



## Sustainability of Gangatiri cattle rearing

PUSPENDRA KUMAR SINGH<sup>1</sup>, G SANKHALA<sup>2</sup>, AMIT SINGH<sup>3</sup> and KAMTA PRASAD<sup>4</sup>

ICAR-National Dairy Research Institute, Karnal, Haryana 132 001 India

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### ABSTRACT

The present study was undertaken in the native tract of Gangatiri cattle in Uttar Pradesh. Information was collected from 108 dairy farmers. Sustainability of Gangatiri cattle rearing was evaluated by measuring 3 indices i.e. economic sustainability index, social sustainability index and environmental sustainability index. Economic efficiency was measured by 6 indicators, viz. production efficiency, net profit, marketing, lactation length, dry period, and calving interval. Community relation of dairy farmers and their access to resource and support services were considered for measuring social equity. Indicators like dung utilization pattern, waste management and preparedness for flood were taken for measuring environment sustainability. The cattle rearing of dairy farmers was measured as composite sustainability index (CSI), ranging from 0 to 1. The results showed that most of dairy farmers (67.59%) had medium CSI score ranging from 0.3 to 0.6 followed by high CSI (>0.6) among 21.30% dairy farmers of study area, suggesting cattle rearing had lineage toward sustainability.

**Key words:** Gangatiri cattle, Livelihood security, Resource poor farmers, Sustainability

Gangatiri cattle are dual purpose indigenous cattle breed with good draught capacity. The average milk production of Gangatiri is 4.5 l/day and fat per cent varies from 4.1 to 5.2% (Anonymous 2006). Gangatiri is native of *duaba* area falling between Ganga and Ghaghara rivers. This is a medium size cattle breed reared mainly by resource poor farmers on zero or low input system for their livelihood (Singh *et al.* 2007). A livelihood is socially sustainable when it can cope with and recover from stress and shocks and provide for future generations (Chambers and Conway 1992). Sustainable agriculture may be regarded as successful management of resources for agriculture to satisfy the changing human needs while maintaining or enhancing the quality of environment and conserving natural resources (FAO 1991). The sustainable livelihood is environmentally sustainable when it maintains or enhances the local and global assets in which livelihoods depends, and has net beneficial effects on other livelihoods. Sustainable agriculture integrates 3 components i.e. environmental health, economic profitability and social equity. Swaminathan (1991) identified 14 major dimensions of sustainable agriculture covering social, economic, technological, political and environmental facts of sustainability. Out of these facts, economical, social and

environmental facts are important from livelihood security point of view. Gangatiri rearing is the mainstay of economy and sustenance of life of the people engaged in Gangatiri cattle rearing in the state of Uttar Pradesh. It provides employment to the farmers directly as well as indirectly, helps in securing nutritional requirement and counteracting economic risk. The intimate conceptual, casual and operational linkages between sustainable livelihood security and other welfare goals like poverty alleviation, meeting basic needs for human development and quality of life (Saleth and Swaminathan 1993) justify composite sustainability index (CSI) of Gangatiri cattle rearing as a basic indicator of sustainable agricultural development in study area.

### MATERIALS AND METHODS

*Locality of the study and sampling procedure:* The Native tract of Gangatiri cattle covers Varanasi, Ghazipur, Balia, and Chandauli, districts of eastern Uttar Pradesh (Anonymous 2006). There is higher probability of existence of genetically pure Gangatiri cattle. Varanasi and Ghazipur were selected for study because these are having highest population of Gangatiri cattle. Gangatiri cattle population in these districts was 5,722, 5,501, 2,431 and 525, respectively (Anonymous 2007). One block from each district, namely Araziline from Varanasi and Mohammadabad from Ghazipur were selected randomly. From each selected block, 3 villages were selected by simple random sampling technique. A list of dairy farmers, who were rearing at least 1 Gangatiri cattle and the animal should

Present address: <sup>1</sup>Ph.D. Scholar (puspendra2001@gmail.com), Division of Extension Education, ICAR-IVRI, Izatnagar. <sup>2</sup>Principal Scientist (gssitaram@gmail.com), <sup>3</sup>Ph.D. Scholar, Dairy Extension Division. <sup>4</sup>Scientist (kamta1969@gmail.com), ICAR-IISR, Lucknow.

have completed at least one lactation at the time of investigation, was prepared from each village. Dairy farmers were selected by proportionate random sampling method from the each village under different operational land holding category. Thus, dairy farmers (108) were selected for study.

