COMPENDIUM OF ADVISORIES REGARDING ANIMAL HUSBANDRY, DAIRYING & FISHERIES

Department of Animal Husbandry, Dairying and Fisheries

CONTENTS

Note on Measures to be taken for Increasing Availability of Fodder

1. Availability of adequate quantity of feed and fodder for livestock is essential for improving livestock productivity. Under the Rashtriya Krishi Vikas Yojana (RKVY), the States have sufficient funds and autonomy to undertake development of feed and fodder besides other agricultural and allied activities. Government of India has also released funds under the Centrally Sponsored Scheme, and distributed 'Minikits' of high yielding fodder varieties to assist the States in their endeavor to augment the availability of quality feed and fodder. The Accelerated Fodder Development Programme (AFDP) launched in the financial year 2011-12 as a component of RKVY has also provided additional funds to the selected States. Further, as per the latest guidelines, MNREGS funds can also be utilized for improving availability of fodder.

2. Though the availability of feed and fodder has improved in the last decade, still there exists a substantial gap between the demand and availability of fodder in the country, particularly during the lean periods and at the time of natural calamities including droughts/floods. Following measures may be taken for ensuring maximum availability of fodder for sustaining livestock production:

Optimum utilization of land resources

3. India with above 2.3% of the land area of the world, is maintaining about 10.71% of the world's livestock. The availability, requirement and shortage of fodder as estimated by NABCONS in 2007 is as under:

(Dry matter in million tones)

S.No.	Type of fodder	Demand	Availability	Gap
1.	Dry Fodder	416	253	163 (40%)
2.	Green Fodder	222	143	79 (36%)
3.	Concentrate	53	23	30 (57%)

Source: NABCONS-2007.

4. The number of livestock is growing rapidly, but the grazing lands are gradually diminishing due to pressure on land for agricultural and non-agricultural uses. Most of the grazing lands have either been degraded or encroached upon restricting its availability for grazing. The area under fodder cultivation is limited to about 4% of the cropping area, and it has remained static for the last four decades. Owing to the importance of food crops and other cash crops, it is very unlikely that the area under fodder cultivation would increase substantially.

5. Therefore, the need of the time is to adopt the practice of land use with multiple crops in a sustainable manner. Adopting Silvi-pastoral and Horti-pastoral models suitable to the area can help in substantially enhancing the availability of forage for the livestock. About 29 Million Ha area in the country falls under the category of open forests with less than 0.4 canopy density which can be developed with fodder trees. This huge land resource can be utilized for growing fodder, not only as an under-storey on the partially shaded ground without affecting standing trees. Similar development is also possible in the area under horticulture orchards. While the forest department can undertake silvi-pastoral plantations through the Joint Forest Management Committees, the horti-pastoral activities can be initiated by incentivizing the farmers who are owners of the orchards.

Improving production by using high yielding fodder varieties

6. Use of quality fodder seeds including dual purpose grains like bajra, maize and jowar, etc., is essential for improving productivity. Some of the cultivated fodder species for different regions are indicated below (list is illustrative):

Type of Land	Rainfed	Irrigated
(a) Arid Tracts	Jowar, Bajra, Moth, Guar, Lobia	Lucerne, Berseem, Oats, Maize, Jowar, Bajra
(b) Semi-dry	Bajra, Jowar, Lobia, Moth, Guar, Velvet Bean, Field Bean, Moong	Jowar, Maize, Lobia, Teosinte, Lucerne, Berseem, Sarson, Turnips, Hybrid Napier, Oats, Sudan grass, Guinea grass, Setaria sphacelata, Rhodes
(c) Semi-wet	Dinanath Grass, Jowar, Lobia, Rice Bean, Velvet Bean, Teosinte, Sunnhemp	Berseem, Oats, Sudan grass, Hybrid Napier, Guar, Jowar, Maize, Para grass, Rhodes, Setaria
(d) Wet regions	Jowar, Dinanath, Rice Bean	Berseem, Oats, Hybrid Napier, Guinea, Lucerne, Berseem, Sarson, Turnips, Hybrid Napier, Oats, Setaria, Para grass, Jowar
(c) Lower hills	Jowar, Lobia, Bajra, Velvet Bean, Field Bean, Guar	Maize, Jowar, Oats, Berseem, Lucerne, Hybrid Napier, Sudan, Setaria, Rhodes

7. An illustrative list of trees, shrubs and grasses for development of pastures, suitable for different regions is enclosed in the **Annexure-I**.

8. Inadequate availability of quality fodder seeds is a major constraint. Fodder seed production is not remunerative in many of the fodder crops. State Governments may take initiatives to encourage farmers for taking up the production of high yielding varieties by providing sufficient incentives to farmers for production of fodder seeds of high yielding varieties by way of assured procurement with a remunerative price and assistance of inputs. State Governments can avail the benefit of the component of 'Fodder Seed Procurement and Distribution' under the 'Centrally Sponsored Fodder and Feed Development Scheme'. Provisions under AFDP can also be utilized for this purpose.

9. Following high yielding fodder varieties may be considered for seed production programme for improving fodder yield per hectare in respect of existing area under fodder:

S.No.	Name of the fodder crop	Name of varieties
1	Maize	African tall, J-1006, Vijay composite.
2	Sorghum	SSG 59-3, PC-23, PC-9, PC-6, HC-136, MP Chari, CO-FS-29,
3	Hybrid Napier	CO-4, C-23, NB-21,PNB -84
4	Bajra	Giant, L-74, GFB-1, Bajra rajco, HC 20, AVKB-19.
5	Cowpea	EC-4216,NP-3,
6	Guar	BG-1, BG-2, BG-3, Bundel-2, HG 365, HG563, RG- 1003
7	Berseem	BL-I, BL-10
8	Oats	Kent, OS-6,
9	Chinese cabbage	

10. Emphasis be also laid on availability of seeds of short duration and dual purpose crops, which can be used in emergency of drought / floods, for getting fodder in short period. States may ensure availability of such dual purpose quality seeds in consultation with respective Agricultural Universities.

Adopting suitable crop combinations

11. Productivity potential of most lands can be best uitlised through not only crop rotation, but also adopting suitable crop combinations. An indicative list of possible

production under different combinations of fodder crops is at **Annexure-II** which shows higher productivity for different crops.

12. There is a need to disseminate the benefits of using high yielding quality fodder seeds and combination of crops among the farmers through front line demonstrations (FLD) and minikits. For this purpose, funds available under RKVY, AFDP and Centrally Sponsored Fodder and Feed Development Scheme can be utilised.

13. Cultivation of Azolla may be taken up on large scale as it is highly nutritious, rich in protien and ready within a week's period and available every day thereafter. This Department is implementing a scheme on Establishment of Azolla Production Units. States can avail the benefit for the same, besides utilizing funds under AFDP and RKVY for the purpose.

Improvement of grasslands/wastelands, and other community lands

14. This Department is implementing the component of grassland development including grass reserves with 100% Central grant. States can avail benefit under the scheme. Besides, other marginal lands like roadside land, canal side land, land along the railway tracks, etc., may also be utilised for forage cultivation. The forest department can also undertake silvi-pastoral plantations in degraded forest areas through the Joint Forest Management Committees for use of the communities as explained earlier.

15. Wasteland like waterlogged areas, saline soils, sodic soils, etc., can also be utilized for cultivation of fodder varieties suitable for such areas.

Conservation and Utilization of Crop Residues/Bye-products

16. Diversion of crop residues for industrial use, etc., may be restricted / banned.

17. The State Governments should make it a priority programme to install chaff cutters and construction of manger in each and every household keeping cattle, in order to economize the use of available fodder. This measure can result in saving of upto about 30% fodder.

18. Though, in general, there is scarcity of green fodder in the country, but still in most places surplus green fodder is available during the monsoon. A major part of this surplus green fodder goes waste or is improperly stored, reducing its nutritional value. The farmers may be trained in the techniques like making silage, and be provided assistance under the Central or State schemes to facilitate silage making at household level.

19. The availability of dry fodder can be enhanced by installation of low capacity Fodder-block making units at each Primary Milk Cooperative / Panchayat level. Tractor mounted fodder block making units are now available, which can be operated in the fields to store surplus fodder/dry fodder. Agricultural refuge can be

densified with or without mixing it with easily available material like urea, molasses, butter milk, etc., for easy storage and use during the lean period.

20. State Governments may promote use of crop residues and agricultural wastes/bye-products as animal feed by enriching it through available technologies like treatment of straw with urea and molasses along with silage. Green topping of sugarcane and other crops should be saved for use as fodder.

21. The Government of Haryana has imposed a ban on burning of agricultural refuge in the fields. Other States may also adopt similar controls to prevent wastage or diversion of dry fodder.

Development of Fodder Banks

22. The Milk Cooperatives and Panchayat may be assisted for keeping surplus fodder for use during crisis periods. Gaushalas may be encouraged and trained to popularize high-yielding fodder and forage crops and supported for creating fodder banks through silage or fodder blocks and enrichment of crop residues, etc. States with surplus dry fodder may indicate the quantity and type of fodder available with them, so that necessary arrangements for supply to scarcity area can be made.

Strengthening of Extension activities

23. It has been seen that very less emphasis is given on extension activities for feed and fodder development. States may strengthen extension activities by associating KVKs, which must play a lead role in educating the farmers in maximizing fodder output with limited land and ensuring quality of feed. Progressive livestock farmers may be identified for training through KVKs/SAUs for growing improved varieties of fodder. The progressive farmers can in turn train other farmers.

24. Use of leguminous crops with forage varieties may be popularised through frontline demonstrations through the KVKs. The Regional Fodder Stations of the Government of India have the latest varieties and recommended crop mixtures for the region.

Convergence of fodder schemes with MGNREGA

25. State Governments have been requested earlier to dovetail the fodder and feed development programmes with the MNREGA. The guidelines of MNREGA provide for location-specific grassland development for ensuring adequate fodder supply. The guidelines for the new / additional works permitted under MNREGA also prescribe various livestock related works, including construction of fodder trough (manger) and Azolla units. It is suggested that all the beneficiaries who receive or have received the chaff cutters under any of the Govt. schemes must be provided assistance under MNREGA for construction of fodder trough and Azolla.

