources is based on some simple rules and obligations between members. These are:

- *To remain as an active group member of Nayakrishi Andolon, a farming household is obliged to always inform the group planting decisions and plans for each season.*

- *Members should harvest seeds collectively, if possible, to make sure that all the valuable seeds of the village has been collected and conserved at the household level in addition to ensure the quality of the seeds under the leadership of experienced farmers in the village.*
- *If seeds of household are destroyed for any reason a farming household should report to the village leader and must immediately replenish from other group members or collect from CSW centre.*
- *If a farming household is not replanting a variety this year they are obliged as members to give it to the neighbour and make sure that neighbour replants the variety and both collect seeds for the next season.*
- *If a farming household do not find any body to replant, they are obliged to report to the Nayakrishi Seed Network and deposit the seeds, if necessary, to the CSW centre.*

The strategic importance of NSN and CSW is not only in the conservation and regeneration of species and genetic variability of the cultivated crops and homestead forestry providing food, fuelwood and construction materials, but the institutional approach to monitoring and evolving a communication system among the farming communities in and around agro-biodiversity.

Village Pool: Nayakrishi Seed Huts (NSH)

Nayakrishi Seed Network is built up from below by the independent initiative of one or two households in the village, belonging to Nayakrishi Andolon, who are willing to take responsibility to ensure that all common species and varieties are replanted, regenerated and conserved by the farmers. These households in a particular village can also be located by the existing NSN structure covering large areas. These households are known as Nayakrishi Seed Huts (NSH). It often happens that two to three varieties are not replanted in a season in a village. It becomes the responsibility of NSH to replant those varieties. These farmers are specially trained and equipped to handle such a situation. In case the number of unplanted varieties are large during a planting season; she goes to the Nayakrishi Community Seed Network (NCSN), the local level NSN structure. Nayakrishi Andolon constitutes NCSN from farmers who are experienced in seed collection, quality maintenance, conservation and use. The Nayakrishi Seed Network is the net work of NCSN of different villages or areas. In most of the cases NCSN can handle the problem and thus ensures that although a village loses a variety or a species temporarily but the biological and genetic resource is available within the range of the cluster of villages.

To keep a variety within a range of cluster of villages is very important from eco-systemic point of view. Bangladesh is rich in biodiversity, and it is important to note the eco-biological features of a village and its relation to the local knowledge and skills. Therefore, seed conservation activities should take into account the particular ecological features of villages. The ecological features decide the clustering for NSN, not the administrative boundary of the village.

Specialisation: Specialised Women Seed Network

To enhance the capacity of the community the Specialised Women Seed Network (SWSN) has been formed. These are the women who are specialised in certain species or certain varieties. Their task is to collect local varieties from different parts of Bangladesh. They also monitor and document introduction of a variety in a village or locality. They keep the information up to the date about the variability of species for which they are assigned. The responsibility is assigned according to the interest and the knowledge of the individual persons. The SWSN often shares their finding in large meeting organised by the Nayakrishi Andolon. Generally SWSN maintains the following vital information:

- *Varieties of a particular crop, their distribution and availability in Bangladesh.*
- *Community knowledge about the characteristics and traits of a variety including why a variety has given names by different localities.*
- *Variety or varieties that have been replaced due to the introduction of a new variety in her area.*
- *With UBINIG staff keeping track with the formal research institution about the variety of her interest.*

The specialisation encourages individual person to be more focused on a few species and as a result they fairly develop valuable knowledge in a particular variety. Since this knowledge is highly valued by the group the person gets immense respect and recognition that contributes in the process of building up collective spirit and knowledge sharing.

Community Seed Wealth Centre

Community Seed Wealth (CSW) is the institutional set up in the village that articulates the relation between village and the National Genebank. The CSW also maintains a well-developed nursery. The CSW can easily finance its maintenance from the income of the nursery as well as from seed sale.

The construction of CSWs is based on two principles: (a) they must be built from locally available construction materials and (b) the maintenance should mirror the household seed conservation practices. Any difficulty encounter in the CSW reflects the problem farmers are facing in their household conservation.

Three women members of the network run Community Seed Wealth Centre. Any members of the Nayakrishi Andolon can collect seed from CSW with the promise that they will deposit double the quantity they received after the harvest. The seeds are sold to other farmers of the village and the cost of the CSW is maintained from the income. Farmers can claim the deposited specie or a variety any time they want. All they need is to walk to the nearest CSWs. A farming household can decide not to replant a specie or a variety in a season but may come back after two to three years for the same.

In addition to the three seed women, the CSW requires two more persons for the nursery. This is more or less a standard from the experience gained so far. The CSW, which Nayakrishi

Andolon runs in Tangail, is already self-sustaining. However, the cost of documentation and maintenance of passport data information has been subsidised by UBINIG, the organisation that plays the catalytic role for Nayakrishi Andolon. The subsidy costs are in terms of time by the staff and costs of stationery, use of computers and other materials.

Apart from seed collection, storage, preservation, distribution, exchange and regeneration, tasks of the CSW also include documentation and maintenance of overall information of the area. The experience of the CSW for the last three years shows very clearly that CSW may maintain its costs by selling seeds and saplings.