Table 1. Selection of the respondents from each village

Villages	Small farmers	Marginal farmers	Landless farmers	Total respondents
Shahanshahpur (V1)	6	9	5	20
Sherwan (V2)	5	8	5	18
Gobindpur (V3)	4	5	7	16
Gauspur (V4)	8	13	4	25
Tiwaripur (V5)	3	7	6	16
Alawalpur (V6)	4	4	5	13
Total	30	46	32	108

*Measurement of sustainability:* The sustainability of dairy farms was assessed as per Rahman (2011) and suitably modified to use in context of Gangatiri cattle rearing. The multi-dimensional concept of sustainability of Gangatiri cattle rearing is considered to be composite of 3 indices, i.e. economic sustainability index (ESI), social sustainability index (SSI), environmental sustainability index (EnSI) so that it took the stock of both, the conflict and synergy between ecological, social and environmental aspect of sustainable development of Gangatiri cattle rearing. Indicators used in each dimension are according to Swaminathan’s concept of sustainable livelihood security that is “livelihood options which are ecologically secure, economically efficient and socially equitable” (Swaminathan 1991).

Indicators taken for economic sustainability estimation were production efficiency of Gangatiri cows, net profit from rearing of these cattle, market availability for products. dry period, lactation length and calving interval. Community relation and assess to resource and support services were indicators for social sustainability estimation and animal welfare; use of dung, waste management and preparedness for flood were taken as indicators for estimation of environmental sustainability. Sustainability assessment of Gangatiri cattle rearing were done in following steps.

*Construction of the index:* The first step is to construct the index ( $I_{ij}$ ) for each  $i^{th}$  indicator representing  $j^{th}$  dimension of composite sustainability index. For making indicator scale free following methods were applied:

$$I_{ij} = \frac{X_{ij} - \text{Min}X_{ij}}{\text{Max}X_{ij} - \text{Min}X_{ij}} \tag{1}$$

$$I_{ij} = \frac{\text{Max}X_{ij} - X_{ij}}{\text{Max}X_{ij} - \text{Min}X_{ij}} \tag{2}$$

where  $i, 1, 2, 3, \dots, n$  indicators;  $j, 1, 2, 3$  dimension of sustainability;  $X_{ij}$ , value of  $i^{th}$  indicator of  $j^{th}$  dimension. Equation (1) was applied for indicators having positive implication on sustainability, while

Equation (2) for negative.

*Calculation of the indices for various dimensions of composite sustainability index:* Having calculated the  $I_{ij}$  for all the indicators, the second step is to calculate the indices for various dimensions of composite sustainability index. It is calculated as the simple mean of their respective variables, that is:

$$ESI = \frac{\sum_{i=1}^6 I_{ij}}{6}, \quad SSI = \frac{\sum_{i=1}^2 I_{ij}}{2}, \quad EnSI = \frac{\sum_{i=1}^4 I_{ij}}{4}$$

*Calculation of the composite sustainability index (CSI):* The composite sustainability index for Gangatiri cattle rearing for each respondent was calculated as a weighted mean of the indices obtained from equations mentioned above by following formula:

$$CSI = \frac{W_1 * ESI + W_2 * SSI + W_3 * EnSI}{3}$$

where,  $W$  denotes the weight assigned to the respective dimension of composite sustainability index. Cumulative square root frequency method was used for categorization of index in different categories.

## RESULTS AND DISCUSSION

The sustainable Gangatiri cattle rearing practices should encompass efficient cattle farming practices which are economically viable, socially acceptable and ecologically compatible. With this view, economic, social, environmental and composite sustainability of cattle rearing was worked out.