Annexure-I

LIST OF FORAGE GRASSES, LEGUMES, SHRUBS AND TREES FOR GRASSLAND/GRAZING LAND IMPROVEMENT ON AGRO-ECOLOGICAL BASIS

Agro-eco Regions	Grasses	Legumes	Shrubs/Trees
Western Himalaya, cold arid with shallow skeletal soils	*Agrostis spp., Poa alpina, Trisetum spicatum*	*Medicago sativa/subsp sativa, M. sativa, subsp fslcuta*	*Hippophae rhamonides*
Western plains and Kaccha Penisula, hot arid with desert and saline soils	*Cenchrus ciliaris, C. setigerus (Sandy plains), Lasiurus scindicus (Sandy interdunal plains), Panicum turgidum (Sand dunes) Chloris gayana, Sporobolus marginatus (salt affected lands)*	*Cassia rotundifolia*	*Acacia nilotica, A. tortilis, Albizia lebbeck, Ailanthes excelsa, Dichrostachys cinerea, Prosopis cineraria, Ziziphus nummularia, p. juliflora, Salvadora oleoides, S. persica (Saline soil)*
Deccan Plateau, hot arid with red and black soils	*Andropogon gayanus, Chrysopogon fulvus (Red soil), Dichanthium annulatum, Bothriochloa intermedia (Black soil)*	*Clitoria ternatea, Stylosanthes hamata, S. scabra*	*Acacia nilotica, Albizia amara, A.lebbeck, Desmanthus virgatus, Leucaena leucocephala, Tamarindus indica*
Northern plains and central highlands incluldling Aravallis, hot semi-arid with Alluvium	*Bothriochloa intermedia, Cenchrus ciliaris, Chrysopogon fulvus, Dichanthium annulatum, Sehima neroosum*	*Macroptilium atropurpureum, Stylosanthes hamata, S. scabra*	*Acacia nilotica, A. holosericea, Albizia amara, A.lebbeck, A. procera, Azairachta indica, Dichrostachys cinerea, Hardwickia binata, Leucaena leucocephala, Sesbania grandiflora, S. sesban*
Central (Malwa) highlands, Gujarat plains & Kathiawar Peninsula, hot semi-arid with red loamy soils	*Bothrichloa intermedia, Chloris gayana, Cynodon dactylon, Dichanthium annulatum, Pancium maximum*	*Arachis hagenbackii, Clitoria ternatea, Stylosanthes hamata, S.scabra*	*Albizia lebbeck, Artocarpus lackoocha, Dendrocalamus strictus, Gliricidia sepium, Faidherbia albida, Holoptelia integrifolia, Pithecellobium dulce*
Deccan Plateau, hot semi-arid with shallow and medium black soils	*Bothriochloa intermedia, Brachiaria decumbens, Cenchrus setigerus, Dichanthium annulatum, Pennisetum pedicellatum, Panicum maximum*	*Arachis hagenbackii, Stylosanthes hamata, S. scabra*	*Acacia nilotica, Albizia procera, Anogeissus pendula, Bauhinia variegata, B. purpurea, Leucaena leucocephala, Moringa oleifera, Pterocarpus marsupium, Sesbania sesban, Terminalia arjuna*
Deccan (Telangan) Plateau and Eastern Ghats, hot semi-arid with red and black	*Andropogon gayanus, Bothriochloa intermedia, Chrysopogn fulvus, Pennisetum pedicellatum, Dichanthium annulatum*	*Atylosia scrabaeoides, Macrotyloma axillare, Macroptilium atropurpureum, Stylosanthes scabra*	*Albizia lebbeck, Gliricida sepium, Faidherbia albida, Holopteaia integrofolia, Leucaena leucocephala*
Eastern Ghats,	*Brachiaria decumbens, B.*	*Arachis*	*Ailanthes malabarica, albizia*

TN uplands and Deccan (Karnataka) Plateau, hot semi-arid with red and black soils	*ruziziensis, Cynodon dactylon, Dichanthium annulatu, Bothriochloa intermedia*	*hagenbackii, A. glabrata, Stylosanthes guinensis, S. hamata*	*falcataria, Erythrina variegata, E. poppygyana*
Northern plains, hot sub-humid (dry with Alluvium derived soils	*Bothriochloa intermedia, Cynodon dactylon, Chloris gayana, Dicanthium annulatu, Pennisetum pedicellatum*	*Clitoria ternatea, Macroptilium atropurpureum, Stylosanthes hamata*	*Albizia stipulata, Desmathus virgatus, Azadirachata indica, Ficus racemosa, Leucaena leucocephala, Robinia, pseudoacacia*
Central Highlands (Malwa, Bundelkhand & Satpura) noth sub-humid with black and red soils	*Andropogon gayanus, Pennisetum pedicellatum (red soil), Bothriochloa intermedia, Chrysopogon fulvus, Sehima nervosum, Dichanthium annulatum (black soil)*	*Atylosia scarabaeoides, Macroptilium atropurpureum, Stylosanthes hamata, S. scabra*	*Albizia amara, A. lebbeck, Anogeissus latifolia, A. pendula, Dichrostachys cinera, Hardwickia binata, Leucaena leucocephala*
Eastern Palteau (Chhatisgarh), hot sub-humid with red	*Bothriochloa intermedia, Cynodon dactylon dichanthium annulatum, Panicum maximum, Pennisetum pedicllatum, Setaria sphacelata*	*Arachis hagenbackii, Stylosanthes hamata*	*Bauhinia variegata, Dalbergia sissoo, Leucaena leucocephala, Moringa oleifera*
Eastern (Chhotangapur) Plateau and Eastern Ghats hot sub-humid with red and laterite soils	*Andropogon gayanus, Bothriochloa intermeida, chrysopogon fulvus, Pennisetum, pedicellatum, Urochloa mosambicensis*	*Atylosia scarabaeoides, Macroptilium atropurpureum, Macrotyloma axillare, Stylosanthes hamata*	*Artocarpus heterophyllus, A. lakoocha, Leucaena leucocephala, Moringa oleifera*
Eastern plain, hot sub-humid (moist) with Alluvium derived soils	*Brachiaria brizantha, B. decumbens, B. mutica, Cynodon dactylon, Paspalum notatum*	*Arachis glabrata, A. hagenbackii*	*Bauhinia variegata, Dalbergia latifolia, D. sissoo, Desmanthus virgatus, Pterocarpus marsupium*
Western Himalayas, warm sub-humid with brown forest and Podzolic soils	*Dactylis glomerata, Festuca rubra, Lolium perenne, Poa spp.*	*Trifolium pratense, T. repens, Lotus comiculatus*	*Quercus incana, Robinia pseudoacacia, Grewia optiva, Celtis australis, Fagus sylvatica, Celtis australis, Morus alba*
Bengal and Assam plains, hot sub-humid (moist) to humid with Alluvium	*Brachiaria decumbens, B. mutica, Paspalum notatum*	*Desmodium uncinatum, D. heterophyllum*	*Artocarpus heterophyllus, A. lakoocha, Ficus hookeri, F. nermoralis, Parkia roxburghii, Morus alba*

derived soils			
Eastern Himalayas, warm per-humid with brown and red soils	*Coix lacryma-jobi, Pennisetum clandestinum, Tripsacum dactyloides*	*Desmodium spp., Pueraria phaseoloides*	*Celtis australis, Ficus hookeri, F. nemoralis, F. semicordata*
North-eastern Hills (Purvanchal), warm per-humid with red and laterite soils	*Brachiaria decumbens, Pennisetum clandestinum, Tripsacum dactyloides*	*Arachis spp. Desmodium uncinatum*	*Dendrocalamus hamiltonii, Parkia roxbrughii, Morus alba., Robinia pseudoacacia*
Eastern Coastal plain, hot sub-humid to semi-arid with coastal Alluvium derived soils	*Chloris gayana, Cynodon dactylon, Dichanthium annulatum, Pennisetum pedicellaum, Stenotaphrum dimidiatum, Urochloa mosambicensis*	*Stylosanthes guinensis*	*Ailanthes malabarica, Erythrina variegata, E. poeppigiana, Ficus retusa*
Western Ghats and Coastal Plain, hot humid per humid laterite and Alluvium derived soils	*Cynodon dactylon, Dichanthium annulatum, Panicum maximum, Pennisetum clandestinum, P. polystachyon, Setaria sphacelata*	*Clitoria ternatea, Desmodium heterophyllum, Pueraria thunbergiana, Stylosanthes hamata, S. guiensis*	*Ailanthes malabarica, Erythrina variegata*
Islands of Andman Nicobar and Lakshdweep hot humid to per humid island with red loamy and sandy soils	*Andropogon gayanus, Cynodon dactylon, Cenchrus ciliaris, Pennisetum pedicellatum, p. polystachyon, Brachiaria ruziziensis, Tripsacum laxum*	*Centrosema pubescens, Clitoria ternatea, Macroptilium atropurpureum, Stylosanthes guianensis, S. scabra*	*Bauhinia purpurea, Erythrina variegata, Leucaena leucocephala, Trema tomentosa, Pithecellobium dulce, Gliricidia sepium*

Annexure-II

Stratified fodder-production potential of the best fodder crop combinations

Best 2-3 rotations at various centres	Green fodder yield (q/ha)
(1) Jhansi	
1. Hybrid Napier + Cowpea - *Berseem* + *Sarson*	2,863
2. Maize + Cowpea - M.P. Chari - *Berseem* + *Sarson*	1,972
3. M.P. Chari - Turnips - Oats	
(2) Hyderabad	
1. Hybrid Napier + Cowpea - Hybrid Napier + Cowpea - Hybrid Napier +*Berseem*	1,334
2. Maize + Cowpea - *Bajra* +Cowpea + *Berseem*	1,267
3. *Madikattujonna* + Cowpea - Jonna (Ratoon) + Cowpea - *Berseem*	1,098
(3) Anand	
1. Hybrid Napier alone	2,877
2. Hybrid Napier + *Guar* - Lucerne	2,529
3. Maize + Cowpea - Maize - Cowpea - Oats - Maize + Cowpea	1,685
(4) Kalyani	
1. Maize + Cowpea - *P. Pedicellatum* - Oats	1,308
2. Maize + Cowpea - Rice Bean - *Berseem* + *Sarson*	1,115
3. Maize + Cowpea + *Jowar* + *Cowpea* - *Oats*	884
(5) Kanker	
1. Maize + Cowpea - Oats - *Bajra* + Cowpea	1,026
2. *Jowar* + Cowpea - *Berseem* + *Sarson* - Maize + Cowpea	960
3. *Bajra* + Cowpea - *Berseem* + *Sarson* - Maize + Cowpea	959
(6) Pantnagar	
1. Napier + *Berseem* intercropped and cut at the optimum time	2,141

2. Napier + *Berseem* intercropped and cut at the same time	1,998
3. Napier +Lucerne intercropped and cut at the optimum time	1,960
(7) Jorhat	
1. Hybrid Napier alone	1,442
2. Maize + Cowpea - Maize - *Jowar* - Oats	664
3. Guinea alone	607
(8) Hissar	
1. Napier - *Bajra* Hybrid intercropped with *Berseem*	2,117
2. Napier - *Bajra* Hybrid + Lucerne	1,760
3. *Berseem* + Japan Rape - *Jowar* + Cowpea - *Jowar* + Cowpea	1,705
(9) Coimbatore	
1. Sorghum + Cowpea - Maize + Cowpea - Maize + Cowpea	1,107
2. Maize + Cowpea - Maize + Cowpea - Maize + Cowpea	1,060
3. Guinea grass round the year	935
(10) Palampur	
1. Maize + Cowpea - Lucerne + Oats + *Sarson*	844
2. Maize + Cowpea - Turnip - Oats + Pea - Cowpea	833
3. M.P. Chari + Cowpea - Oats + Pea - Cowpea	782
(11) Jabalpur	
1. Hybrid Napier intercropped with Cowpea - *Berseem* and Cowpea	1,761
2. M.P. Chari - Cowpea - *Berseem* + *Sarson* - *Jowar* + Cowpea	1,686

Based on All-India Coordinated Project for Research on Forage Crops of ICAR

Monitoring the quality of Livestock / Poultry / Fish Feeds

With the increase in demand of animal proteins, the demand for animal feed is also growing rapidly. There is a need to regulate the quality of animal feed vis-à-vis the BIS standards. The list of various standards notified by BIS in respect of animal feed and fish feed are available on BIS website www.bis.org.in, which may be referred to.

2. As fodder and feed is not included in the Schedule under the Essential Commodity Act, 1955, the possibility of monitoring the quality of feeds available in the market using the provisions under the 'Consumer Protection Act, 1986', and 'The Bureau of Indian Standards Act', 1986 may be examined.

3. The relevant provisions of the **Consumer Protection Act are given below:**

Under section 2 (1) (c), "**complaint**" means any allegation in writing made by a complainant that-

(i) An **unfair trade practice** or a restrictive trade practice has been adopted by any trader or service provider;
(ii) The goods bought by him or agreed to be bought by him suffer from one or more defects;
(iii) Service hired or availed of or agreed to be hired or availed of by him suffers from deficiency in any respect;
(iv) a trader or the service provider, as the case may be, has charged for the goods or for the service mentioned in the complaint, a price in excess of the price in excess of the price-

(a) fixed by or under any law for the time being in force;
(b) displayed on the goods or any package containing such goods;
(c) displayed on the price list exhibited by him by or under any law for the time being in force;
(d) agreed between the parties;

(v) goods which will be hazardous to life and safety when used are being offered for sale to the public:

(A) **in contravention of any standards** relating to safety of such goods as required to be complied with, by or under any law for the time being in force;

(B) if the trader could have known with due diligence that the goods so offered are unsafe to the public;

(vi) service which are hazardous or likely to be hazardous to life and safety of the public when used, are being offered by the service provider which such person could have known with due diligence to be injurious to life and safety.