The exploration of the relation between National Genebanks and the Community Seed Wealth has only started, and development of the relation largely depends on the co-operation of the formal systems. The institutional strength of a farmers seed network and community germplasm conservation and regeneration can further be demonstrated if the linkage between the formal and informal institutions is rationalised. A recent exercise with Bangladesh Jute Research Institute (BJRI) to regenerate jute seeds was very satisfactory. Nayakrishi Andolon has received support and collaboration from the scientists active within the structure of the formal systems. The main problem is still bureaucratic hindrance and the research priority of these institutions in a direction that excludes the farmers.

However, formal systems recognise the value of research and activities of UBINIG with Nayakrishi Seed Network. UBINIG plays very active role in the National Committee on Plant Genetic Resources (NCPGR) and has contributed in their efforts to draft Biodiversity and Community Knowledge Protection Act as well as Plant Variety Act. Both the drafts have been endorsed by NCPGR and have been accepted by the Ministry of Food & Agriculture for inter-ministerial discussion.

The NSN through its organisational structure, mediated by the set up such as CSW, demonstrates profound potentiality in various directions. Not only in collection and conservation of germplasm, the practice envisages an institutional arrangement and linkages by which a dynamic system of National Genetic Resource Conservation and Management can be contemplated. Bangladesh can maintain, manage, regenerate and enhance agricultural biodiversity and genetic resources with very little cost only when farmers' network is linked to the national strategy. A lot of further research is definitely required but the direction of investigation is more or less clear. Bangladesh can not afford to finance a large genetic resource conservation strategy. More importantly, maintenance of expensive genebanks without interactive articulation with the farming community can be dangerous because of the possibility of technological failure and for various reasons and lack of human resources. A strategy based on the dynamic interaction of in situ and ex situ is the only strategy that is viable for the country, and perhaps for the region.

Management of Community Seed Wealth

The Community Seed Wealth (CSW) receives germplasm from the NSN. Three farmer women manage it. All germplasm are registered and relevant information is kept. To facilitate the communication with the National Genebanks the accession data are kept in accordance with the standard practice.

Continuous research is being done on the traditional processing of seeds for storage. The storage technology depends on three factors: (a) container, (b) drying technique, and constant monitoring of the weather. Management of pest and insect attacks in the container is not a major problem and does not require complicated technology. Usually dried Neem leaves are used and containers are sealed with mud and cowdung.

The third factor, monitoring of weather, is not difficult in terms of management. But in rainy seasons at least two people should always attend the CSW. For the drying of the seeds the month of Bhadra (August-September) is crucial and sometimes more persons are required for quick drying of the seed. The CSW did not face any major management crisis until now, although there were problems requiring creative solutions. The problems that are faced in the conservation and management of the CSW are documented. Very little research has been done on the seed conservation under normal household conditions and weather.

Seeds are mainly kept in earthen pots. The earthen pots, available from the local potters, are tested by observation for porosity and humidity control. The emphasis is given on the locally available earthen pots. Different types of earthen pots are used for different types of seeds. Seeds that are not going to be transplanted in the next season require different types of pot with specific feature. Colored glass jars are generally used for vegetable seeds, a common practice of the farmer women in the village.

Nayakrishi Natural Resource Auditing Committee (NNRAC)

What are the existing species and genetic variability of a village? The NSN forms Nayakrishi Natural Resource Auditing Committees (NNRAC) among themselves for an area that can be covered by walking within a day. Depending on the extent of the village, the area is comprised for 5 to 7 villages. The NNRAC undertakes an audit of the existing species and varieties of a village, and starts depositing the germplasms in the Community Seed Wealth (CSW), freely accessible by the villagers, and document resources that must be maintained and managed *in situ*. When possible, Nayakrishi Andolon declares some areas as communally protected and encourages collective responsibility of the villagers to maintain and manage the biodiversity for that ecosystem. Although, there is no legal regimes available to farmers to ensure their community action. Species and varieties in the field, cultivated or uncultivated, are documented and registered as the wealth of the community, including their use, as a precaution against unauthorised collection.

On the other hand, there are a large number of species and varieties that are not cultivated. The conservation and regeneration of biodiversity for these species and varieties are mainly maintained by the overall structure of the Nayakrishi Andolon. Every village, where Nayakrishi is active, has Gramkarmi (village worker). Apart from networking and campaigning for Nayakrishi, Gramkormis maintain audits of the natural resources of the village. The information is maintained collectively. It is a vital practice to maintain and manage the local biodiversity. The Nayakrishi farmers can easily be put into alert if any "land race" or "wild" species or variety is noticed as getting eroded or lost.

Conclusion

In last 45 years, more than 10 fold increase in amount and toxicity of synthetic insecticides used, but crop yield losses due to insects nearly doubled is already a wellknown facts signalling the fact that industrial food production can not be the future of agriculture. Pesticide resistance, mounting costs, impacts on ground water and degradation of soil are major crises that are threating the very survival of all life forms. The loss of biodivesity and genetic resources on the one hand and their privatisation through intellectual prperty rights are making food production difficult by the farming communities. It has also been demonstrated that the productivity of the modern varieties is stagnant.

On the top of that food such as cereals necessary for human consumption are being increasingly turned into animal feed and large area of land is dedicated to the production of biofuels making the global food crisis severe and disastrous. There is no way the current trend of industrial food production can solve the crisis we are all heading towards unless we start rethinking the nature and role of agriculture in contrast to industrialisation of food production.

The strategic insight and the results that we have achieved in Nayakrishi in practicing its principal could be a good beginning to rethink our idea of food production and what we can achieve by integrating advanced scientific knowledge grounding on ethics of responsibility to others and and magnificent foundation of experiential knowledge of farming communities around the world.

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