*Economic sustainability index:* The indicators used to calculate this index were productivity, profitability and viability of the cattle rearing activities. Productivity is the input efficiency over output in farming system. The average production efficiency of Gangatiri cattle was  $2.93 \pm 0.49$  l/day/animal. Gangatiri being dual purpose had better feed conversion efficiency into milk. The findings were in line with findings of Rao *et al.* (2000), Hussain (2001) and Singh (2008).

The average net profit per annum from the Gangatiri cattle of respondents was ₹  $1,637 \pm 365$ /animal/year (for year 2012–13). The findings had similarity to the findings of Das (2010) and Rahman (2011) but Singh (2008) observed that net return from cow milk was negative, which might be due to inadequate number of observations.

Lactation length, another important economic indicator, was  $187.80 \pm 14$  days. Average dry period of Gangatiri cattle was  $176.60 \pm 14.7$  days and average calving interval was  $372.40 \pm 23$  days. Proper and easy marketing of milk are important for the sustainability of Gangatiri cattle rearing. The findings were supported with that of Singh *et al.* (2007), Prakash *et al.* (2008), Prakash (2009) and Rahman (2011). Majority of respondents (87.81%) sold milk to the informal channels like milk vendors, *halwai*, tea stalls etc. while 12.19% respondents sold milk to formal source like milk

cooperative society etc. the findings are in corroboration with the results of Rahman (2011) while Senthilkumar (2004) found that most of the respondents were marketing their milk in market only.

Majority of the respondents (66.67%) were having medium (0.41 to 0.62) economic sustainability index (ESI), while 19.44% respondents were in high (more than 0.62) ESI category followed by low category (less than 0.41) for 13.89% respondents. Economic sustainability of Gangatiri cattle rearing can be increased by improved farming practices to increase the production of milk and strengthening marketing infrastructure, so that respondents can be remunerated with better price of milk and better income from cattle rearing which will lead to high economic sustainability of Gangatiri cattle rearing.

*Social sustainability index:* Social sustainability index (SSI) indicates overall social equity status of dairy farmers engaged in rearing of Gangatiri cattle for their livelihood security. It was observed that maximum number of respondents were having low (33.33%) followed by medium (30.56%) level of community relation. About 25.92% respondents were having no community relationship. Majority of the owners were marginal farmers who carried out their agricultural work and remaining time is devoted for cattle rearing practices like grazing, cleaning, milking etc. As a result of which they did not get appropriate time to maintain better community relation. High access to resources and support services by respondents provides chance to develop a level of well being. Majority of the respondents (59.26%) had medium level of access to resources and support services followed by 25.93 and 14.81% respondents who had low and high level of access to resources and support services, respectively. The findings were in line with findings of Hema (2003), Singh (2006), Prakash (2009) and Rahman (2011).

Social sustainability index (SSI) depicted that majority of respondents (56.48%) were in medium category followed by low and high SSI of rearing Gangatiri cattle. Rearing of Gangatiri cattle was sustainable for the society in terms of access to resources and support services available in locality.

#### *Environmental sustainability index*

*Environmental indicators:* Animals reared under unfavourable conditions will never perform to their full potential. So, it was necessary that respondents must care for animal welfare. The animal welfare of cattle reared by respondents was assessed from following indicators.

*Overall health condition of the cattle herd:* Majority of the respondents (64.00%) were having medium proportion of diseased cattle in their herd, followed by 30.50 and 5.50% of them having high and low proportion of diseased cattle in their herd, respectively. The result supported the fact that these cattle had better disease and parasitic resistance, and had well acclimatization to local climatic conditions.

*Housing condition:* The housing condition maintained by 75.93% respondents for their cattle herds was unsatisfactory while only 24.07% had satisfactory

conditions. The unsatisfactory condition of cattle shade might be due to inadequate space and lack of affordability of resource poor farmers. Most of the respondents were having *kuchcha* floor (earthen floor) which is posing difficulty in maintaining the hygiene and sanitation.