4. As is evident from the above, if any livestock feed/fish feed being sold in the market is found to be deficient with reference to the prescribed BIS standard for the said feed, then it may be examined if there is any violation of the Section 2(1)(c)(i) or 2(1)(i)(ii) or any other provision of the Consumer Protection Act and necessary penal action against the defaulter may be initiated. It may be noted that, as defined under section 2 (1) (b) (iii) of the said Act, the Central Government or any State Government can also act as 'complainant'.

5. Under section 11 and 12 of **'The Bureau of Indian Standards Act, 1986'** (reproduced below), using the Standard mark without authority, or on articles or processes not conforming to Indian Standards, is prohibited.

> **"Section 11 -** (1) No person shall use, in relation to any article or process, or in the title of any patent, or in any trade mark or design the Standard Mark or any colourable imitation thereof, except under a licence.
>
> (2) **No person shall**, notwithstanding that he has been granted a licence, **use** in relation to any article or process **the Standard Mark** or any colourable imitation thereof **unless such article or process conforms to the Indian Standard**.
>
> **Section 12** - No person shall, except in such cases and under such conditions as may be prescribed, use without the previous permission of the Bureau, -
>
> a. any name which so nearly resembles the name of the Bureau as to deceive or likely to deceive the public or which contains the expression "Indian Standard" or any abbreviation thereof; or
> b. any mark or trade mark in relation to any article or process containing the expressions "Indian Standard" or "Indian Standard Specification" or any abbreviation of such expressions."
>
> Contravention of above provisions is punishable under section 33 (1), with imprisonment for a term which may extend to one year or with fine which may extend to fifty thousand rupees, or with both.

6. The State Governments may designate officials with the Animal Husbandry Departments and / or the Milk Cooperatives for regular collection of samples of branded feed being sold in the market, get the samples sealed in a transparent manner, and send the samples for testing against relevant BIS Standards. In case of any deviation from the standards, a designated official may inform the competent authority to initiate appropriate legal action in addition to making the farmers aware of the deficiency in the feeds through extension officials and advertisement / circulars, etc., and a copy of such circular be also sent to DADF. The concerned manufacturer / supplier may also be informed.

Modifications in the Centrally Sponsored Scheme of Feed & Fodder Development

The competent authority has approved the following modifications in the Centrally Sponsored Fodder and Feed Development Scheme (CSFFDS), within the budget provision for the year, 2012-13.

(i) Including a new component of 'Establishment of Fodder Banks' under the CSFFDS within the budget provision, for the financial year, 2012-13.

(ii) The Central share for the component of 'Establishment of Fodder Block Making Units' under the CSFFDS has been increased from 50% to 75% for the financial year 2012-13 for Cooperatives / Milk Unions / Federations, and for State Governments to facilitate harvesting and storage of surplus fodder in areas where rainfall has been good or where fodder has been grown in irrigated land.

2. The detailed guidelines are given below at **Annexure-I**.

Annexure-I

New Component of 'Establishment of Fodder Banks'

The Centrally Sponsored Scheme on Fodder and Feed Development does not provide for establishment of fodder banks. Some of the States may establish fodder banks in the year 2012-13 to meet the requirement of livestock in areas notified as drought affected. The fodder banks will facilitate procurement and storage of fodder from surplus areas or areas where rainfall has been satisfactory, and this fodder can be distributed to cattle camps and deficient areas. Therefore, the component of 'establishment of fodder banks' has been included in the Centrally Sponsored Fodder and Feed Development Scheme for the year 2012-13 to meet the situation on account of drought in this Kharif. The cost of establishment of fodder bank may vary depending upon the availability of fodder and crop residues, location, capacity of the fodder block making machine and other machinery, etc. However, in order to reduce the cost, low capacity tractor mountable fodder block machines should be used as far as feasible.

The guidelines with respect to the component of 'establishment of fodder banks' are at **Appendix-I**.

The component of establishment of fodder block making units, which is a part of the Centrally Sponsored Fodder and Feed Development Scheme, provides for 50% Central share, limited to Rs. 42.50 Lakh, which is half of the estimated cost of the Unit of 50 MT per day capacity. To encourage greater use of fodder blocks and establishment of fodder banks, the central share has been enhanced to 75% for year 2012-13, for those units which are established by Cooperatives / Milk Unions / Federations or by the State Government directly. Accordingly, for establishing fodder block making units of 50MT capacity, the Cooperatives / Milk Unions / Federations, or the State Government may avail assistance of 75% of the actual cost as Central share for the year 2012-13. The maximum Central share for 50MT/day capacity fodder block making unidt for Cooperatives / Milk Unions, Federations and State Government will be Rs. 63.75 lakh which is 75% of the cost of such unit. For private individuals / entrepreneurs, the central share will remain 50%, with maximum ceiling of Rs 42.50 lakh for 50MT / day capacity.

Appendix -I

GUIDELINES FOR ESTABLISHMENT OF FODDER BANKS

S. No.	Particulars	Description
1.	Objectives	(i) Preservation / storage of surplus fodder to meet the nutritional requirement of livestock in deficient areas over the period till June 2013. (ii) To stabilize the price of fodder and keep the supply intact in problematic areas.
2.	Salient Features	(i) The States / State implementing agencies will arrange for growing / harvesting and procurement of green fodder under a buy back arrangement, procurement of dry fodder, creation of infrastructure for storage of green / dry fodder and machinery for harvesting, bailing, densifying, and transportation of fodder (ii) The seeds of fodder varieties / dual purpose varieties will be provided to the farmers for sowing in the area wherever it is possible, with buy-back arrangement of green fodder. The fodder thus produced will be procured by the State / Implementing Agencies at pre-decided remunerative prices as would be decided by State Government. (iii) The fodder will be temporarily stored through silage or by making fodder blocks, and supplied to the needy farmers on cost plus basis. The sale proceeds can be used for continuing procurement of green fodder for sustaining the fodder bank, which should be operated through a separate bank designated account by the implementing agency. (iv) State Governments / implementing Agency would submit an appropriate project proposal for consideration of the DADF. Cost of land should not be included in the estimate. Cost of temporary platforms and low-cost covers can be included to facilitate storage of fodder for limited periods.

3.	Pattern of financial assistance	(i) One time grant 100% Central Assistance will be provided as per the requirement of the State / Implementing Agency. (ii) Implementing Agency will assess the fodder seed requirement with their cost, make contract with farmers for rates of fodder with farmers, including farmers in irrigated areas for producing green fodder with the assurance for buy back of green fodder produced at a remunerative price to be decided by the State Government. The State Government will make arrangement for converting the green / dry fodder into usable form by chopping, enrichment, densification, etc. through silage or fodder blocks. Low capacity tractor mountable fodder block machines should be given preference for such projects in view of its flexibility in being used at different places where surplus fodder may be available. (iii) States will also explore the possibilities of growing / procuring fodder for fodder bank from the forest areas through the Joint Forest Management Committees, in consultation with the Forest Department.
4.	Implementing agencies	State Animal Husbandry / Agriculture Departments, Milk Federations / Cooperatives / Unions, State Livestock Boards, National Seed Corporation, and State Farms Corporation of India, etc.

Annexure-II

Provision for Feed Concentrates in Drought Affected Areas:

Although providing sustenance fodder to the livestock is the priority during the drought situation, it is vital to ensure that the nutritional level of productive milch animals is maintained to sustain production of milk. Under the SDRF and NDRF, there is provision for supply of concentrates in cattle camps. But such a provision is not available for milch animals outside the cattle camps. Taking into account the drought situation in the year 2012-13, States may consider to provide subsidised feed concentrates to milch animals at the rate of 1 Kg per cattle per day from the National Mission for Protein Supplements (NMPS) with following conditions:-

(i) This provision will be applicable only in the areas notified as drought affected.

(ii) The expenditure on subsidies on feed concentrates shall be met from the NMPS within the existing allocation to the concerned State for the year 2012-13. The NMPS guidelines may be treated as modified accordingly.

(iii) The State Governments will devise a suitable mechanism to ensure that only deserving farmers get the benefit of subsidised feed in a transparent manner. The list of eligible farmers and the number of cattles / buffaloes to be provided with subsidised feed concentrates will be approved by the Gram Panchayat or Gram Sabha of the concerned village within the area notified as drought affected.

(iv) One farmer household will be entitled to subsidized fodder for maximum 6 cattle or buffaloes.

(v) The subsidy to be provided on the feed concentrates may vary from 25% to 50% of the cost of the feed, as would be decided by the State Government.

(vi) The States may also provide assistance for feed and feed supplements to goats and sheep if required, to maintain production of meat, within the relevant component of NMPS in the areas declared as drought affected. Adult goats and sheeps, in the areas where these are under stress due to drought, may be provided 200 gm per head of concentrates per day at a subsidy of 25% - 50% of cost as would be decided by the State Government.

(vii) State Governments are advised to give preference to BPL farmers in providing assistance under different fodder schemes, including supply of concentrates to cattle and goats / sheep.

(viii) Efforts should, however, be made to meet the nutritional requirements of livestock through locally available feed material, and to reduce dependence on funds

under NMPS. Funds under MNREGA may also be used, especially in drought affected areas, for promoting Azolla cultivation and other activities to augment availability of fodder, as allowed under the guidelines for MNREGA.

Advisory on improving sheep & goats production

(i) In the short term, prevention of loss should be the strategy to augment production. A number of animals die because of diseases and many of the animals do not reach desired growth because of parasitic infestations. A strategy of universal de-worming, once post-weaning, and once during last month of pregnancy and before sale for meat production will radically minimize production loss. Studies are available to indicate that such practices have the potential of enhancing weight at 8 months by almost 3 Kilos. This means enhanced production of 1½ kg meat per animal can be achieved simply through adoption of a programme of administration of anthelmintics to weaned kids and lambs as well as pregnant mothers. Cost of such de-worming per animal is expected to be less than Rs.40/- approximately, while the expected gain will be over Rs.500/-. This is to be further strengthened with vaccination programme, particularly against PPR, HS, and Enterotoxaemia, FMD, Sheep-pox, etc. total cost of which will not exceed Rs.25/- per animal approximately **(Annexure-I**). Model health schedule adopted by Central Sheep & Wool Research Institute, Avikanagar, Tonk, Rajasthan **(Annexure-II**) / Central Institute for Research on Goats, Makhdoom, Mathura, Uttar Pradesh **(Annexure-III**) may be adopted by the States after required modifications.

(ii) Grazing resources for small ruminants are continuously shrinking. Therefore, arrangements for supply of complete feed blocks would greatly supplement nutritional inputs required for optimum production, particularly during periods of nutritional stress as in draught. Feed blocks can further be fortified with trace elements which the particular area is deficient in as per mineral mapping documents available with research organizations. It will be useful if the Panchayats are involved and MNREGA funds roped in to procure raw material which will facilitate production and distribution of complete feed blocks in a regulated manner.

(iii) An advisory has already been issued by the Department in July, 2012, which gives the list of shrubs and trees suited to different agro-ecological regions of the country. These may be made integral part of land use planning to augment grazing resources for small ruminants.

(iv) Lamb/kid survival may be increased by adopting a sound pre-breeding management program, close attention to ewes/does nutritional and health status during late gestation, keeping housing facilities clean and well ventilated, adequate colostrum intake by lambs/kids, selection of sheep/goat that are easy lambing/kidding, good mothers, heavy milking and vigorous at birth.

(v) A ram/buck is "half the flock." His genetics will be spread over many more offspring than an ewe/doe. Rams/Bucks will be the primary means by which genetic improvement will be made in a flock. To avoid inbreeding, exchange of bucks/rams between farmers may be adopted through appropriate exchange programmes/ breeding policy.

(vi) Rams/Bucks having maximum post weaning growth rate should be selected for breeding. Rams/Bucks with any congenital abnormalities or any other abnormalities in testis should be culled. Identify and cull unproductive animals.

(vii) Sheep/Goats consume 4 times as much water as dry matter but for lactating goats, provide additional 1.3 litres of water per litre of milk produced. Ensure availability of adequate clean water to animals.

(viii) An external parasitic free rearing will lead to reduction in infection and increase in production. Each State with the help of nearby SAUs/ ICAR institutions must develop 'An integrated parasitic disease control programme' for their respective areas. The haphazard/injudicious use deworming in animals is derecommended and States should exercise judicious use of anthelmintics including timely rotation as well as control on the sale of anthelmintics drugs.

(ix) Following institutes of Central Government/ICAR impart training to farmers on modern sheep/goat management practices to enhance production which may be utilized by the farmers as well as by the technical staff:

- Central Sheep Breeding Farm, Post Box No. 10, Hisar, PIN-125001, Haryana. Phone: +91-1662-264329, Fax: +91-1662-264263.
- Central Sheep & Wool Research Institute, Avikanagar, Tehsil - Malpura, Distt.- Tonk, Rajasthan, PIN-304501. Phone: +91-1437-220162, Fax: +91-1427-220163.
- Central Institute for Research on Goats, Makhdoom, Mathura, Uttar Pradesh, PIN-281122. Phone: +91-565-2763380, Fax: +91-565-2763246.

Annexure-I

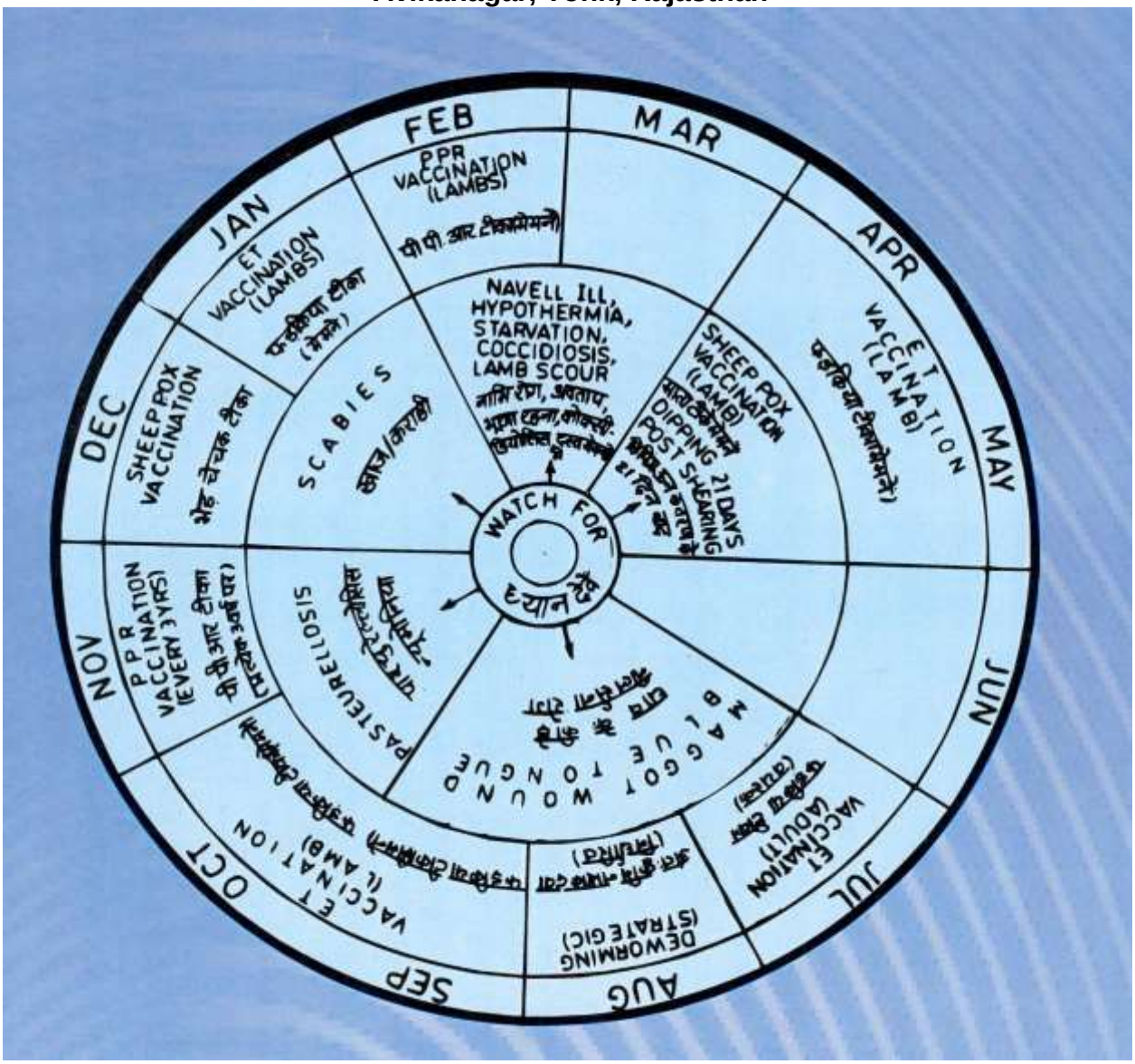
Annual Health Calendar (Sheep & Goat) adopted by Central Sheep Breeding Farm, Hisar, Haryana

1	VACCINATION			
a).	Sheep Pox Vaccine Cost per dose :- Rs 1.00	Live Attenuated	December / January	All Breed At 4 Months Annually
b).	Goat Pox Vaccine Cost per dose :- Rs 2.00	Live Attenuated	October / November	All Goat At 4 Months Annually
c).	Multi Component Clostridial Vaccine Cost per dose :- Rs 1.97	Inactivated	August/October	All stock, New Born Lambs(Sheep &Goat) 1. At 1 month & Booster Dose after 21days. 2. Repeat after 9 months.
d)	Biovac (FMD +HS) Cost per dose :- Rs 5.21	Oil Adjuvant	October/June	Sheep & Goat 1. At3 months. 2. Repeat after 9 months.
e)	Contagious Ecthyma Vaccine (Farm Produce)	Formalized	Feb./March	Lambs & Kids 1. At 2 months.
f)	PPR Cost per dose :- Rs 1.00	Live Attenuated	October / November	All sheep& Goat 1. At 6months & Repeat after 3 years.
g)	Reverine 1 Br.melitensis. Cost per dose :- Rs 46.00	Live Attenuated	Before Breeding	All Sheep& Goat 1. At 3-6 months & Booster dose is not necessary.
2.	DEWORMING:			
a).	Broad Sepectrum Anthelmentic	Ivermectin / Closental / Albendazole		At every two rotation of months/medicines
b).	Narrow Spectrum Anthelmentic	Praziquintol	April/May	All Lambs , Kids & Weaners 1. At 2&Repeat at 4-6 months.
c).	Anti Coccidial treatment	Sulphamethazine + Trimethoprim	June/July	Young animals & at the time diarrhoea 1. At 2-3months

				mix with feed.
3)	ECTOPARASITIC INFESTATION			
a).	Dipping	Ectomin / Butox	Sept/Oct/Mar/Apr.	Post-Shearing
4)	LAMB/KID CARING			
a).	Naval dressing with Povidine /Betadine Immediately after birth.			
b)	Colostrum feeding to entire yound stock.			
c).	Antibiotic treatment during change of weather			
5)	IMMUNOSTIMULENT	In. Lemasol	With vaccination (Twice in a year)	

Annexure-II

Model health schedule adopted by Central Sheep & Wool Research Institute, Avikanagar, Tonk, Rajasthan



Annexure-III

Annual Goat Health Calendar adopted by Central Institute for Research on Goats, Makhdoom, Mathura, Uttar Pradesh

(for prevention and management of important goat diseases)

A. Vaccination:

Diseases	Primary Vaccination		Repeat vaccination
	First Injection	Booster Injection	
1. Peste-des-Petitis Ruminants (PPR)	At 3 months of age	Not required	Every 3 years
2. Foot & Mouth Disease (FMD)	At3-4 months of age	3-4 weeks after 1st Injection	Every 6/12 month interval*
3. Goat Pox (GP) **	At3-4 months of age	3-4 weeks after 1st Injection	Every 12 month interval*
4. Enterotoxaemia (ET)	At3-4 months of age	3-4 weeks after 1st Injection	Every 6/12 month interval*
5. Haemorrhagic Septicaemia (HS)	At3-4 months of age	3-4 weeks after 1st Injection(2 dosesat1 month interval)	Every 6/12 month interval*

*As per the recommendations of manufacturers

Kids are naturally protected from diseases up to 3 months by proper feeding of colostrum immediately after birth.

For optimum benefits of vaccination, deworm your animals at least 15 days before vaccination

***For sheep** – replace goat pox vaccine with **sheep pox** vaccine*

B. Drenching, deworming and dipping

Diseases	Age groups	Treatment period	Recommended as feed mix
1. **Drenching** Coccidiosis	1 – 6 months	Anti - coccidialdrug for 5-7 days	Amprolium @50-100 mg / Kg body weight
2. **Deworming** Endoparasitic infection	3 months and above	Twodewormings annually (pre and post monsoon)	Fenbendazole @7.5 -10 mg / Kg body weight. Additional deworming may be needed in cases of heavy parasitic load or extended rainy season
3. **Dipping***/ Ectoparasitic infestation	Any age	Pre & Post winter	As and when required Close monitoring and treatment of shed / soil is essential to avoid re-infection

*Avoid cold, cloudy and rainy days for dipping. Preferred time for dipping - 9am. To 11am.

C. Screenings:

Diseases	Period	Recommendations
1. Brucellosis+	Once in a year	Positive animals need to be euthanized and buried
2. Johne's Disease*	6 months/ Once in a year,	Positive animals are to be removed from herd/ flock
3. Mycoplasmosis	Once in a year	Treatment with specific drugs
4. Mastitis	Early milking stage	Treatment with specific drugs

5. Endo- parasites	Regular screening of fecal samples	Monitor worm load (EPG/OPG) of the animals to decide time of deworming.

+ Screening of adult goats especially breeding bucks and breedable females. From aborted animals submit 2 serum samples (Zero day i.e., day of abortion / still births and 21 days after abortion / still birth).

*Preferably one month after kidding

Advisory on Dairy Development

1. Reproductive efficiency among breedable bovines decline substantially due to deficiency of green fodder and quality concentrates. Animals do not come into heat at the right time (i.e. within 90 to 100 days after calving) and dry period increases significantly. Some times animal come into heat but do not conceive because of anovulatory heat during stress period. The decline in milk production and reproductive efficiency will be highest in crossbred cattle followed by buffaloes. If dry period is increased by one month the total milk production in the country will be declined by 11.25 Million Tonnes (As 75 million animals are in milk).

2. The dairy farmers may be explained the importance of area specific mineral mixture scientific nutrition programme for milch animals to increase productivity of animals to produce milk commensurate with their genetic potential and to reduce methane emission. Ration Balancing Programme (RBP) may be taken up wherein milk producers are advised to balance the ration of their animals with the locally available feed resources.

3. Since the reach of ATMA and KVKs are limited it is necessary for them to identify Progressive Farmers in each village/ cluster of villages who can be imparted training, demonstration and taken on field visits. He can then be made a community resource person (CRP) to train the other farmers in the village/ villages.