*Calf rearing conditions:* Calves, the future cow or bull, are the replacement stock for the herd. Majority of the respondents (50.93%) were maintaining satisfactory calf raising conditions and almost equal respondent (49.07%) had unsatisfactory conditions. Respondents knew the importance of a calf, as the female calf with better nutrition and management will be a good milker in future and a male calf will be good bullock/bull fetching better prices for draught as well as breeding purposes. The farmers not maintaining the satisfactory calf raising conditions might be those who were devoid of the resources.

The factors like dung utilization pattern and waste disposal were checked to see the effect on environment. Cow dung cakes is the cheapest fuel used for cooking though it causes serious respiratory disorder. Majority of the respondents (53.70%) used it for both fuel as well as manure purposes, followed by respondents using it either for fuel (28.70%) or manure (17.60%), while Premchand (2008) reported that it was mostly used for manure purposes followed by fuel purposes. The waste disposal pattern of majority of respondents (64.00%) was satisfactory. Poor waste management was having many bad consequences e.g. waterlogging leads to much health related problems either by supporting vectors like mosquito or by contaminating drinking water source and finally leading to deterioration of environment. Since, native tract of Gangatiri comprises many rivers, the Ganga, Ghaghara, Varuna etc., there are high chances of flood in rainy season. So, respondents' preparedness to the flood and after flood consequences is essential for successful rearing of Gangatiri. The efforts of majority of the respondents (68.50%) were satisfactory for combating such situation. The respondents prepared animal sheds at raised places, preserved dry fodder in advance and conducted deworming and vaccination in animals before and after flood.

For environment sustainability index (EnSI) all the above discussed indicators were used. The EnSI for the respondents ranged from 0 to 1. Majority (66.67%) of respondents' EnSI of Gangatiri cattle rearing was medium (0.23–0.51) followed by 18.52 and 14.81% respondents having high (>0.51) and low (<0.23), respectively.

*Composite sustainability index:* Composite sustainability index of Gangatiri cattle rearing was worked out by considering all the 3 dimensions of sustainability, viz. economic, social and environmental dimensions. Composite sustainability index for the rearing of Gangatiri cattle by respondents ranged from 0 to 1. Majority (67.59%) of respondents had medium (0.3 to 0.6) composite sustainability index of Gangatiri cattle rearing followed by 21.30% respondents having high (>0.6) and 10.19% respondents poor (<0.3) composite sustainability index. Sustainability of rearing Gangatiri cattle means degree up

to which it cannot be replaced by other source of income available and affordable to the respondents. If the index value is 1, means it should not be replaced and it is best option for livelihood security, out of all the option available and affordable to respondents. Gangatiri cattle rearing was a traditional practice for their livelihood security, and followed by generation to generation mainly on low or zero input system by utilizing natural resources available freely in the study area. The mean composite sustainability index of Gangatiri cattle rearing was 0.50 which indicated that it was a sustainable practice. The other objective of the study was that whether Gangatiri should be replaced with other high yielding cattle breed or not. The observation is that, for maintaining high producing cattle breeds, more financial resources are required besides the bullock of milch cattle breed and crossbred has poor draught performance. Respondents had following advantages of rearing of Gangatiri cattle:

1. Milk was a cheaper and only acceptable source of animal protein for vegetarian population.
2. Regular income from sale of milk, manure, dung cake and use of bullocks for agricultural operations on other farmers' fields.
3. Bullocks met the draught requirement of small and marginal farmers.
4. Maintenance cost of rearing Gangatiri cattle was very low.
5. Being indigenous cattle, milk of Gangatiri cattle has A<sub>2</sub> β casein, which is very safe for human health.

Most of respondents were resource poor farmers, they could not afford animals with higher maintenance cost. It was better to improve the performance of Gangatiri cattle by strengthening extension services for disseminating knowledge and regular training of farmers on improved cattle rearing practices. These measures may help improving sustainability of rearing of Gangatiri and the future generation will have a better option for their livelihood security.