4. Training programmes breing conducted under the various dairy development scheme and proposed additional programmes under the proposed new scheme NPBBD in addition to the ongoing training programmes is given below:-

Existing training programmes under Dairy Development schemes of Department of AHDF

IDDP	CMP
Training programmes	
Cooperative Development programme	Training of farmer members
Farmer induction programme/ training of farmers	Training of Dairy Coop Societies (DCS) Staffs
Training of Dairy Personnel	Training of village extension workers
Training of DCS staffs	Training of BMC/ Chilling Plant Staff
Training of First Aid/ Field workers	Training of Board of Directors
Training of Management Committee Members & Board of Directors of Milk Union	Training of Dairy Plant staffs, marketing staffs
Training of farmers in good hygienic practices	

New programmes included in NPBBD

Training Programmes	Duration	Norms	Institutes/ Organizations
Training of Management Committee Members & Board of Directors of Milk Union	1-3 months	As per requirement	National Centre for Cooperative Education, New Delhi.
Training of staffs of Dairy Plant, DCS, BMC, Chilling plants, farmers (customized training programme quality control, hygienic practices etc or as per requirement)	1-5 days	Do	Through 630 KVKs all over India, State Agri/ Veterinary university, NDRI etc. Training centres of various milk Unions/ Federatioins can also impart training.
Training of Technical staffs of Dairy Plants on ISO9001-2008 (requirement of quality management system), ISO 22000-2005 (Food Safety Management System) for effective implementation of these certifications	1-2 weeks	Do	Various certification bodies and consultation agencies like TQV(TQV Certification services Ltd), DNV (Det Norske Veritas), BIS (Bureau of Indian Standards) etc.

Fresh Water Aquaculture

A. Composite Fish Culture

Fish is the cheapest and most easily digestible animal protein and was obtained from natural sources from time immemorial for consumption by human beings. Fish farming has become the easier way of increasing the fish production and its availability for consumption. Farmers can easily take up fish culture in village ponds, tanks or any new water body and can improve their financial position substantially. It also creates gainful employment for skilled and unskilled youths. The technology developed for fish culture in which more than one type of compatible fishes is cultured simultaneously is the most advanced and popular in the country. This technology is known as Composite Fish Culture. This technology enables to get maximum fish production from a pond or a tank through utilization of available fish food organisms in all the natural niches, supplemented by artificial feeding. Any perennial fresh water pond/tank retaining water depth of 2 metres can be used for fish culture. However, the minimum level should not fall below one metre. Even seasonal ponds can also be utilised for short duration fish culture.

1. Fish species involved in composite fish culture

Depending on the compatibility and type of feeding habits of the fishes, the following types of fishes of Indian as well as Exotic varieties are identified and recommended for culture in the composite fish culture technology:

Indian Major Carps: Catla, Rohu, Mrigal

Exotic carps: Silver Carp, Grass Carp, Common carp

2. Potential:

The area under tanks and ponds available for warm fresh water aquaculture is estimated to be 2.41 million ha. In addition 0.1.31 million ha of swamps, beels, etc. and low lying water logged area not good for agriculture as also any land where there is copious water supply can be converted for fish farming. Out of the total inland fish production around 80% is contributed by the culture sector. The average productivity from ponds at present is to the tune of 2500 kg/ha/year. This shows the tremendous scope for fish culture in the country. Only 15 % of the potential area of tanks and ponds available is developed so far, showing immense possibilities for horizontal expansion of fish culture.

3. Culture Method: Technical parameters of composite fish culture is given below which includes site selection, items of development, pre and post stocking operations, stocking density, fertilisation, feeding etc.

3.1. Selection of Pond:

The main criteria to be kept in mind while selecting the pond is that the soil should be water retentive, adequate supply of water is assured and that the pond is not in a flood prone area. Derelict, semi derelict or swampy ponds can be renovated for fish culture by dewatering, desilting**,** repair of the embankments and provision of inlet and outlet. The pond may be owned by the individual or taken on lease in which case the lease period should be more or coterminous with the repayment period. The eligible items of pond development are as follows:

i)	Desilting of existing ponds
ii)	Deepening of shallow ponds.
iii)	Excavation of new ponds.
iv)	Impoundment of marginal areas of water bodies.
v)	Construction / repairs of embankments.
vi)	Construction of Inlets / Outlets.
vii)	Any other item like civil structures, watchmen sheds, pump sets water supply arrangements / electricity supply arrangements etc. depending on requirements of the project based on its size etc.

3.2 Pond Management: Pond Management plays a very important role in fish farming before and after the stocking of fish seed. Various measures that are required to be undertaken in pre and post stocking practices are as below:

a) Pre-stocking:

In case of new ponds, pre stocking operations starts with liming and filling of the pond with water. However, the first step for existing pond requiring development deals with clearing the pond of unwanted weeds and fishes either by manual, mechanical or chemical means. Different methods are employed for this.

i) Removal of weeds by Manual/Mechanical or through Chemical means.

ii) Removal of unwanted and predatory fishes and other animals by repeated netting or using mahua oil cake @ 2500 kg/ha metre or by sun drying the pond bed.

iii) Liming - The soils/ tanks which are acidic in nature are less productive than alkaline ponds. Lime is used to bring the pH to the desired level. In addition lime also has the following effects –

a) Increases the pH.
b) Acts as buffer and avoids fluctuations of pH.
c) It increases the resistance of soil to parasites.
d) Its toxic effect kills the parasites; and
e) It hastens organic decomposition.

The normal doses of the lime desired ranges from 200 to 250 Kg/ha. However, the actual dose has to be calculated based on pH of the soil and water.

iv) Fertilisation/ Manuring:

Fertilisation of the pond is an important means for intensifying fish culture by increasing the

natural productivity of the pond. The fertilisation schedule has to be prepared after studying the quality of the pond soil. A combination of both Organic and Inorganic fertilisers may be used for best results. The fertiliser programme has to be suitably modified depending on the growth of the fish, available food reserve in the pond, physico chemical conditions of the pond and climatic conditions.

Inorganic Fertiliser Application (kg/ha/month)

Fertilisation of the pond is an important means for intensifying fish culture by increasing the natural productivity of the pond. The fertilisation schedule has to be prepared after studying the quality of the pond soil. A combination of both Organic and Inorganic fertilisers may be used for best results. The fertiliser programme has to be suitably modified depending on the growth of the fish, available food reserve in the pond, physico chemical conditions of the pond and climatic conditions.

b) Stocking:

The pond will be ready for stocking after 15 days of application of fertilisers. Fish fingerlings of 50- 100 gm size (approx.) should be used for stocking @ 5000 nos. per hectare. However, if fingerlings of smaller size are used, suitable allowance may be made accounting for mortality. The present model envisages stocking of advanced fingerlings and rearing for 10-12 months. Depending on availability of seed and market condition, stocking can be of 3, 4 or 6 species combination in the following ratio.

Species combination (ratio)

Species	3-species	4-species	6-species
Catla	4.0	3.0	1.5
Rohu	3.0	3.0	2.0
Mrigal	3.0	2.0	1.5
Silver Carp	-	-	1.5
Grass Carp	-	-	1.5
Common Carp	-	2.0	2.0

C. Post Stocking:

a) Supplementary feeding:

Fishes need much more food than what is available naturally in the pond. Fishes can be fed with a mixture of rice bran and oilcakes in the ratio 4:1. Due to the high cost of Ground nut Oil Cake (GOC) farmers have tried using alternate sources like Cotton seed oil cake which is comparatively cheaper than GOC. GOC and cotton seed oil cake can be mixed in equal proportions and fed to the fish and is reported to give almost the same growth rate as that of GOC. The feed should be placed on a feeding tray or in feeding bags and lowered to the pond bottom or it can be dispersed at the corners of the pond. After some time the fishes will

get used to this type of feeding and aggregate at the same place at particular time for regular feeding thereby reducing the feed losses. The recommended feeding rate is 5 - 6 % of the body weight up to 500gm size of fish and then reduce to 3.5% of body weight from 500-1000gm size. The feeding is supplementary in nature.

b) Manuring:

i) Organic manuring may be done in monthly instalments @ 1000 kg/ha.

ii) Inorganic fertilisation may be done at monthly intervals alternating with organic manuring. However, the monthly rate of fertilisation will depend on pond productivity and the growth of the fishes. It should be ensured that excess fertilisation does not take place which may result in eutrophication.

c) Harvesting:

Harvesting is generally done at the end of 1st year, when the fishes attain average weight of 800 gm to 1.25 kg. With Proper management a production of 4 to 5 tons/ha can be obtained in a year. Harvesting is done by partial dewatering and repeated netting. In some cases complete dewatering of ponds is resorted to. Some farmers resort to partial harvesting also depending on the season and demand for fish.

B. Intensive Carp Culture

2.1. Fish species involved in intensive fish culture

Composite fish culture using six varieties of fishes is generally being practiced by farmers throughout the country, however, taking into consideration the growth rate , consumer preference and seed availability the farmers in various parts of the country adopt poly culture/ mixed culture of these varieties in varied proportions. The farmers in certain locations have developed the technique for intensive fish culture of two varieties of carps viz; Rohu and Mrigal depending on the compatibility, feeding habits and market preference of the fishes.

Indian Major Carp- Species feeding habit /feeding zone/stocking Density

Catla	Zoo plankton feeder	Surface feeder	550
Rohu	Omnivorous	Column feeder	5000

2.1 Technical Parameters:

Technical parameters of intensive fish culture includes site selection, items of development, pre and post stocking operations, stocking density, fertilisation, feeding etc. which is given below:

1. Selection of Pond:

The main criteria to be kept in mind while selecting the pond is that the soil should be water retentive, adequate supply of water is assured and that the pond is not in a flood prone area. Derelict, semi derelict or swampy ponds can be renovated for fish culture by dewatering, desilting, repair of the embankments and provision of inlet and outlet. The pond may be owned by the individual or taken on lease in which case the lease period should be more or coterminous with the repayment period. The eligible items of pond development are as follows:

B) Stocking:

The pond will be ready for stocking after 15 days of application of fertilisers. Fish fingerlings of 250 gms weight (approx) should be used for stocking @ 5500 nos. per hectare.

C) Post Stocking:

a) Supplementary feeding:
The stocked fishes need much more food than what is available naturally in the pond. Fishes can be fed with a mixture of bran and oilcake in various proportions based on their stage of growth. The feed should be placed on a bamboo tray and lowered to the pond bottom or it can be broadcasted at the corners. After some time the fishes will get used to this type of feeding and aggregate at the same place at particular times of the day. The recommended feeding rate is as under:

Feed Item	%	Kgs
Rice bran	80	9600
Ground Nut Oil Cake	10	1200
Cotton Seed Cake	10	1200
Total	100	12000

b) Manuring:
i) Organic manuring may be done in monthly installments @ 1000 kg/ha.
ii) Inorganic fertilisation may be done at monthly intervals alternating with organic manuring. However, the monthly rate of fertilisation will depend on pond productivity and

the growth of the fishes. It should be ensured that excess fertilisation does not take place which may lead to eutrophication.

D) Harvesting:

Harvesting is generally done at the end of 6 months, when the fishes attain average weight of 1 to 1.25 kg. A production of 4 to 5 tons/ha/ crop can be obtained in one crop and two crop cycles can be taken in a year. However, for the purpose of working out economics' a production level of 8.8 tons/ha/year may be considered. Harvesting is done by partial dewatering and repeated netting while in some cases complete dewatering of ponds is also resorted to.

Coastal Aquaculture

I. Farming of Black Tiger shrimp.

1. Introduction

Coastal aquaculture has been identified by the Government of India as high potential area for increasing the fish and shell fish production and also to achieve economic and social benefits. India with over 8100 Km of coastline, vast stretches of estuaries/ backwaters, lagoons provide enormous opportunities for brackish water shrimp farming. Commercial shrimp farming is almost two decades old in India. During the early nineties due to proven technology in post larvae production and farming of two varieties of shrimps viz: white shrimp (*Penaeus indicus*) and tiger shrimp (*Penaeus monodon*) large scale growth of shrimp farms and hatcheries was witnessed during a short span of five years. However, in December 1996 the Supreme Court had to step in to protect the environment and to control the indiscriminate growth of shrimp farms. To overcome the various problems and also to have sustainable growth guidelines have been issued by the government to ensure that coastal aquaculture is regulated, planned, developed and managed with adequate checks, controls and within the framework and guidelines provided by Coastal Aquaculture Authority, Chennai.

After the successful Green and White Revolution, it is time for Blue Revolution to exploit the huge potential in fisheries sector. Shrimps are called the "Pinkish Gold" of the sea because of its universal appeal, unique taste, high unit value realisation and increasing demand in the world market.

2. Scope for brackish water shrimp farming

The over exploitation of shrimp from coastal waters and the ever increasing demand for shrimp and shrimp products in the world market has resulted in the wide gap between the demand and supply in the International market. This has necessitated the need for exploring newer avenues for increasing shrimp production. The estimated brackish water potential suitable for undertaking shrimp cultivation in the country is around 1.2 million ha. spread over 10 states and union territories. Of this, only around 1.5 lakh ha are under shrimp farming now and hence lot of scope exists for entrepreneurs to venture into this field of activity.

3. Location of site

The first and foremost requirement for entering into the venture is the acquisition of suitable land. The details of land surveyed and identified suitable for shrimp farming in coastal districts are available with the Department of Fisheries of the concerned State Governments. A suitable site is one that can support optimum conditions for the growth of shrimps at targeted production level. Most of the lands available along the coastline are owned by the State Governments. In such cases, the entrepreneur has to get it on long term lease from the revenue authorities of the State Government. If it is a private land, one has to preferably purchase on outright basis. While selecting the site for the project, the entrepreneur should ensure the following:

i) Area should be accessible preferably by a road even during the monsoon season.

ii) Mangrove area with large tree stumps should be avoided.
iii) Site should have good pollution free water supply of both freshwater and brackish water. Water quality parameters should be optimum for the culture of tiger shrimp for maximum feed efficiency and maximum growth
iv) The areas should be flood free
v) A location with a natural slope, for proper drainage should be selected.
vi) Social problems due to competing use of water resources and drainage of waste water should be properly taken care of.
vii) Availability of necessary infrastructure namely electricity, ice factory, cold storage, communication facilities etc., are necessary for successful management.

A-1. Design and Construction of shrimp farm:

An extensive shrimp farm should be of the size 0.4 - 0.5 ha. and preferably drainable from the pond management point of view. The ponds generally should have concrete dikes, elevated concrete supply canal with separate drain gates and adequate life supporting devices like generators and aerators.

The design, elevation and orientation of the water canals must be related to the elevation of the area with particular reference to the mean range of tidal fluctuation. The layout of the canals and dikes may be fitted as closely as technically possible to existing land slopes and undulation for minimizing the cost of construction.

2. Earth Work

It is normally carried out in the following order:

- Site clearing
- Top soil stripping
- Staking of centre lines and templates
- Preparation of dike foundation
- Excavation of drainage canals
- Construction of dikes (peripheral and secondary)
- Formation and compaction of dikes.
- Excavation of pits for gates.
- Levelling of pond bottom.
- Construction of gates and refilling of pits
- Construction of dike protection.

The top soil may be set aside and should again be spread later to preserve pond bottom fertility.

3. The essential components of a shrimp farm are:-

- Ponds
- Water intake structure
- Store room for feed and equipment
- An area for cleaning of the harvest
- Pump house
- Watch and ward room, office and a mini laboratory.

B. Ponds

From the pond management point of view it is better to go in for smaller ponds of 0.4 ha-0.5 ha size and should be preferably completely drainable. The ponds are partitioned by secondary dykes. In order to render over all protection to the standing crop and other related structures a perimeter dyke also can be constructed.

The height of the perimeter dyke will depend upon the following factors, such as:

- Height of water level in the area.
- Elevation above mean sea level.
- Height of free board.
- The percentage allowance for soil shrinkage.

The partition dykes determine the size and limit of each grow out pond and its height is determined by the following factors namely:

- The height of water column in the pond
- Free board
- Wave action
- Shrinkage factor

The shrinkage factor is decided by the type of soil like heavy, medium and light soils.

C. Gates

They regulate the inflow and outflow of water into the pond and also are responsible for maintaining the desired water column in the pond. The main gates are constructed on the perimeter dyke and are usually located on the partition dykes and they regulate the water column in the individual ponds. It can be made out of concrete or PVC or asbestos piping.

D. Drain canals

They are generally trapezoidal in cross section and its discharge capability is decided by area of cross section and velocity of water flow.

E. Pond preparation

Proper pond preparation will ensure higher productivity and production levels. The main objectives of pond preparation are:

- To eradicate weed fishes and other harmful organisms
- To remove abnoxious gases
- To improve the natural productivity of the pond eco system

- To maintain high water quality for proper growth and higher survival percentage.

Eradication of unwanted organisms is usually carried out by draining out the entire water and drying the pond bottom till it cracks. This also helps in removal of obnoxious gases and oxygenation of the pond bottom. It also improves the fertility of the soil.

Liming is done for correcting the pH and to kill pathogenic bacteria and virus. In undrainable ponds mahua oil cake should be applied @ 200 ppm to eradicate the weed fishes. After around two weeks organic and inorganic fertilisers are applied to enrich the soil and water. Once the thick lab-lab is formed the water level is raised and the pond is made ready for stocking.

F. Selective stocking:

The most suitable species for culture in India are the Indian white shrimp ***Penaeus indicus*** and tiger shrimp ***P. monodon***. The stocking density varies with the type of system adopted and the species selected for the culture. As per the directives of Supreme Court only traditional and improved traditional shrimp farming can be undertaken within the CRZ with a production range of 1.0 to 1.5 tonnes/ha/crop with stocking density up to 60,000/ha/crop. Outside CRZ extensive shrimp farming with a production range of 1.5 to 2.5 tonnes/ha/crop with stocking density up to 1,00,000/ha/crop viz; 10 nos/sq.m may be allowed. In order to have uniform growth it is always advisable to go in for hatchery reared and PCR tested seeds.

G. Food and feeding

Shrimp diets may be supplementary or complete. In an extensive system the shrimps need a complete diet. Although natural food items have good conversion values, it is difficult to procure in large quantities and maintain a continuous supply. At present most of the aquaculture farms depend on imported feed with a FCR of 1:1.5 - 1.8. The feeding could be done by using automatic feed dispensers, or by broadcasting all over the pond. If feeding trays are employed in selected pockets in the pond wastage of feed can be reduced.

H. Harvesting:

Complete harvesting can be carried out by draining the pond water through a bag net and hand picking. The average culture period required is around 150-165 days during which time the shrimps will grow to 25-30 gm. size (depending on the species). It is possible to get two crops in a year. Harvested shrimps can be kept between layers of crushed ice before transporting the consignment to market.

B. Culture of white legged shrimp, *Litopenaeus vannamei*

1. Introduction:

Shrimp farming in India, till 2009, was synonymous with the mono culture of tiger shrimp, *Penaeus monodon.* About 1, 90,000 ha brackish water area have been developed for shrimp culture in the country spread over all the coastal states. Since 1995 culture of P *monodon* is affected by White Spot Syndrome Virus (WSSV) and the development of shrimp farming has become stagnant. Most of the Southeast Asian countries like Thailand, Vietnam, Indonesia were also culturing P. monodon and since 2001-02 onwards most of them have shifted to culture of exotic White leg shrimp, *Litopenaeus vannamei* because of the availability of Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) brood stock. In India, Pilot-scale introduction of L.*vannamei* was initiated in 2003 and after a risk analysis study large-scale introduction has been permitted in 2009.

2. Biology

L. *vannamei* is native of Pacific coast of Mexico and Central and South America as far south as Peru. It is mainly found on mud bottoms, down to a depth of 75 m. It is commonly known as white legged shrimp or Mexican white shrimp. It is greyish-white in color. The growth at 30°C is much higher than at 25°C. The optimal range of temperature for the species is between 30 and 34°C. At 20°C growth virtually stops. It can tolerate salinity levels of 0 to 50 ppt. Growth is uniform within 10-40 ppt. They can grow in freshwater also but the growth is slow below 10 ppt. pH range of 7 to 9 is tolerated with optimal growth at pH 8.0. Dissolved oxygen levels above 4.5 ppm are required for optimal growth. Turbid water with flocculated particles of more than 0.5 micron resulted in better growth than clean water mainly because of the presence of algae and bacteria. Ammonia -N and Nitrite - N levels should be less than 0.1 ppm and 1 ppm respectively.

L. *vannamei* is an omnivorous scavenger and is less aggressive and less carnivorous than P. *monodon.* Food intake is more during evening and night. Retention time of food in the gut is 2.2 to 5 hours. Food is digested at modest acidities of pH 5.5-7.0. Growth of L. *vannamei,* under confined culture conditions was similar to P *monodon* till they attain 20g size. Beyond that the growth rate was poor. The shrimps attained the size of 20g within a period of 100-120 days depending on the stocking density.

3 Advantages of *L. vannamei:*

Culture of L. *vannamei,* is being taken up in many countries because of the following characteristics: –

- 1. It grows as fast as P. *monodon* up to 20 g.
- It is easier to culture in very high stocking densities of up to 150/sqm due to their less aggressive nature.
- It is tolerant to wide range of salinities of 0.5 to 45 ppt.

- It is very tolerant to low temperatures of up to 15 degree centigrade.
- It requires low protein feed (20-35%).
- It is an easy to breed species and hence domestication of the species is very successful with the production of SPF stock. Commercial availability of SPF and high-health stock is an added advantage.
- Selective breeding work for the production of SPR brood stock is easier because of the short generation period and easier captive breeding.
- Higher survival rates in hatchery (50-60%).
- Has a very good market in the US, as the most preferred species with higher meat yield (66-68%).

4 Disadvantages of L. *vannamei:*

Though the above advantages make L. *vannamei* a very important cultivable species, but the following disadvantages create some apprehension for their introduction in the country:

- L. *vannamei* is highly susceptible to and a carrier of Taura Syndrome Virus (TSV), White Spot Syndrome Virus (WSSV), Yellow Head Virus (YHV) , Infectious Hypodermal and Haematopoietic Necrosis Virus (IHHNV) and Lymphoid Organ Vacuolization Virus (LOVV). Though SPF stocks are available for these viruses, the performance of these in the virus ladden environment is doubtful. WSSV is prevalent in the country and its infectivity and pathogenicity for L. *vannamei* is similar to that of P. *monodon* (Tapay et al. 1997)
- L. *vannamei* is being cultured in very high densities under intensive management, which might lead to environment problems like nutrient loading.
- L. *vannamei* is highly susceptible to hypoxic conditions and hence there is a need for continuous aeration during high density cultures.
- Handling, processing and transport are more difficult in L. *vannamei* compared *Penaeus monodon.*
- There is high competition in the International market with world -wide production.

5 Specific pathogen Free Stock:

L. *vannamei* is highly susceptible to a number of viral pathogens. White Spot Syndrome Virus (WSSV), Taura Syndrome Virus (TSV), Yellow Head Virus (YHV), Infectious Hypodermal Haematopoietic Necrosis Virus (IHHNV), Lymphoid Organ Vacuolization Virus (LOVV), Reo like Viruses (REO) are some of the viruses reported in the species. In order to eliminate the presence the virus in the seed, Specific Pathogen Free (SPF) stock has been developed by producing a number of generations in highly bio-secure facility with continued surveillance of pathogen presence. Although SPF shrimp are, by definition, free of all specifically listed pathogens, SPF shrimp may be infected with a known pathogen that is not included on the SPF list of the shrimp supplier, or with an un-known pathogen that has not yet been described. Offspring of SPF shrimp are not considered SPF unless they are produced and maintained at an SPF facility. SPF status changes with the pathogen condition of the shrimp, as well as the type of environment within which they are cultured (level of biosecurity). One of the main advantages of culturing L. *vannamei* is commercially available as high health

animals from Specific Pathogen Free (SPF) stocks while P. *monodon* have very limited availability from SPF stocks.

6 Bio – Security requirements of shrimp farms:

Stocking of pathogen free post larvae alone will not guarantee a disease free culture since the pathogens could still enter the culture environment horizontally and infect shrimps during the culture. Viral pathogens still enter the culture through:

1. By persisting in the soil
2. Intake water
3. Aquatic vectors introduced through intake water, by crabs and other animals
4. Contaminated land animals and birds
5. Contaminated farm inputs
6. Contaminated farm implements

Crabs are one of the carriers of viral pathogens and providing crab fencing in shrimp farms is considered as one of the important bio-secured measure. Carriers like crabs could also move from pond to pond over land barriers. To prevent such movements fencing made of 0.5 m plastic sheet should be put around culture pond.Birds such as crow/ water crow pick up the dead and moribund shrimps affected with viral disease from ponds and may drop in unaffected ponds, there by transmitting the virus mechanically. This could be avoided by using bird scares and bird fencing over the pond.