The study revealed that Gangatiri rearing had its significant impact on livelihood security of dairy farmers in field or existing conditions especially in view of the fact that owners are resource poor and cannot afford high yielding exotic or crossbred cattle having high maintenance cost due to their non-acclimatization with local tropical humid climatic conditions. With the results it could be concluded that rearing of Gangatiri cattle had lineage toward sustainability. Although various shades of sustainability can be improved with regular and strong breed specific extension services related to improving performance of Gangatiri cattle. Strengthening the economic and social status of these dairy farmers through rearing of Gangatiri cattle will further contribute to its sustainability. Better marketing facilities of the milk and milk products and strengthened state milk cooperative network in that area will provide better remuneration to the farmers and motivate the young generation to take it as a livelihood option.

## REFERENCES

- Anonymous. 2006. *Cattle Genetic Resources of India: Gangatiri*. Research Bulletin, Network Project on Animal Genetic Resources, ICAR, New Delhi, India.
- Anonymous. 2007. *18<sup>th</sup> Livestock Census 2007*. Department of Animal Husbandry, Dairying and Fisheries, Government of India, New Delhi, India.
- Chambers R and Conway G R. 1992. *Sustainable rural livelihood: practical concepts for the 21<sup>st</sup> century*. IDS discussion paper 296, Brighton.
- Das M. 2010. 'Certain economic traits and input-output relationship with milk production of crossbred and indigenous cattle in Kamrup district of Assam.' M.V.Sc. Thesis (Unpub.), AAU, Khanapara, Guwahati, Asom.
- FAO. 1991. *Sustainable Agriculture and Rural Development in Asia and Pacific*. Regional development No. 2, FAO/Netherlands conference on agriculture and environment, 5-heterogenbosch, The Netherlands, April, pp. 15-19.
- Hema D. 2003. 'Functioning of women SHGs in Pondicherry union territory: A critical analysis.' M.Sc.Thesis (Unpub.), TNAU, Coimbatore.
- Hussain J. 2001. *Performance of Assam Local Cattle and their Crosses with Jersey and Holstein-Friesian*. AAU, Khanapara, Guwahati, Asom.
- Prakash A. 2009. 'Impact of self help group on growth of dairy farming in Haryana.' Ph.D. Thesis (Unpub.), NDRI, Karnal, Haryana.
- Prakash O, Ahmad M, Singh O P and Singh P K. 2008. Reproductive and productive performance of Gangatiri cow under management production system. *Journal of Rural and Agricultural Research* 8 (2): 34-36.
- Premchand. 2008. Sustainability assessment of livestock production System in Rajasthan.' Ph.D. Thesis, NDRI, Karnal, Haryana.
- Rahman S. 2011. 'Sustainability of dairy based self help groups (SHGs) Assam: an exploratory study in Kamrup district.' Ph.D. Thesis (Unpub.), NDRI Karnal India.
- Rao J S, Rao. B V R and Rao G N. 2000. Performance of crossbred cows and buffaloes under village condition of Visakhapatnam district of Andhra Pradesh. *Indian Journal of Dairy Science* 53 (30): 222-26.
- Saleth R M and Swaminathan M S. 1993. Sustainable livelihood security at the household level: Concept and evaluation methodology. *Proceedings of an Interdisciplinary Dialogue on Ecotechnology and Rural Employment*, Chennai, 12-15 April, pp105-22.
- Senthilkumar R. 2004. 'Entrepreneurial behavior of dairy farmers of Tamil Nadu.' Ph.D. Thesis (Unpub.), NDRI, Karnal, Haryana.
- Singh P K, Gaur G K, Pundir R K and Singh A. 2007. Characterization and evaluation of Gangatiri cattle breed in its native tract. *Indian Journal of Animal Sciences* 77 (1): 66-70.
- Singh S. 2008. 'Economic analysis of milk production in Varanasi District of Uttar Pradesh.' M.Sc. Thesis (Unpub.), NDRI, Karnal, Haryana.
- Singh U. 2006. 'Multidimensional impact of women dairy co-operative societies on beneficiaries in Haryana.' Ph.D. Thesis (Unpub.), NDRI, Karnal, Haryana.
- Swaminathan M S. 1991. *From Stockholm to Rio de Janeiro: The Road to Sustainable Agriculture*. Monograph No. 4, M. S. Swaminathan Research Foundation, Chennai, India.