Feed ingredients of aquatic origin and wet/ moist feeds could be potential source of pathogens. Pond to pond transmission could occur through the use of farm implements and farm workers. Providing an independent set of implements for each ponds and its routine disinfection before use should be mandatory. Minimum movement of workers from pond to pond and also personal disinfection of workers may also be resorted to.

Bio security requirements for L vannamei farming are

- Farm to be fenced (including crab fencing)
- Water intake through reservoirs
- Installation of bird scare/ bird netting
- Separate implements for each pond
- Effluent Treatment System ETS) in position
- Only tested and certified seeds produced in hatcheries authorized by Coastal Aquaculture Authority (CAA) to be used
- Pelleted feed manufactured by reputed companies for *L vannamei* farming alone to be used for minimizing feed wastage and degradation of ecosystem

Farmers are required to maintain proper records regarding seed procurement, source, quantity, stocking density as well as the quantity of shrimp produced and sold indicating the name and address of processors.

7. Technical Parameters:

Technical parameters of *L vanammei* culture includes site selection, items of development, pre and post stocking operations, stocking density, fertilisation, feeding etc.

I. Farm Design Requirements:

L.vannamei lives in the column and hence increasing the depth of the pond will help in increasing density. Generally shrimp farms which were culturing P. *monodon* had a water depth of about 1 mt, but it is advisable to have a depth of 1.5 to 1.8 m water column for culturing L. *vannamei*

Since mechanical aeration is one of the major requirements for L. *vannamei* culture, constant circulation water is expected in the pond. This will lead to the erosion of the soil in the dyke and bottom. To avoid this compacting of the pond bottom and the dykes is essential. In intensive culture ponds, total lining of the pond HDPE sheets is done to avoid any erosion. In high density cultures, accumulation of sludge in the bottom is a major problem and provisions of central drainage or use of sludge pumps is essential. Positioning of paddle wheel/long arm aerators should aid in bringing the sludge to the centre of the pond from where it can be removed.

Bio-security requirements like reservoir ponds, fencing, crab fencing bird fencing, and disinfection facilities are incorporated in the design. To avoid disease in most cases zero-water exchange system of farming is practiced with recirculation facilities. In such cases more than *40%* of the water area in the farm is allocated for reservoirs and waste sedimentation ponds.

II Management *of* the farm

1 Drying and Liming

The sludge left in the pond, which might have had viral disease outbreak during the previous culture, may contain high organic load, bacteria, viral particles and DNA as well as many other viral carriers. All these should be removed to prevent the persistence of viral disease. This could be achieved by the application of quick lime (CaO) @100 ppm, followed by exposure of the pond bottom to sunlight until it dries and cracks, removal of the top soil and compacting the bottom soil

2 Water Management:

White spot virus has been reported to survive as a free-living form in water up to seven days. Direct use of creek or sea water carries the risk of introducing the virus into the system. Most of the aquatic crustaceans including the planktonic forms are reported to be carriers of WSSV virus. A number of other aquatic organisms could be mechanical carriers because of their filter-feeder habit. There is a need to eliminate these from water before use in culture ponds. Use of filter nets 160 micron mesh/cm2 in the delivery pipes/ inlet sluice should be strictly followed. Water should be taken in reservoir ponds and treated with calcium hypochlorite @ 30 ppm and aged up to seven days, to

eliminate the viral pathogens. Farmers should ensure that only treated water be used in the culture ponds for compensating the evaporation losses. Regular water exchange is not advised to avoid cross contamination pathogens from source water.

3. *Fertilization and addition of carbon source*

Culture of L. *vannamei* can be done under two systems - with plankton as natural feed or with bacterial floc. The fertilization schedule with urea and super phosphate is followed for plankton method while provision of carbon source in the form of molasses and dolomite is used for development of bacterial floc. The volume of bio-floc was controlled at 15 ml/ liter.

4. Stocking:

SPF shrimp seed from a reputed hatchery can be used for stocking. PL8- PL9 is normally selected after ensuring the pathogen free status of the seed. The seed acclimatization is a very important, requirement before stocking. Temperature, salinity and pH of the transportation water should gradually bring to the level of pond water by gradual mixing of both over a period of 6-12 hours depending on the difference. Stocking densities of 40 to 60 no/m2 is preferred. Higher stock density above 60 no./m2 is not permitted.

5 Feed Management:

Protein requirement varies between 25 to 40% depending on the density. Marine source protein was more effective than plant source. Lipid requirement was around 6-8% with 2% marine unsaturated fatty acids and 0.25 to 0.4% of cholesterol. Feeding rate was between 6.6 to 16% for 1 gm of shrimp which will be reduced to 2% for 15 gms shrimp. Optimal feeding frequency was between 2 and 6 in a day with maximum percentage of feed distributed in the evening and night rations. Check trays are used to monitor the feed consumption and the feeding ration is adjusted accordingly. FCR levels of 1.1 to 1.3 are expected.

6 Maintenance of Water Quality:

Regular monitoring of water quality is very essential. Water quality parameters like temperature, salinity, pH and alkalinity are monitored on daily basis. DO levels are recorded at least 2 times a day. Other parameters like Ammonia, Nitrite, Calcium, Magnesium are monitored on weekly basis. DO levels should be maintained above 4 ppm although and operation of paddle wheel /long arm aerators should be able to maintain the level. The number of aerators required is about 1 HP per every 300 kg of biomass. The location of the aerators should be adjusted in such way the sedimentation occurs at centre of the pond, which will aid in its easy removal.

Aerators are positioned in such a way that the sludge is accumulated in the centre of the pond and from there it could be removed through central drainage or using sludge pumps. Removal of sludge from the pond bottom during culture is essential in case of high density culture. In order to aid the process, sludge settled at other places should be

disturbed regularly. This is achieved through dragging of chains at the bottom at regular intervals from all the sides of the pond

***7. Health Management*:**

Weekly monitoring of shrimps for their growth and wellbeing is essential. *L. vannamei* normally grows at the rate of 0.2gms/day after the first 30 days. Weekly growth rate will range between 1.5 to 2.0 gms depending on the stocking density. At 60 nos./m2, the shrimps attain 20g size within 100-120days.

8. Harvest and post-harvest

L. vannamei is a column living shrimp and hence maximum stock can be harvested by either by cast nets or drag netting and this will help in harvesting them without much overcrowding and stress. Final harvesting by draining the water should be done within 6 hours. Compared to *P. monodon,* L. *vannamei* discolours faster in case there is any delay in icing the harvested stock. Hence the stock should be 'ice killed' immediately on harvest and stored in ice.

9. Cost of production:

The cost of production of L. *vannamei* in Indian conditions considering the industrial rate for electricity might work out to Rs. 100 to 120 for production levels of 8 to 10 tons per ha. The average size at harvest ranges from 18 to 22 g and the sale price is more or less same for both P. *monodon and* L. vannamei of similar size at Rs. 200 to 220.

10. Conclusion:

L.vannamei is a suitable species for semi-intensive culture with the availability of pathogen free seed. The major issues to be considered are bio-security and maintenance of water quality through constant monitoring. It also requires higher technical knowledge to achieve better production in sustainable manner. Strict adherence to the guidelines of CAA is a must to ensure environment protection.

Coastal Aquaculture Farming

In India, Coastal Aquaculture plays a vital role in coastal economy, livelihood, employment to rural population, ancillary industries, international trade as well as conversion of unproductive and low productive saline areas into productive purposes. The main species cultivated are indigenous shrimps like *P. monodon, P.indicus and exotic one Litopenaeus vannamei,* finfish, bivalves, crabs and sea weeds.

Coastal Aquaculture Authority (CAA) has been constituted by the Government and there are rules & regulations under the Act. Guidelines are also available to adopt sustainable farming in the coastal aquaculture sector. Farmers should be aware of the following important points.

- It is compulsory that all coastal aqua farms are registered under CAA.
- Application forms and other details can be obtained from **www.caa.gov.in**.
- Specific permission from CAA is a must to start any aqua culture activity in the "Coastal Areas".
- Seed production and sale will be accountable and one also punishable act of CAA, if prior permission is not obtained.
- No pond reared brood stock be used for seed production.
- *L. vannamei,* being an exotic species needs specific permission from CAA for production in hatcheries.
- Bio security and ETS should be ensured in all the hatcheries producing SPF stocks.
- Farms should have Effluent Treatment System (ETS) to handle waste water.
- No banned antibiotic and chemicals be used in farming on account of food safety concerns.
- Proper water quality maintenance and feed management are required for sustainable production. In case of *L. vannamei* culture, only seed from SPF broodstock should be derived and seed may be sourced from CAA short listed hatcheries.
- Follow strict quarantine procedure to prevent entry of exotic pathogens and control on occurrence of diseases.
- It is preferred to follow and practice Organic based coastal aquaculture farming to avoid/ minimize the complications during culture period.
- Harvesting schedule and post harvest handling may be carried out properly to keep freshness of the product.
- Maintenance of detailed record by farmers, on purchase of seed (name and address of the hatchery from where they are procured, quantity procured, valid registration of the hatchery etc), feed procurement & use, quantity of shrimp produced, sold and the name and address of the processor to whom sold etc. is essential to enable traceability and improvements in future crops.

- Non-compliance and not to keep the records would be punishable under the act including destruction of the farm stock.

For more details may contact: -

- Coastal Aquaculture Authority, Shastri Bhawan Annexe 26, Haddows Road, Chennai.
- Dept. of Animal Husbandry, Dairying & Fisheries, Govt. of India, Krishi Bhawan, New Delhi.
- Coastal State Fisheries Departments.

Ornamental Fish Breeding

1. Introduction

Keeping colourful and fancy fishes known as ornamental fishes, aquarium fishes etc. is one of the oldest and most popular hobbies in the world. The growing interest in aquarium fishes has resulted in steady increase in aquarium fish trade globally. The ornamental fish trade with a turnover of US $ 6 Billion and an annual growth rate of 8 per cent offers lot of scope for development.

The entire industry, including accessories and fish feed is estimated to be worth US $ 14 Billion. The top exporting country (with percentage contribution to global trade) is Singapore (19.8%) followed by Czech Republic (7.8%), Japan (7.4%), Malaysia (7.3%), Indonesia (5.3%), Israel (4.3%), Thailand (3.9%), Sri Lanka (2.9%) and India (0.008%). The largest importer of ornamental fish is the USA followed by Europe and Japan. The emerging markets are China and South Africa.

India's share in ornamental fish trade is estimated to be less than 1 % of the global trade. The major part of the export trade is based on wild collection. There is very good domestic market too, which is mainly based on domestically bred exotic species. The overall domestic trade in this field cross Rs. 1000 lakh and is reportedly growing at the rate of 20 per cent annum. The earning potential of this sector has hardly been understood and the same is not being exploited in a technology driven manner. Considering the relatively simple techniques involved, this activity has the potential to create substantial employment opportunities, besides earning foreign exchange.

2. Ornamental Fishes

Aquarium fishes are mainly grouped into two categories, viz., Oviparous (egg - layers) and Viviparous (live-bearers). Further, the fresh water ornamental fish varieties can be broadly grouped into Tropical and Cold water species also. Management of these two categories are different in nature. According to water tolerance fishes are hard water tolerant, soft water tolerant species and those with wider tolerance. The common varieties of fishes and the details of grouping is given below.

Species	*Water Quality*	*Breeding Season*	*Breeding Type*	*Parental Care*
Molly	Hard water Sp.	Summer/Monsoon	Live Bearer	Young Ones
Guppy	Hard water Sp.	Summer/Monsoon	Live Bearer	Young Ones

Platy	Hard water Sp.	Summer/Monsoon	Live Bearer	Young Ones
Swordtail	Hard water Sp.	Summer/Monsoon	Live Bearer	Young Ones
Blue Gourami	Wide Tolerance	Summer/Monsoon	Nest Builder	Male Guard eggs
Pearl Gourami	Wide Tolerance	Summer/Monsoon	Nest Builder	Male Guard eggs
Rosy Barb	Wide Tolerance	Summer/Monsoon	Egg Scatterer	Adhesive
Gold Fish	Wide Tolerance	Monsoon/Winter	Egg Scatterer	Adhesive
Z/P/Vl Danio	Wide Tolerance	Summer/Monsoon	Egg Scatterer	Non Adhesive
S Fighter	Wide Tolerance	Summer/Monsoon	Nest Builder	Male Guard eggs
Catfish	Wide Tolerance	Monsoon/Winter	Egg depositor	Enclosures Reqd.
Angel*	Soft Water	Summer/Monsoon	Egg depositor	Airing of eggs with fins
FM Cichlid	Soft Water	Summer/Monsoon	Egg Depositors	Enclosures Reqd.
R D Cichlid	Soft Water	Summer/Monsoon	Egg Depositors	Enclosures Reqd.
Bl W Tetra	Soft Water	Summer/Monsoon	Egg Scatterer	Adhesive
B A Tetra	Soft Water	Summer/Monsoon	Egg Scatterer	Adhesive
Serpa Tetra	Soft Water	Summer/Monsoon	Egg Scatterer	Adhesive
Manila Carp	Soft Water	Monsoon/Winter	Egg Scatterer	Adhesive

Monsoon - June to August, Summer - March to May, Winter - November to January

3. Marine Ornamental Fishes

Marine ornamental fishes are also popular among hobbyists and the technology of breeding and larval rearing has now been developed for certain species by research institutes. The present model has been restricted to freshwater species only**.**

4. Technology

At present in India, hundreds of exotic and indigenous ornamental fish varieties are being bred under captive condition. Majority of the production goes to domestic market and to some extent for export. A generalised production cycle of ornamental fishes is given below.

There are quite a large number of tropical aquarium fishes known to the aquarists. While many of the fishes are easy to breed, some of these are rare, difficult to breed and expensive. Most of the exotic species can be bred and reared easily since the technology is simple and well developed. It is advisable to start with common, attractive, easily bred and less expensive species before attempting the more challenging ones. An ornamental fish project can be either 1) rearing only 2) breeding only 3) breeding and rearing depending upon the space available/ scale of operations desired and the expertise.

4. a. Culture/rearing:

The culture/rearing of these fishes can be taken up normally in cement tanks. Cement tanks are easy to maintain and durable. One species can be stocked in one tank. However, in case of compatible species two or three species can occupy the same tank. Ground water from dug wells / deep tube wells/ bore wells are the best for rearing fish. The fishes reach marketable size in around 4 to 6 months. Eight to ten crops can be taken in a year.

4. b. Feeding:

Young fish are fed mainly with Infusoria, Artemia, Daphnia, Mosquito larvae Tubifex and Blood worms. For rearing, formulated artificial or prepared feed can be used. At present no indigenous prepared feed for aquarium fish is available. The amount and type of food to be given depends on the size of the fry. Feeding is generally done twice in a day or according to the requirement. For rearing from fry stage dry/ prepared feed can be used.

4. c. Breeding:

Ninety five per cent of our ornamental fish export is based on wild collection. Such capture based export is not sustainable and it is a matter of concern for the industry. In order to sustain the growth it is absolutely necessary to shift the focus from capture to culture based development. Moreover, most of the fish species grown for their ornamental importance can be bred in India successfully. Organised trade in ornamental fish depends on assured and adequate supply, which is possible only through mass breeding.

The method of breeding is based on the family characteristics of the fish. The success of breeding depend on the compatibility of pairs, the identification of breeders which is a skill gained through experience. Generally the brooders are selected from the standing crop or purchased and reared separately by feeding them with good live food. However, it is always better to buy good brood stock and replace the breeders. Otherwise, the original characteristic of the species keeps on getting diluted because of continuous inbreeding. Brooders especially egg layers should be discarded after few spawnings.

4.d. Health care

Water exchange, is a must for maintaining water quality conducive for the fish health.

Only healthy fish can withstand the effects of transportation and fetch a good price. Permitted chemicals / antibiotics, vitamins, etc. can also be used for preventing / treating diseases.

4.e. Market

At present the market is mainly domestic and the demand is increasing steadily. The export market for indigenously bred exotic species is also fast growing and encouraging.

5.0 Ornamental Fish breeding

5.1. Site selection

Site should be located in a flood free area having continuous supply of good quality water. The water source can be dug well or tube well, ponds and rivers having required water quality parameters conducive for breeding of aquarium fishes.

5.2. Water quality parameters

The degree of hardness of water has several biological effects on aquatic life. Hard water containing bicarbonates tend to prevent a solution from changing its acidity. Water lacking this protection may become acidic when carbon dioxide is present, and this change causes stress to the organisms. But in the case of soft water species and sensitive naked cells like egg and milt, excess hardness causes problems in absorbing substances through its delicate membranes. Hence soft water is found to play a vital role in successful reproduction of many species of ornamental fishes and for purpose of fish breeding a soft solution is desirable.

To maintain softness of the water, all sources of calcium carbonate such as calcareous rocks, gravels, corals, broken shell and algae must be kept out of the aquarium system. Some of the important water quality parameters and their optimum ranges for aquarium fish are given below.

Temperature	24 to 28 degrees C
pH	7.0 to 8.5
Carbon di oxide	<10 ppm
Alkalinity	75 to 120 ppm as CaCO3
Hardness	60 to 100 ppm as CaCO3
Dissolved Oxygen	6.0 to 8.0 ppm
Free Ammonia	< 0.05 ppm
Ionized Ammonia	< 0.4 ppm

Accessibility by road, rail and air is a prime requisite for transportation of brood stock / other raw materials as well as to move the produce (live fish) to domestic/ international markets. Apart from these, uninterrupted power supply is essential for water pumping,

aeration, lighting/ other machinery.

A thorough survey of the site as well as strong considerations on the engineering aspects are inevitable for the larger volume water holding structures as well as building.

General outline of an ornamental fish breeding unit consists of components such as (a) maturation/ brood stock development, (b) breeding cum hatching, (c) larval rearing and (d) grow-out subsections. All these sections will have provisions for continuous supply of unpolluted water and air. Apart from these associated subsections such as live feed production section, water-quality testing laboratory cum chemical store, disease treatment cum quarantine section, packaging cum sales section and feed preparation cum storage section are associated to the breeding units. Species such as guppies, mollies, sword tails, angelfishes etc. can be matured, bred and grown up in glass aquaria and small cement tanks, whereas goldfishes, barbs and many of the cichlids require a minimum water volume of 1000 litres and requires larger cement tanks. Earthen ponds of larger capacities are also used for grow out purpose. Apart from cement tanks, breeding and grow out of catfishes and carp varieties, require earthen ponds having a minimum water volume of 10 to 20 m3. Earthen ponds lined with plastic sheets are commonly used as breeding/ holding tanks for ornamental fishes. But the possibility of tearing and strength loss associated with sunlight exposure are some of the problems associated with lined ponds.

Generally one species is stocked in one tank/ pond but a number of compatible species can be stocked in one tank/ pond. The number of tanks/ ponds/ aquaria required depends on the variety of species bred.

The basic requirements for successful breeding and rearing of ornamental fish are adequate space, quality water and sufficient feed. Considering this the following investments are required for starting an Ornamental fish project

5.3. Tanks: The tanks can be of RCC or brick masonry work having flat bottoms with inlet and outlet pipes. Clay, cement, fibre glass or plastic tanks can also be used. Rearing of fishes should be done in large tanks. Size of the tanks varies according to the space, the number and type of fish cultured.

5.4. Aquariums: Glass tanks of varying size are required for breeding. Small glass bottles of 250 ml are used for keeping individual male fighter fishes. Number and size of the glass tanks depend on the specific breeding / spawning behaviour of the species selected.

5.5. Overhead tank: An overhead tank of suitable size for storing and to enable sedimentation of water is required.

5.6. Water Supply: Deep tube wells would be the best source of water. Recycling of water through bio-filters or other sort of filtering mechanism can be tried. Other sources like dug wells, municipal water if available can also be used. A small pump to lift the water to overhead tank and a network of pipes are needed to feed the culture tanks.

5.7. Work Shed: Work shed should be designed in such a way that the tanks get filtered sunlight. Translucent HDPE sheets can be used. This also protects the culture tanks from falling debris and bird dropping etc.

5.8. Aeration equipment: A blower pump with network of tubes for aeration is a must. Continuous power supply should also be ensured through generator set or UPS or inverter.

Composite fish culture

Fish is a major source of protein. Farmers can easily take up fish culture in village ponds, tanks, new water bodies and can improve their financial position substantially. In India, the area under tanks & ponds available for warm freshwater aquaculture is estimated to be 2.41 million ha. In addition 1.31 million ha. of swamps, beels etc and low lying water logged area which is not suitable for agriculture can also be used for fish culture.

At present, the average fish production from ponds is 2500 kg/ha/year. Only 15% of the potential area of tanks and ponds available is developed so far, showing immense possibility for horizontal expansion of fish culture. Many culture technologies have been evolved to increase the fish production but Composite Fish Culture system is best. This technology enable to get maximum fish yield from a pond/tank through utilization of available fish food organism in all niches as well as supplemented artificial feed by stocking of fish fingerlings of high growth variety of fishes having different food habits. For application of this culture system, a pond should be perennial, minimum water area 1.0 ha, water depth 1.5 – 2.0 meter, water retentiveness soil, assured water supply with properly controlled inlet & outlet and strong pond embankment having average 1.0 – 1.5 meter height and 2.5 – 3.0 meter width.

Under Composite Fish Culture System, pre and post pond management is very important for getting higher fish yield.

Pre stocking management:

- **Liming**: Dose @ 200 – 25 kg/had to maintain the desirable pH 8.0 – 8.5.
- **Eradication of Aquatic weed**: By manually / mechanically /chemically /biologically.
- **Eradication of unwanted and predatory fishes and other aquatic animals:** By repeated netting, or drain the pond fully and exposed the bottom for sun drying or putting Mahua oil cake @ 2500 kg/ ha.
- **Fertilisation/ Manuring:** To increase the natural productivity of pond water to develop planktons. Organic manure – Cow dung @ 1000 kg/ha/month and Inorganic fertilizer–NPK/ single super phosphate 15-20 kg/ha/month.
- **Stocking :** After 15 days of manuring, the fingerlings of IMC (rohu, catla and mrigal) and exotic carps (silver, grass and common carps) each 50-100 gm in weight can be stocked @ 5000 nos/ha adopting one combination either 3/4/6 species.
- **Post Stocking Management:**
- **Supplementary feeding and manuring:**
- Supplementary feeding: Rice bran, Oil cakes 1:1 ratio, and 5-6% of fish bodyweight.

  Soft aquatic weeds 2-3 times body weight of grass carp may be supplemented, if grass carp is a component of the culture.
- Organic and Inorganic manuring: Cow dung @ 1000 kg/ha/month and NPK/SSP @ 15-20 kg /ha / month.

- **Harvesting:** After 1year of completion, the fish attain weight 800 gm. to 1.2kg with a survival of > 98% with a total weight 5000 Kg /ha / year.

Precautions: - Maintenance of the water depth, water parameters, quality, & quantity of feed given. Measurement of growth of fish at every 2 months. Watch on poaching. Transport facilities at the time of harvesting. The stocking of common carp seed should be in stone pitching pond only, due to burrowing nature of the fish.

For more details may please contact: -

- Dept. of Animal Husbandry, Dairying & Fisheries, Govt. of India, Krishi Bhawan, New Delhi.
- State Fisheries Departments.